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PRELIMINARY DRAFT

Shasta Lake Water Resources Investigation

Environmental Impact Statement



U.S. Department of the Interior
Bureau of Reclamation
Mid-Pacific Region

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Preliminary Draft Environmental Impact Statement
Shasta Lake Water Resources Investigation

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This Preliminary Draft Environmental Impact Statement (EIS) for the Shasta Lake Water Resources Investigation (SLWRI) has been prepared by the U.S. Department of the Interior, Bureau of Reclamation (Reclamation), Mid-Pacific Region, consistent with requirements of the National Environmental Policy Act (NEPA). Cooperating agencies pursuant to NEPA include the U.S. Forest Service, Bureau of Indian Affairs, Colusa Indian Community Council of the Cachil Dehe Band of Wintun Indians, and U.S. Army Corps of Engineers. A companion document to the Preliminary Draft EIS, the Draft Feasibility Report, has been published under separate cover.

This Preliminary Draft EIS evaluates the potential environmental effects of alternative plans to enlarge Shasta Dam and Reservoir to (1) increase anadromous fish survival in the upper Sacramento River, primarily upstream from Red Bluff Diversion Dam, (2) increase water supplies and water supply reliability for agricultural, municipal and industrial, and environmental purposes, and (3) address related water resource problems, needs, and opportunities. In addition to the No-Action Alternative, this Preliminary Draft EIS considers five action alternatives, which include potential dam raises ranging from 6.5 to 18.5 feet and related reservoir enlargements ranging from 256,000 to 634,000 acre feet.

The SLWRI is a feasibility study that is one of five studies for potential surface water storage projects included in the 2000 CALFED Bay-Delta Programmatic Record of Decision, and is being conducted under the general authority of Public Laws 96-375, which was reaffirmed under Public Law 108-361, also known as the CALFED Bay-Delta Authorization Act. Reclamation is releasing the Preliminary Draft EIS and Draft Feasibility Report to share the information generated since completion of the Plan formulation Report in 2007.

Release of these documents is intended to inform interested agencies, organizations, and individuals of the potential impacts, costs, and benefits of the alternative analyzed to-date. A complete Draft EIS will be prepared and processed for formal public review and comment, consistent with NEPA, following additional refinements to the action alternatives with changes in regulatory conditions in the Sacramento-San Joaquin Delta affecting operations of the State and Federal water projects.

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Shasta Lake Water Resources Investigation, California

Preliminary Draft
Environmental Impact Statement

Prepared by:

United States Department of the Interior
Bureau of Reclamation
Mid-Pacific Region

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Bureau of Reclamation

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Summary

S.1 Introduction

This Preliminary Draft Environmental Impact Statement (PDEIS) has been prepared to evaluate the potential environmental, cultural, and socioeconomic effects of implementing the proposed action to modify the existing Shasta Dam and Reservoir as part of the ongoing Shasta Lake Water Resources Investigation (SLWRI). The SLWRI is a feasibility study being conducted by the U.S. Department of the Interior, Bureau of Reclamation (Reclamation), Mid-Pacific Region, and includes this PDEIS and the accompanying Draft of the *Shasta Lake Water Resources Investigation Feasibility Report* (Feasibility Report) and appendices. Reclamation is serving as the Federal lead agency for compliance with the National Environmental Policy Act (NEPA). Cooperating agencies for the SLWRI, pursuant to NEPA, include U.S. Forest Service (USFS), Colusa Indian Community Council of the Cachil Dehe Band of Wintun Indians, U.S. Army Corps of Engineers, and U.S. Bureau of Indian Affairs. This document has also been prepared in accordance with the California Environmental Quality Act (CEQA).

The purpose of the proposed action is to improve operational flexibility of the Sacramento-San Joaquin Delta (Delta) watershed system through modifying the existing Shasta Dam and Reservoir to increase water supply reliability for agricultural, municipal and industrial, and agricultural purposes, and increase anadromous fish survival in the upper Sacramento River, and address other related resource needs.

Public Law 96-375 (October 3, 1980) provides feasibility study authority for the SLWRI and allows the Secretary of the Interior to do the following:

> …*engage in feasibility studies relating to enlarging Shasta Dam and Reservoir, Central Valley Project, California or to the construction of a larger dam on the Sacramento River, California, to replace the present structure.*

Section 103(c), "Authorizations for Federal Activities Under Applicable Law," of the CALFED Bay-Delta Authorization Act (Public Law 108-361, October 25, 2004), authorizes the Secretary of the Interior to carry out the activities described in paragraphs (1) through (10) of Subsection (d), which include the following:

> *…(1)(A)(i) planning and feasibility studies for projects to be pursued with project-specific study for enlargement of (1) the Shasta Dam in Shasta County.*

Also, Section 103(a)(1) of Public Law 108-361 (October 25, 2004) states the following:

> *The Record of Decision is approved as a general framework for addressing the CALFED Bay-Delta Program, including its components relating to water storage, ecosystem restoration, water supply reliability (including new firm yield), conveyance, water use efficiency, water quality, water transfers, watersheds, the Environmental Water Account, levee stability, governance, and science.*

The CALFED Bay-Delta Program (CALFED) Programmatic Record of Decision (ROD) called for the Secretary of the Interior to do the following:

> *…engage in feasibility studies for the purpose of determining the potential costs, benefits, environmental impacts, and feasibility of using the Sacramento River for conveying water from the enlarged Shasta Dam and Reservoir or the larger dam to points of use downstream from the dam.*

Other Federal legislation influences the SLWRI. Two laws of special note are Public Law 89-336 (November 8, 1965) and Public Law 102-575 (October 30, 1992). Public Law 89-336 created the Whiskeytown-Shasta-Trinity National Recreation Area, which includes Shasta Dam and Reservoir. Public Law 102-575, the Central Valley Project Improvement Act, directed numerous changes to the operation of the Central Valley Project (CVP). Among these changes was adding fish and wildlife protection, restoration, and enhancement as a project purpose, which resulted in substantial changes to water supply deliveries, river flows, and related environmental conditions in the study area.

S.1.1 Intended Use of This Preliminary Draft Environmental Impact Statement

Release of this Preliminary Draft EIS, the Draft Feasibility Report, and their appendices presents SLWRI findings to date, and provides another opportunity for public and stakeholder input.

S.1.2 Intended Use of Final Environmental Impact Statement

An environmental impact statement (EIS) identifies and evaluates alternatives that meet the project purpose and can also avoid project-related impacts, analyzes the environmental effects of an action, and indicates additional measures to reduce or avoid potential environmental effects resulting from the action alternatives (i.e., mitigation measures). An EIS must also disclose significant environmental effects that cannot be avoided, growth-inducing effects, significant cumulative impacts, and effects found not to be significant.

The purpose of an EIS is not to recommend approval or rejection of a project, but to provide information to aid the public and decision makers/permitting agencies in the decision-making process.

This EIS, when finalized, is intended to be used by the Federal lead agency when considering approval of the proposed action or an alternative to the proposed action. All cooperating agencies, responsible agencies, and other Federal, State, and local agencies with permitting or approval authority over any aspect of the proposed action are expected to use the information contained in the Final SLWRI EIS to meet most, if not all, of their information needs to make decisions and/or issue permits with respect to the proposed action.

S.2 Purpose and Need for Proposed Action and Project Objectives

NEPA regulations require a statement of "the underlying purpose and need to which the agency is responding in proposing the alternatives, including the proposed action," described below. The State CEQA Guidelines require a clearly written statement of objectives, including the underlying purpose of a project (Section 15124(b)), also described below.

S.2.1 Purpose and Need

The purpose of the proposed action is to improve operational flexibility of the Sacramento-San Joaquin Delta (Delta) watershed system through modifying the existing Shasta Dam and Reservoir to increase water supply reliability and anadromous fish populations in the upper Sacramento River. Specifically, the purpose of the proposed action is to accomplish all of the following:

- Promote increased survival of anadromous fish populations in the upper Sacramento River, primarily upstream from the location of the Red Bluff Diversion Dam (RBDD).
- Increase water supplies and water supply reliability for agricultural, municipal and industrial, and environmental purposes to help meet current and future water demands.
- To the extent possible, through meeting these objectives, include features that conserve and restore ecosystem resources in the Shasta Lake area and along the upper Sacramento River, reduce flood damage along the Sacramento River, increase hydropower capabilities at Shasta Dam, maintain and increase recreation opportunities at Shasta Lake, and maintain or improve water quality conditions in the Sacramento River downstream from Shasta Dam and in the Delta.

The need for the proposed action is described below and summarized from the 2007 Reclamation *Shasta Lake Water Resources Investigation Plan*

Formulation Report, the 2004 Reclamation *Shasta Lake Water Resources Investigation Initial Alternatives Information Report*, and the Plan Formulation Appendix.

S.2.1.1 Anadromous Fish Survival

The Sacramento River system is unique in California in that it supports four separate runs of Chinook salmon: fall-, late fall-, winter-, and spring-run. The adult populations of the four runs of salmon and other important fish species that spawn in the upper Sacramento River have considerably declined over the last 40 years. Several fish species in the upper Sacramento River have been listed under the Federal Endangered Species Act: Sacramento River winter-run Chinook salmon (endangered), Central Valley spring-run Chinook salmon (threatened), Central Valley steelhead (threatened), and the Southern Distinct Population Segment of North American green sturgeon (threatened). Two of these species are also listed under the California Endangered Species Act: Sacramento River winter-run Chinook salmon (endangered) and Central Valley spring-run Chinook salmon (threatened).

Unsuitable water temperatures in the upper Sacramento River, especially in dry and critically dry years, is a critical factor affecting the abundance of Chinook salmon and steelhead in the river. Releases of cold water stored behind Shasta Dam can improve seasonal water temperatures in the Sacramento River for anadromous fish, particularly winter-run Chinook salmon, during critical periods. Prolonged droughts depleting the cold-water storage in Shasta Reservoir could extirpate the entire Sacramento River winter-run Chinook salmon population. Under current conditions, even 2 consecutive years of drought could reduce Shasta Reservoir cold-water storage to levels insufficient to support the Sacramento River winter-run Chinook spawning and incubation season. This could result in complete year-class failure, virtually eliminating all of a single year's spawning and incubating winter-run Chinook in the Sacramento River. Various actions have been taken to address these problems, ranging from minimum instream flow requirements to structural changes at Shasta Dam. Despite these steps, additional actions are needed to address anadromous fish survival in the upper Sacramento River.

S.2.1.2 Water Supply Reliability

Demands for water in the state of California exceed available supplies. Reclamation's 2008 *Water Supply and Yield Study* describes dramatic increases in statewide population, land use changes, regulatory requirements, and limitations on storage and conveyance facilities have resulted in unmet water demands and subsequent increases in competition for water supplies among urban, agricultural, and environmental uses. The 2009 *California Water Plan Update* concludes that California is facing one of the most significant water crises in its history; drought impacts are growing, ecosystems are declining, water quality is diminishing, and climate change is affecting statewide hydrology. Challenges are greatest during drought years, when water supplies are less available.

As the population of California grows, and the demand for adequate water supplies becomes more acute, the ability to maintain a healthy and viable industrial and agricultural economy while protecting aquatic species will be increasingly difficult. Compounding these issues, potential effects of climate change such as changed precipitation patterns, less snowfall, and earlier snowmelt may considerably increase the demands on available water supplies in the future. As owner and operator of the CVP, one of the largest water storage and conveyance systems in the world, Reclamation has identified the need to increase the reliability of CVP water deliveries to its water contractors, particularly during dry and critically dry water years. Similar needs and challenges are faced by the SWP and other water projects throughout the State. As one of many efforts to improve the reliability of California's water supply, the SLWRI was established to evaluate the potential to improve water supply reliability primarily by modifying Shasta Dam and enlarging Shasta Lake.

S.2.1.3 Other Resources

Reclamation has identified other resource needs that could be addressed through potential modification of Shasta Dam and Reservoir. Escalating demands on statewide electricity production, continuing modification of natural aquatic and riparian habitats in the Sacramento River system, increasing threats of potential flooding in the Sacramento River system, and greater demands for recreational opportunities are all potential local, regional, or statewide problems exacerbated by California's population growth in general and particularly in the Sacramento Valley. The SLWRI provides opportunities to address these other resource needs, as well as the primary SLWRI objectives of increased anadromous fish survival and water supply reliability.

S.2.2 Project Objectives

To address the identified purpose and need described above, two primary project (i.e., planning) objectives were developed for the SLWRI. Five secondary project objectives were developed to take advantage of other beneficial project opportunities.

S.2.2.1 Primary Project Objectives

Primary project objectives are those which specific alternatives are formulated to address. Primary project objectives developed for the SLWRI are as follows:

- Increase the survival of anadromous fish populations in the Sacramento River, primarily upstream from the RBDD.

- Increase water supply and water supply reliability for agricultural, municipal and industrial, and environmental purposes to help meet current and future water demands, with a focus on enlarging Shasta Dam and Reservoir.

The primary project objectives are considered to have coequal priority, with each pursued to the maximum practicable extent without adversely affecting the other.

S.2.2.2 Secondary Project Objectives

Secondary project objectives are actions, operations, or features that should be considered in the plan formulation process, but only to the extent possible through pursuit of the primary objectives. Five secondary project objectives were developed for the SLWRI:

- Conserve, restore, and enhance ecosystem resources in the Shasta Lake area and along the upper Sacramento River.
- Reduce flood damage along the Sacramento River.
- Develop additional hydropower generation capabilities at Shasta Dam.
- Maintain and increase recreation opportunities at Shasta Lake.
- Maintain or improve water quality conditions in the Sacramento River downstream from Shasta Dam and the Delta.

S.3 Study Area

Shasta Dam and Shasta Lake are located on the upper Sacramento River in Northern California, approximately 9 miles northwest of Redding in Shasta County. Because of the potential influence of the proposed modification of Shasta Dam and Reservoir and subsequent system operations and water deliveries on resources over a large geographic area, the SLWRI includes both a primary study area and an extended study area. The primary study area includes Shasta Dam and Reservoir, the lower portions of all contributing major and minor tributaries flowing into Shasta Lake, Trinity and Lewiston reservoirs, and the Sacramento River between Shasta Dam and the RBDD facilities, including tributaries at their confluence. The RBDD is directly adjacent to the Red Bluff Pumping Plant (RBPP), which is currently under construction. The extended study area includes the Sacramento River downstream from the RBDD, including portions of the American and Feather river basins downstream from CVP/State Water Project (SWP) facilities, San Francisco Bay/Sacramento-San Joaquin Delta (Bay-Delta), lower portions of the San Joaquin River basin downstream from CVP facilities (Friant and New Melones reservoirs), and facilities and water service areas of the CVP and SWP.

S.4 Summary Description of Alternatives

The following sections summarize the no-action and five action alternatives evaluated in the PDEIS.

S.4.1 No-Action Alternative

For the SLWRI, under the No-Action Alternative, the Federal Government would continue to implement reasonably foreseeable actions, including actions with current authorization, secured funding for design and construction, and environmental permitting and compliance activities that are substantially complete, but would not take additional actions toward implementing a plan to raise Shasta Dam to help increase anadromous fish survival in the upper Sacramento River, nor help address the growing water supply and reliability issues in California. The following discussions highlight the consequences of implementing the No-Action Alternative, as they relate to the objectives of the SLWRI.

Anadromous Fish Survival

Much has been done to address anadromous fish survival problems in the upper Sacramento River. Solutions have ranged from changes in the timing and magnitude of releases from Shasta Dam to constructing and operating the temperature control device (TCD) at the dam. Actions also include site-specific projects, such as introducing spawning gravel to the Sacramento River, and work to improve or restore spawning habitat in tributary streams. However, some actions have had an adverse effect on Sacramento River habitat, including implementing requirements of the Trinity River ROD, as amended in 2000. Increased demand for water for agricultural, municipal and industrial, and environmental uses is also expected to reduce the reliability of cold water for anadromous fish. According to 2009 National Marine Fisheries Service *Public Draft Recovery Plan*, under the No-Action Condition, a drought lasting several years would likely result in the extirpation of winter run Chinook salmon. Under the No-Action Alternative, it is assumed that actions to protect fisheries and benefit aquatic environments would continue, including maintaining the TCD and satisfying other existing regulatory requirements.

Water Supply Reliability

Demands for water in California will continue to exceed available supplies, and the need for additional supplies is expected to grow. Competition for available water supplies would intensify as water demands increase to support population growth. Water conservation and reuse efforts are expected to significantly increase, and forced conservation as the result of increasing water shortages would continue. It is likely that with continued and deepening shortages in available water supplies, adverse economic impacts would increase over time in the Central Valley and elsewhere in California.

Ecosystem Resources, Flood Management, Hydropower, Recreation, and Water Quality

As opportunities arise, some locally sponsored efforts will likely continue to improve environmental conditions on tributaries to Shasta Lake and along the upper Sacramento River. However, overall, future environmental-related conditions in these areas will likely be similar to existing conditions. The quantity, quality, diversity, and connectivity of riparian, wetland, and riverine habitats along the Sacramento River have been limited by confinement of the river system by levees, reclamation of adjacent lands for farming, bank protection, channel stabilization, and land development.

Under the No-Action Alternative, the threat of flooding would continue, and may increase as population growth continues. California's demand for electricity is also expected to increase substantially in the future. Under the No-Action Alternative, no actions would be taken to help meet this growing demand.

To address the impact of water quality deterioration on the Sacramento River basin and Delta ecosystems, several environmental flow goals have been established through legal mandates. Despite these efforts, under the No-Action Alternative, these resources would continue to decline and ecosystems would continue to be impacted. In addition, Delta water quality may continue to decline.

S.4.2 Management Measures Common to All Action Alternatives

Eight of the management measures identified during the alternatives development process would be included in all action alternatives to some degree:

- Enlarge the cold-water pool of Shasta Lake
- Modify the TCD
- Increase water conservation storage
- Reduce water demand
- Modify flood operations
- Modify hydropower facilities
- Maintain and increase recreation opportunities
- Maintain or improve water quality

These eight common management measures are described below.

All action alternatives would involve, at a minimum, enlarging the cold-water pool by raising Shasta Dam to enlarge Shasta Reservoir. Minimum modifications to the TCD under all action alternatives would include raising the existing structure and modifying the shutter control. All action alternatives

would also increase the conservation storage in Shasta Reservoir by raising Shasta Dam. To reduce water demand, all action alternatives would include an additional water conservation program for new water supplies created by the project. This program would augment current water use efficiency practices. Enlarging Shasta Reservoir would require adjustment of the existing flood operation guidelines, or rule curves, to reflect physical modifications such as an increase in dam/spillway elevation; the rule curves would be revised with the goal of reducing flood damage and enhancing other objectives to the extent possible. Enlarging Shasta Dam would probably also require various modifications to the dam's existing hydropower facilities to enable their continued efficient use. Recreation is important to the Shasta Lake region; therefore, existing recreation opportunities would be maintained and/or increased. All action alternatives would maintain and potentially improve water quality by increasing Delta outflow during drought years and reducing salinity during critical periods, and may also provide operational flexibility for Delta emergency response.

S.4.3 Alternative CP1

Comprehensive Plan (CP) 1 focuses on both anadromous fish survival and water supply reliability. CP1 consists of enlarging Shasta Dam by raising the crest 6.5 feet and implementing the set of eight common management measures described above. By raising Shasta Dam from a crest at elevation 1,077.5 feet above mean sea level (elevation 1,077.5) to elevation 1,084.0, this alternative would increase the height of the reservoir's full pool by 8.5 feet. The additional 2-foot increase in the height of the full pool above the dam raise height would result from spillway modifications, including replacing the three drum gates with six sloping, fixed-wheel gates. This increase in full pool height would add approximately 256,000 acre-feet of additional storage to the overall reservoir capacity. Accordingly, the overall full pool storage would increase from 4.55 million acre-feet (MAF) to 4.81 MAF.

Under CP1, operations for water supply, hydropower, and environmental requirements would be similar to existing operations, with the additional storage retained for water supply reliability and as an expanded cold-water pool for fisheries benefits. As mentioned, this alternative (and all action alternatives) includes extending the existing TCD for efficient use of the expanded cold-water pool.

CP1 would also include the potential to revise the operational rules for flood control for Shasta Dam and Reservoir, which could reduce the potential for flood damage, and benefit recreation. Reservoir reoperation may provide recreation benefits by raising the bottom of the flood control pool elevation and, thus, allowing higher winter and spring water levels and increasing Shasta Lake's surface area. In addition, reservoir reoperation may provide more operational flexibility in reservoir drawdown requirements in response to storms, resulting in a net increase in the rate of spring reservoir filling during some years.

S.4.4 Alternative CP2

CP2 also focuses on both anadromous fish survival and water supply reliability. CP2 consists of enlarging Shasta Dam by raising the crest 12.5 feet and implementing the set of eight common management measures described above. A dam raise of 12.5 feet was chosen because it represents a midpoint between the likely smallest dam raise considered and the largest practical dam raise that would not require relocating the Pit River Bridge. By raising Shasta Dam from a crest at elevation 1,077.5 to elevation 1,090.0, CP2 would increase the height of the reservoir's full pool by 14.5 feet. This increase in full pool height would add approximately 443,000 acre-feet of storage to the reservoir's capacity. Accordingly, storage in the overall full pool would increase from 4.55 MAF to 5.0 MAF.

Under CP2, operations for water supply, hydropower, and environmental requirements would be similar to existing operations, with the additional storage retained for water supply reliability and as an expanded cold-water pool for fisheries benefits. The existing TCD would be extended for efficient use of the expanded cold-water pool.

As described for CP1, this alternative would also include the potential to revise flood control operational rules, which could reduce the potential for flood damage and benefit recreation.

S.4.5 Alternative CP3

As for CP1 and CP2, CP3 focuses on both anadromous fish survival and water supply reliability. CP3 consists of enlarging Shasta Dam and Reservoir by raising the dam crest 18.5 feet and implementing the set of eight common management measures described above.

By raising Shasta Dam from a crest at elevation 1,077.5 to elevation 1,096.0, CP3 would increase the height of the reservoir's full pool by 20.5 feet. This increase in full pool height would add approximately 634,000 acre-feet of storage to the reservoir's capacity. Accordingly, storage in the overall full pool would be increased from 4.55 MAF to 5.19 MAF. Although higher dam raises are technically and physically feasible, 18.5 feet is the largest dam raise that would not require extensive and costly reservoir area relocations, such as relocating the Pit River Bridge, Interstate-5, and the Union Pacific Railroad tracks.

Under CP3, operations for water supply, hydropower, and environmental requirements would be similar to existing operations, with the additional storage retained for water supply reliability and as an expanded cold-water pool for fisheries benefits. The existing TCD would be extended for efficient use of the expanded cold-water pool.

As described for the above alternatives, this alternative would also include the potential to revise flood control operational rules, which could reduce the potential for flood damage and benefit recreation.

S.4.6 Alternative CP4

CP4 focuses on increasing anadromous fish survival by raising Shasta Dam 18.5 feet, while also increasing water supply reliability. In addition to raising the dam and implementing the set of eight common management measures described above, CP4 would dedicate part of the increased storage in Shasta Lake to maintaining cold-water volumes.

The additional storage created by the 18.5-foot dam raise would be used to both improve the ability to meet water temperature objectives for winter-run Chinook salmon during drought years and increase water supply reliability. The reservoir's capacity would increase by 634,000 acre-feet to a total of 5.19 MAF. Of the increased reservoir storage space, about 378,000 acre-feet would be dedicated to increasing the supply of cold water for anadromous fish survival purposes.

Operations for the remaining portion of increased storage (approximately 256,000 acre-feet) would be the same as for CP1, while the cold-water pool would be subject to an adaptive management plan that may include operational changes to the timing and magnitude of release from Shasta Dam to benefit anadromous fish. The existing TCD would be extended to achieve efficient use of the expanded cold-water pool.

As described for the above alternatives, this alternative would also include the potential to revise flood control operational rules, which could reduce the potential for flood damage and benefit recreation.

Two additional ecosystem restoration features under CP4 would include augmenting spawning gravel in the upper Sacramento River at targeted locations to provide either immediate spawning habitat or long-term recruitment, and restoring riparian, floodplain, and side channel habitat in the upper Sacramento River to provide rearing habitat for juvenile salmonids.

S.4.7 Alternative CP5

CP5 focuses on anadromous fish survival, increased water supply reliability, ecosystem enhancements in the Shasta Lake area and the upper Sacramento River upstream from the RBDD facilities, and increased recreation opportunities around Shasta Lake. CP5 consists of raising Shasta Dam 18.5 feet; constructing additional resident fish habitat in Shasta Lake and along the lower reaches of its tributaries (the Sacramento River, the McCloud River, and Squaw Creek); constructing shoreline fish habitat around Shasta Lake; augmenting spawning gravel in the upper Sacramento River; restoring riparian, floodplain, and side channel habitat in the upper Sacramento River; increasing recreation

opportunities at Shasta Lake; and implementing the set of eight common management measures described above.

The additional storage created by the 18.5-foot dam raise would be used primarily to increase water supply reliability, while also improving the ability to meet water temperature objectives for winter-run Chinook salmon during drought years. The reservoir's capacity would increase by 634,000 acre-feet to a total of 5.19 MAF.

Under CP5, operations for water supply, hydropower, and environmental requirements would be similar to existing operations, with the additional storage retained for water supply reliability and as an expanded cold-water pool for fisheries benefits. The existing TCD would be extended to achieve efficient use of the expanded reservoir.

As described the above alternatives, this alternative would also include the potential to revise flood control operational rules, which could reduce the potential for flood damage and benefit recreation.

S.5 Alternatives Considered and Eliminated

Formulation of a range of comprehensive alternatives for evaluation in this PDEIS began with a review of problems, needs, and opportunities identified and defined previously, study authorities, and other pertinent direction, including information contained in the 2000 CALFED ROD, followed by development of primary and secondary planning objectives, and, finally, development of comprehensive alternatives to meet the project purpose and need. Some project alternatives suggested during this process were not retained because they did not adequately meet, or were beyond the scope of, the purpose and need statement, did not contribute to both primary planning objectives, or had high social or environmental impacts.

S.6 Major Conclusions of Environmental Analysis

An environmental document prepared to comply with NEPA must consider the context and intensity of the environmental effects that would be caused by, or result from, the proposed action. Under NEPA, the significance of an effect is a determining factor in whether an EIS must be prepared. An environmental document prepared to comply with CEQA must identify the significance of the environmental effects of a proposed project. As stated in State CEQA Guidelines, Section 15382, a "[s]ignificant effect on the environment means a substantial, or potentially substantial, adverse change in any of the physical conditions within the area affected by the project."

S.6.1 Methods and Assumptions

The PDEIS analyzes the direct and indirect effects of the No-Action Alternative and comprehensive plans (i.e., action alternatives) for each environmental resource area. Direct effects are those that would be caused by the action and would occur at the same time and place. Indirect effects are reasonably foreseeable consequences that may occur at a later time or at a distance from the project area. Examples of indirect effects are growth inducement and other effects related to changes in land use patterns, population density, or growth rate, and related effects on the physical environment.

The effects of the No-Action Alternative and action alternatives were determined by comparing estimates of resulting conditions with baseline conditions. These baseline conditions differ between NEPA and CEQA. Under NEPA, the No-Action Alternative (i.e., expected future conditions without the project) is the baseline to which the action alternatives are compared; the No-Action Alternative is also compared to existing conditions. Under CEQA, existing conditions are the baseline to which alternatives are compared.

Uncertainties Affecting Definition of Reasonably Foreseeable/Without-Project Conditions

Federal water resources planning and NEPA procedures require the application of best available information, sound science, and definition of a reasonably foreseeable future condition as the basis for comparing the potential effects of alternative plans, which leads to identification of a recommended plan and/or action and supports decision making. A variety of physical, environmental, socioeconomic, regulatory, and operational conditions and uncertainties in the Bay-Delta and related watersheds is impacting the SLWRI's ability to establish a reasonably foreseeable future condition. These same challenges are affecting other water resource studies, operations, and management actions in the Bay-Delta and related watersheds.

Plan formulation efforts and analysis of the No-Action Alternative and action alternatives discussed in this chapter are based on CVP and SWP operational conditions described Reclamation's 2004 *Long-Term CVP and SWP Operations Criteria and Plan* (OCAP) *Biological Assessment*. Modeling studies will be updated to reflect changes in water operations resulting from ongoing OCAP reconsultation and other relevant water resources projects and programs, including, potentially, Bay-Delta Conservation Plan/Delta Habitat Conservation and Conveyance Plan efforts. The results of these updated studies will be incorporated into the Draft EIS and other future SLWRI documents.

Effects of Project Implementation with Climate Change

Council on Environmental Quality guidance, issued February 18, 2010, suggests that Federal agencies consider opportunities to reduce greenhouse gas (GHG) emissions caused by proposed Federal actions, adapt their actions to climate change impacts throughout the NEPA process, and address these issues in the

agencies' NEPA procedures. Following are the two main factors to consider when addressing climate change in environmental documentation:

- Effects of a proposed action and alternative actions on GHG emissions
- Impacts of climate change on a proposed action or alternatives

Council on Environmental Quality notes that "significant" national policy decisions with "substantial" GHG impacts require analysis of their GHG effects. That is, the GHG effects of a Federal agency's proposed action must be analyzed if the action would cause "substantial" annual direct emissions; would implicate energy conservation or reduced energy use or GHG emissions; or would promote cleaner, more efficient renewable-energy technologies. Qualitative or quantitative information on GHG emissions that is useful and relevant to the decision should be used when deciding among alternatives.

Each resource area analyzed in the PDEIS evaluates the effects of comprehensive plans combined with predicted effects of climate change. The ways SLWRI comprehensive plans could affect GHG production are also addressed. The Climate Change Projection Appendix provides a summary of global climate forecasts and climate change implications for California water resources are discussed, particularly those of Shasta Lake, including predictions about changes in monthly and annual natural runoff, reservoir storage and temperature, flood management, power generation, fish conservation, and water supply and quality. The discussion of climate change implications provided in the Climate Change Projection Appendix provides the context for consideration of cumulative conditions.

S.6.2 Summary of Impacts

The action alternatives would affect environmental resources in the primary and extended study areas. The primary study area is the area surrounding Shasta Dam and Reservoir, and the Sacramento River corridor from Shasta Dam downstream to the RBDD facilities. The extended study area consists of the lower Sacramento River and the lower portion of major tributaries, the Delta, and the CVP/SWP water service areas, which includes a substantial portion of California, such as much of Southern California. Some of the impacts would be temporary, construction-related effects that would be less than significant or would be reduced to less-than-significant levels through mitigation. Other impacts would be permanent, some of which would remain significant and unavoidable despite proposed mitigation measures. In addition, some effects of the project would be beneficial.

Table S-1, included at the end of this summary, summarizes the environmental impacts of the action alternatives, the duration and quantification of each impact, the level of significance of each impact before mitigation, recommended mitigation measures and the level of significance of each impact after mitigation.

S.6.3 Significant and Unavoidable Impacts

As shown in Table S-1, the action alternatives would likely result in the following significant and unavoidable direct and indirect impacts:

- **Botanical Resource** – Loss of Multi-Species Conservation Strategy (MSCS) covered species; loss of USFS sensitive, U.S. Bureau of Land Management (BLM) sensitive, or California Rare Plant Rank (CRPR) species; loss of jurisdictional waters; and loss of general vegetation habitats (all action alternatives).

- **Wildlife Resources** – Take and loss of habitats for the Shasta salamander, bald eagle, northern spotted owl, and Pacific fisher; impact on the foothill yellow-legged frog, tailed frog, northwestern pond turtle, purple martin, special-status bats, American marten, ringtail, terrestrial mollusks, and their habitat; impact on willow flycatcher, Vaux's swift, yellow warbler, yellow-breasted chat, long-eared owl, northern goshawk, Cooper's hawk, great blue heron, and osprey, and their foraging and nesting habitat; permanent loss of general wildlife habitat; take and loss of foraging and nesting habitat for other birds of prey and migratory bird species; and loss of critical deer winter and fawning range (all action alternatives).

- **Geology, Geomorphology, Minerals, and Soils** – Loss or diminished availability of known mineral resources; loss or diminished soil biomass productivity; and soil erosion or loss of topsoil due to shoreline processes (all action alternatives).

- **Air Quality and Climate** – Short-term emissions of criteria air pollutants and precursors during project construction (all action alternatives).

- **Agriculture and Important Farmlands** – Direct and indirect conversion of forest land to nonforest uses in the vicinity of Shasta Lake (all action alternatives).

- **Land Use and Planning** – Conflicts with existing land use goals and policies of affected jurisdictions (Shasta Lake and vicinity and upper Sacramento River), and disruption of existing land uses (Shasta Lake and vicinity and upper Sacramento River) (all action alternatives).

- **Cultural Resources** – Inundation of traditional cultural properties and sacred sites (all action alternatives).

- **Aesthetics and Visual Resources** – Consistency with guidelines for visual resources in the USFS 1995 *Shasta-Trinity National Forest Land and Resource Management Plan*; degradation and/or obstruction of a

scenic view from key observation points; and generation of increased daytime glare and/or nighttime lighting (all action alternatives).

- **Wild and Scenic River Considerations for McCloud River** – Effect on McCloud River's eligibility for listing as a Federal Wild and Scenic River; conflicts with the USFS 1995 *Shasta-Trinity National Forest Land and Resource Management Plan* or USFS 1995 *Coordinated Resource Management Plan*; and conflicts with the California Public Resources Code, Section 5093.542 (all action alternatives).

The action alternatives could also result in the following significant and unavoidable cumulative impacts (i.e., an impact would make a considerable contribution to a significant cumulative effect):

- **Hydrology, Hydraulics, and Water Management** – Cumulative effects on south Delta water levels, X2 position, and Delta outflow (all action alternatives).

- **Botanical Resources and Wetlands** – Cumulative effects from increased water delivery in the service areas and growth-related loss of sensitive plant communities and special-status plant species (all action alternatives).

- **Wildlife Resources** – Cumulative effects from inundation at Shasta Lake, leading to take and loss of habitat for numerous special-status species at Shasta Lake and vicinity (all action alternatives).

- **Geology, Geomorphology, Minerals, and Soils** – Cumulative effects from use of soil and mineral resources, leading to diminished regional availability of cement, concrete sand, and aggregate and loss of soil productivity (all action alternatives).

- **Aesthetics and Visual Resources** – Changes to aesthetic values and resources at Shasta Lake (all action alternatives).

- **Environmental Justice** – Cumulative effects from disproportionate placement of environmental impacts on Native American populations, leading to disturbance or loss of resources associated with locations considered by the Winnemem Wintu and Pit River Madesi Band members to have religious and cultural significance in the vicinity of Shasta Lake (all action alternatives).

- **Air Quality and Climate** – Cumulative effects from emissions of NO_X during project construction (all action alternatives).

S.6.4 Environmental Commitments

As part of project planning and environmental assessment, Reclamation and/or its contractors would incorporate certain environmental commitments and best management practices into the action alternatives to avoid or minimize potential impacts. Reclamation will also coordinate planning, engineering, design and construction, operation, and maintenance phases of the project with applicable resource agencies.

The following environmental commitments would be incorporated into any action alternative for any project-related construction activities:

- Develop and implement a construction management plan to avoid or minimize potential impacts to public health and safety during project construction.
- Comply with applicable laws, policies, and plans for this project.
- Develop and implement an erosion and sediment control plan to control short-term and long-term erosion and sedimentation effects, and to stabilize soils and vegetation in areas affected by construction activities.
- Develop and implement a stormwater pollution prevention plan to prevent or minimize the discharge of sediments and other contaminants with the potential to affect beneficial uses or lead to violations of water quality objectives of surface waters.
- Develop and implement a feasible spill prevention and hazardous materials management plan to minimize effects from spills of hazardous, toxic, or petroleum substances for project-related activities occurring in or near waterways.
- Implement in-water construction work windows to occur when sensitive fish species are not present, or would be least susceptible to disturbance (e.g., July through September).
- Monitor potential impacts to important fishery resources throughout all phases of project construction.
- Perform fish rescue/salvage for fish entrapped within construction structures and cofferdam enclosures, and stop construction activities for spawning activities for sensitive fish species.
- Prepare a comprehensive revegetation plan to be implemented in conjunction with other management plans (e.g., erosion and sediment control plan).

- Develop and require implementation of a control plan to prevent the introduction of zebra/quagga mussels and other invasive species to project areas.

- Recycle or reuse demolished construction materials where practical.

- Demolish and remove all asphaltic roadways and parking lots inundated by the proposed Shasta Dam raise, per California Department of Fish and Game Code 5650 Section (a).

S.7 Areas of Controversy and Issues to Be Resolved

Several areas of controversy and issues to be resolved have been identified in the SLWRI to date.

S.7.1 Areas of Controversy

Federal, State, and local stakeholders have identified several areas of controversy during the SLWRI scoping process and agency meetings and workshops. Key topics include potential adverse effects on cultural resources in the Shasta Lake area; recreation and recreation providers in the Whiskeytown-Shasta-Trinity National Recreation Area; terrestrial special-status species around Shasta Lake, including State-designated fully protected species, aquatic special-status species in the Sacramento River and Delta (including delta smelt); the lower McCloud River and its special designation under California Public Resources Code 5093.542(c); Delta water quality and south Delta water levels; Central Valley hydrology below CVP and SWP facilities and resulting effects on water supplies for water contractors and other water users; impacts on reservoir area property owners; reservoir reoperation for flood control; and consistency with the 2000 CALFED ROD.

S.7.2 Issues to Be Resolved

As the SLWRI progresses, various issues will need to be addressed and resolved. Subject areas that have been identified to date are described below.

Native American Concerns and Cultural Resources

This PDEIS and accompanying Draft Feasibility Report are consistent with the National Historic Preservation Act Section 106, and describe supporting analyses, studies, coordination, impacts, and mitigation, as necessary. Reclamation has invited Federally recognized tribes and non-Federally recognized tribal groups to be consulting parties to the SLWRI. Although no Federally recognized tribes reside in the immediate Shasta Lake area, members of the Winnemem band of the Wintu Indians have raised concerns about potential impacts of enlarging Shasta Dam on sites they value for historic and cultural significance. Colusa Indian Community Council of the Cachil Dehe Band of Wintun Indians is a cooperating agency for the SLWRI, pursuant to NEPA. The Winnemem Wintu will continue to have the opportunity to

participate and are anticipated to continue to provide input, through the Section 106 process as an invited consulting party, as well as through the NEPA process.

Impacts on Biological Resources

The physical environment and associated landscapes within and adjacent to the primary study area provide for a wide array of habitat used by a diverse assemblage of wildlife with varying habitat needs and home ranges. To date, species-specific survey efforts as part of the SLWRI have only included focused investigations for a number of special-status species in the inundation and relocation areas described previously. The scale of these surveys has been limited, and because of a variety of external factors, have not addressed habitat for species with a large home range or at a watershed scale. Therefore, for species that have large home ranges (e.g., Pacific fisher), or that use a wide range of habitats for some aspect of their life history, analyses presented in this document assume presence over a conservatively large geographic area to cover the full range of impacts anticipated for these species.

Off-Site Mitigation for Impacts on Biological Resources

Details about off-site opportunities to mitigate impacts on biological resources in the primary study area are not yet available. Potential mitigation lands containing wetland and special-status species habitat comparable to those that would be affected by the proposed action have been identified near the study area. Additional discussion of how these lands may be applied as mitigation and at what ratios will be provided in future documents. A discussion of mitigation for loss of habitat through preservation and enhancement in mitigation areas will be included in future documents.

Water Rights

Improving the reliability of water supplies is a primary objective of the SLWRI. The water supply reliability benefits of the project alternatives are described in Chapter 2. Water rights for the expanded Shasta Reservoir, which are appropriated by the State Water Resources Control Board (SWRCB), must be in place before the project can operate. Evaluation of water rights will remain a focus of the SLWRI.

Coordinated CVP and SWP Operational Conditions

Planning assumptions and information on water operations used to develop alternatives during the SLWRI were developed in 2006, and reflect the coordinated CVP and SWP operations described in Reclamation's 2004 *Long-Term CVP Operations Criteria and Plan* (2004 OCAP). In addition, the model package used to evaluate potential effects of the alternatives included in this PDEIS was based on operations described in Reclamation's 2004 *Long-Term CVP and SWP OCAP Biological Assessment* (2004 OCAP BA).

Reclamation consulted with the National Oceanic and Atmospheric Administration National Marine Fisheries Service (NMFS) and U.S. Fish and

Wildlife Service (USFWS) on the 2004 OCAP, and the two agencies issued the 2004 *Biological Opinion on the Long-Term CVP and SWP OCAP* (2004 NMFS BO) and 2005 *Reinitiation of Formal and Early Section 7 ESA Consultation on the Coordinated Operations of the CVP and SWP and the OCAP to Address Potential Critical Habitat Issues* (2005 USFWS BO), respectively. In 2007, the District Court for the Eastern District of California (District Court), in *Natural Resources Defense Council v. Kempthorne*, found the 2005 USFWS BO to be unlawful and inadequate. In May 2008, in *Pacific Coast Federation of Fishermen's Associations v. Gutierrez*, the District Court found the 2004 NMFS BO to be unlawful and inadequate. The District Court remanded both BOs to the fishery agencies.

In August 2008, Reclamation reinitiated consultation with the fishery agencies based on Reclamation's 2008 *Biological Assessment on the Continued Long-Term Operations of the CVP and SWP*. USFWS issued the *Formal ESA Consultation on the Proposed Coordinated Operations of the CVP and SWP* in December 2008, finding that the long-term operations of the CVP and SWP, as described in the 2004 OCAP BA, would jeopardize the continued existence of the delta smelt. In June 2009, NMFS issued the *BO and Conference Opinion on the Long-Term Operations of the CVP and SWP* (2009 NMFS BO), finding that the same operations would jeopardize populations of listed salmonids, steelhead, green sturgeon, and orcas. Because both agencies made jeopardy determinations, both agencies included a Reasonable and Prudent Alternative (RPA) in their respective BOs.

Several lawsuits were filed challenging the validity of the 2008 USFWS BO and 2009 NMFS BO and Reclamation's acceptance of the RPA included with each BO (*Consolidated Salmonid Cases, Delta Smelt Consolidated Cases*). On November 13, 2009, and March 5, 2010, the District Court concluded that Reclamation had violated NEPA by failing to perform any NEPA analysis before provisionally adopting the 2008 USFWS RPA and 2009 NMFS RPA. On December 14, 2010, the District Court found the 2008 USFWS BO to be unlawful and remanded the BO to USFWS. The District Court issued a similar ruling for the 2009 NMFS BO on September 20, 2011. On May 4, 2011, in the *Delta Smelt Consolidated Cases*, the District Court ordered USFWS to prepare a draft BO by October 1, 2011, which was subsequently extended to an unspecified date to be agreed upon by involved parties. Reclamation and USFWS must prepare a final BO and final NEPA document by November 1, 2013, and December 1, 2013, respectively.

Reclamation and DWR use CalSim-II to study operations, benefits, and effects of new facilities and operational parameters for the CVP and SWP. A set of operational assumptions was developed in 2006 based on water operations described in the 2004 OCAP BA and the Coordinated Operations Agreement between Reclamation and DWR for the CVP and SWP, as ratified by Congress. These assumptions were used to guide development, modeling, and evaluation of potential effects of the No-Action Alternative and action alternatives

included in this PDEIS. Rationale for the decision to use these existing evaluations as the basis of analysis in the PDEIS and accompanying Draft Feasibility Report is provided in Chapter 3, "Considerations for Describing the Affected Environment and Environmental Consequences." Modeling studies and associated analyses will be updated and included in the Draft EIS and other future SLWRI documents.

S.8 Public Involvement and Next Steps

This PDEIS will be published for public, stakeholder, and agency review. During this period, stakeholder workshops will be held to present key findings and solicit input.

A Draft EIS will be prepared considering input from stakeholders and the public and results of updated modeling studies. In accordance with NEPA review requirements, the Draft EIS will be circulated for public and agency review and comment for at least 60 days following the date when the U.S. Environmental Protection Agency publishes the notice of availability of weekly receipt of environmental impact statements in the *Federal Register*. Similar to the approach to public scoping, public meetings will be held in various locations statewide to solicit and receive public input on the Draft EIS. These meetings will be held during the public comment period so that any comments received at the meetings can be addressed in the FEIS. In addition, written comments from the public, reviewing agencies, and stakeholders will be accepted during the public comment period.

An FEIS will be prepared and circulated in accordance with NEPA requirements and will include responses to all comments. Reclamation will circulate the FEIS for at least 60 days before issuing its ROD. In the ROD, which is the final step in the EIS process, Reclamation will document its decision on which actions, if any, to take to address the primary objectives. It will also describe other risk reduction plans it considered, identify any mitigation plans, and describe factors and comments taken into consideration when making its decision.

To date, CEQA scoping has not been initiated. This process will not commence until a State lead agency is identified.

Table S-1. Summary of Impacts and Mitigation Measures

Resource Topic/Impact	Alt[1]	Impact Duration[2]	Quantification/ Relative Magnitude of Impact[3]	LOS Before Mitigation[4]	Mitigation Measure	LOS After Mitigation[4]
Geology, Geomorphology, Minerals, and Soils						
Impact Geo-1: Exposure of Structures and People to Geologic Hazards, Resulting from Seismic Conditions, Slope Instability, and Volcanic Eruptions	N-A	NA	–	NI	No mitigation measures required.	NI
	CP1–CP5	Long-term	–	LTS	No mitigation needed; thus, none proposed.	LTS
Impact Geo-2: Alteration of Fluvial Geomorphology and Hydrology of Aquatic Habitats	N-A	NA	–	NI	No mitigation measures required.	NI
	CP1–CP5	Long-term	–	S	Mitigation Measure Geo-2: Replace Lost Ecological Functions of Aquatic Habitats by Restoring Existing Degraded Aquatic Habitats in the Vicinity of the Impact.	LTS
Impact Geo-3: Loss or Diminished Availability of Known Mineral Resources that Would Be of Future Value to the Region	N-A	NA	–	NI	No mitigation measures required.	NI
	CP1–CP5	Long-term	–	SU	No feasible mitigation available to reduce impact.	SU
Impact Geo-4: Lost or Diminished Soil Biomass Productivity	N-A	NA	–	NI	No mitigation measures required.	NI
	CP1	Long-term	Loss of 1,954.6 acres of moderate productivity land; 1604.5acres of low productivity land; 565 acres of nonproductive land	SU	No feasible mitigation available to reduce impact.	SU
	CP2	Long-term	Loss of 2,128 acres of moderate productivity land; 1,751 acres of low productivity land; 638 acres of nonproductive land	SU	No feasible mitigation available to reduce impact.	SU
	CP3–CP5	Long-term	Loss of 2,301 acres of moderate productivity land; 2,092 acres of low productivity land; 760 acres of nonproductive land	SU	No feasible mitigation available to reduce impact.	SU

Table S-1. Summary of Impacts and Mitigation Measures (contd.)

Resource Topic/Impact	Alt[1]	Impact Duration[2]	Quantification/ Relative Magnitude of Impact[3]	LOS Before Mitigation[4]	Mitigation Measure	LOS After Mitigation[4]
Impact Geo-5: Substantial Soil Erosion or Loss of Topsoil Due to Shoreline Processes	N-A	NA	–	NI	No mitigation measures required.	NI
	CP1	Short-term and long-term	–	SU	No feasible mitigation available to reduce impact.	SU
	CP2–CP3	Short-term and long-term	Similar to CP1, but greater	SU	No feasible mitigation available to reduce impact.	SU
	CP4	Short-term and long-term	Similar to CP1 & CP2, but greater	SU	No feasible mitigation available to reduce impact.	SU
	CP5	Short-term and long-term	Similar to CP1 & CP2, but greater	SU	No feasible mitigation available to reduce impact.	SU
Impact Geo-6: Substantial Soil Erosion or Loss of Topsoil Due to Upland Processes	N-A	NA	–	NI	No mitigation measures required.	NI
	CP1–CP5	Long-term	–	LTS	No mitigation needed; thus, none proposed.	LTS
Impact Geo-7: Be Located on a Geologic Unit or Soil that is Unstable, or that Would Become Unstable as a Result of the Project, and Potentially Result in Subsidence	N-A	NA	–	NI	No mitigation measures required.	NI
	CP1–CP5	Long-term	–	LTS	No mitigation needed; thus, none proposed.	LTS
Impact Geo-8: Failure of Septic Tanks or Alternative Wastewater Disposal Systems Due to Soils that are Unsuited to Land Application of Waste	N-A	NA	–	NI	No mitigation measures required.	NI
	CP1–CP5	Long-term	–	LTS	No mitigation needed; thus, none proposed.	LTS

Table S-1. Summary of Impacts and Mitigation Measures (contd.)

Resource Topic/Impact	Alt[1]	Impact Duration[2]	Quantification/ Relative Magnitude of Impact[3]	LOS Before Mitigation[4]	Mitigation Measure	LOS After Mitigation[4]
Impact Geo-9: Substantial Increase in Channel Erosion and Meander Migration	N-A	Long-term	–	NI	No mitigation measures required.	NI
	CP1–CP5	Long-term	–	LTS	Mitigation Measure Geo-9: Implement Channel Sensitive Water Release Schedules.	LTS
Impact Geo-10: Substantial Soil Erosion or Loss of Topsoil Due to Construction	N-A	NA	–	NI	No mitigation measures required.	NI
	CP1–CP3	Short-term	–	NI	No mitigation needed; thus, none proposed.	NI
	CP4–CP5	Short-term	–	LTS	No mitigation needed; thus, none proposed.	LTS
Impact Geo-11: Alteration of Fluvial Geomorphology	N-A	NA	–	NI	No mitigation measures required.	NI
	CP1–CP3	Long-term	–	NI	No mitigation needed; thus, none proposed.	NI
	CP4–CP5	Long-term	–	LTS	No mitigation needed; thus, none proposed.	LTS
Impact Geo-12: Substantial Increase in Channel Erosion and Meander Migration (Lower Sacramento River and Delta)	N-A	Long-term	–	NI	No mitigation measures required.	NI
	CP1–CP5	Long-term	–	LTS	No mitigation needed; thus, none proposed.	LTS
Impact Geo-13: Substantial Increase in Channel Erosion and Meander Migration (CVP/SWP Service Areas)	N-A	Long-term	–	NI	No mitigation measures required.	NI
	CP1–CP5	Long-term	–	LTS	No mitigation needed; thus, none proposed.	LTS
Air Quality and Climate						
Impact AQ-1: Short-Term Emissions of Criteria Air Pollutants and Precursors at Shasta Lake and Vicinity During Project Construction	N-A	NA	NA	NI	No mitigation measures required.	NI
	CP1–CP5	Short-term	NO_X emissions >137 lb/day, possible ROG & PM_{10} emissions >137 lb/day	S	Mitigation Measure AQ-1: Implement Standard Measures and Best Available Mitigation Measures to Reduce Emissions Levels.	SU

Table S-1. Summary of Impacts and Mitigation Measures (contd.)

Resource Topic/Impact	Alt[1]	Impact Duration[2]	Quantification/ Relative Magnitude of Impact[3]	LOS Before Mitigation[4]	Mitigation Measure	LOS After Mitigation[4]
Impact AQ-2: Long-Term Emissions of Criteria Air Pollutants and Precursors During Project Operation	N-A,	NA	NA	LTS	No mitigation measures required.	LTS
	CP1,	Long-term	Increase of an average of 148 one-way daily trips	LTS	No mitigation needed, thus none proposed.	LTS
	CP2	Long-term	Increase of an average of 251 one-way daily trips	LTS	No mitigation needed; thus, none proposed.	LTS
	CP3 & CP4	Long-term	Increase of an average of 398 one-way daily trips	LTS	No mitigation needed; thus, none proposed.	LTS
	CP5		Increase of an average of 711 one-way daily trips	LTS	No mitigation needed; thus, none proposed.	LTS
Impact AQ-3: Exposure of Sensitive Receptors to Substantial Pollutant Concentrations	N-A	NA	NA	NI	No mitigation measures required.	NI
	CP1–CP5	Short-term and long-term	Exposure to CO, PM_{10}, $PM_{2.5}$, diesel PM	LTS	No mitigation needed; thus, none proposed.	LTS
Impact AQ-4: Exposure of Sensitive Receptors to Odor Emissions	N-A	NA	NA	NI	No mitigation measures required.	NI
	CP1–CP5	Short-term and long-term	–	LTS	No mitigation needed; thus, none proposed.	LTS
Impact AQ-5: Short-Term Emissions of Criteria Air Pollutants and Precursors Below Shasta Dam During Project Construction	N-A,	NA	–	NI	No mitigation measures required.	NI
	CP1–CP3	Short-term	–	NI	No mitigation needed; thus, none proposed.	NI
	CP4–CP5	Short-term	Would add an additional 1 lb/day of ROG, 16 lb/day of NO_X, & 1 lb/day of PM_{10} to construction	LTS	No mitigation needed; thus, none proposed.	LTS

Table S-1. Summary of Impacts and Mitigation Measures (contd.)

Resource Topic/Impact	Alt[1]	Impact Duration[2]	Quantification/ Relative Magnitude of Impact[3]	LOS Before Mitigation[4]	Mitigation Measure	LOS After Mitigation[4]
Impact AQ-6: Generation of Greenhouse Gases	N-A	NA	NA	LTS	No mitigation measures required.	LTS
	CP1–CP5	Long-term	Reduction of GHGs	B	No mitigation needed; thus, none proposed.	B
		Short-term	Emission of 14,043 to 18,311 metric tons CO_2e	LTS	No mitigation needed; thus, none proposed.	LTS
Hydrology, Hydraulics, and Water Management						
Impact H&H-1: Change in Frequency of Flows Above 100,000 cfs on the Sacramento River Below Bend Bridge	N-A	NA	NA	NI	No mitigation measures required.	NI
	CP1–CP5	Long-term		B	No mitigation needed; thus, none proposed.	B
Impact H&H-2: Place Housing or Other Structures Within a 100-Year Flood Hazard Area as Mapped on a Federal Flood Hazard Boundary or Flood Insurance Rate Map or Other Flood Hazard Delineation Map	N-A	NA	NA	NI	No mitigation measures required.	NI
	CP1–CP5	NA	NA	NI	No mitigation needed; thus, none proposed.	NI
Impact H&H-3: Place Within a 100-Year Flood Hazard Area Structures That Would Impede or Redirect Flood Flows	N-A	NA	NA	NI	No mitigation measures required.	NI
	CP1–CP5	NA	NA	NI	No mitigation needed; thus, none proposed.	NI
Impact H&H-4: Change in Water Levels in the Old River near Tracy Road Bridge	N-A	Long-term	Lower water levels	PS	No mitigation measures required.	PS
	CP1–CP5	Long-term	–	LTS	No mitigation needed; thus, none proposed.	LTS

Table S-1. Summary of Impacts and Mitigation Measures (contd.)

Resource Topic/Impact	Alt[1]	Impact Duration[2]	Quantification/ Relative Magnitude of Impact[3]	LOS Before Mitigation[4]	Mitigation Measure	LOS After Mitigation[4]
H&H-5: Change in Water Levels in the Grant Line Canal near the Grant Line Canal Barrier	N-A	Long-term	Lower water levels	PS	No mitigation measures required.	PS
	CP1–CP5	Long-term	–	LTS	No mitigation needed; thus, none proposed.	LTS
Impact H&H-6: Change in Water Levels in the Middle River near the Howard Road Bridge	N-A	Long-term	Lower water levels	PS	No mitigation measures required.	PS
	CP1–CP5	Long-term	–	LTS	No mitigation needed; thus, none proposed.	LTS
Impact H&H-7: Change in X2 Position	N-A	NA	NA	NI	No mitigation measures required.	NI
	CP1–CP5	Long-term	–	LTS	No mitigation needed; thus, none proposed.	LTS
Impact H&H-8: Change in Recurrence of Delta Excess Conditions	N-A	Long-term	Reduced frequency	PS	No mitigation measures required.	PS
	CP1–CP5	Long-term	–	LTS	No mitigation needed; thus, none proposed.	LTS
Impact H&H-9: Change in Deliveries to North-of-Delta CVP Water Service Contractors and Refuges	N-A	Long-term	Reduced frequency	PS	No mitigation measures required.	PS
	CP1–CP5	Long-term	–	B	No mitigation needed; thus, none proposed.	B
Impact H&H-10: Change in Deliveries to South-of-Delta CVP Water Service Contractors and Refuges	N-A	Long-term	Reduced frequency	PS	No mitigation measures required.	PS
	CP1–CP5	Long-term	–	B	No mitigation needed; thus, none proposed.	B
Impact H&H-11: Change in Deliveries to SWP Table A, Contractors South of the Delta	N-A	Long-term	Reduced frequency	PS	No mitigation measures required.	PS
	CP1–CP5	Long-term	–	LTS	No mitigation needed; thus, none proposed.	LTS
Impact H&H-12: Change in Groundwater	N-A	NA	–	LTS	No mitigation measures required.	LTS
	CP1–CP5	Short-term and long-term	Increased groundwater levels	B	No mitigation needed; thus, none proposed.	B

Table S-1. Summary of Impacts and Mitigation Measures (contd.)

Resource Topic/Impact	Alt[1]	Impact Duration[2]	Quantification/ Relative Magnitude of Impact[3]	LOS Before Mitigation[4]	Mitigation Measure	LOS After Mitigation[4]
Impact H&H-13: Change in Groundwater Quality	N-A	Short-term and long-term	–	LTS	No mitigation measures required.	LTS
	CP1–CP5	Short-term and long-term	–	LTS	No mitigation needed; thus, none proposed.	LTS
Water Quality						
Impact WQ-1: Temporary Construction-Related Sediment Effects on Shasta Lake and Its Tributaries That Would Cause Violations of Water Quality Standards or Adversely Affect Beneficial Uses	N-A	NA	NA	NI	No mitigation measures required.	NI
	CP1–CP5	Temporary	–	PS	Mitigation Measure WQ-1: Prepare and Implement a Stormwater Pollution Prevention Plan That Minimizes the Potential Contamination of Surface Waters, and Comply with Applicable Federal Regulations Concerning Construction Activities.	LTS
Impact WQ-2: Temporary Construction-Related Temperature Effects on Shasta Lake and Its Tributaries That Would Cause Violations of Water Quality Standards or Adversely Affect Beneficial Uses	N-A	NA	NA	NI	No mitigation measures required.	NI
	CP1	Temporary	–	LTS	No mitigation needed; thus, none proposed.	LTS
	CP2	Temporary	Similar to CP1, but greater and longer duration (48-month construction period)	LTS	No mitigation needed; thus, none proposed.	LTS
	CP3–CP5	Temporary	Similar to CP1, but greater and longer duration (60-month construction period)	LTS	No mitigation needed; thus, none proposed.	LTS

Table S-1. Summary of Impacts and Mitigation Measures (contd.)

Resource Topic/Impact	Alt[1]	Impact Duration[2]	Quantification/ Relative Magnitude of Impact[3]	LOS Before Mitigation[4]	Mitigation Measure	LOS After Mitigation[4]
Impact WQ-3: Temporary Construction-Related Metal Effects on Shasta Lake and Its Tributaries That Would Cause Violations of Water Quality Standards or Adversely Affect Beneficial Uses	N-A	NA	NA	NI	No mitigation measures required.	NI
	CP1–CP5	Temporary	–	LTS	No mitigation needed; thus, none proposed.	LTS
Impact WQ-4: Long-Term Sediment Effects That Would Cause Violations of Water Quality Standards or Adversely Affect Beneficial Uses in Shasta Lake or Its Tributaries	N-A	NA	NA	NI	No mitigation measures required.	NI
	CP1–CP5	Long-term	–	PS	Mitigation Measure WQ-4: Implement Mitigation Measure WQ-1: Prepare and Implement a Stormwater Pollution Prevention Plan That Minimizes the Potential Contamination of Surface Waters, and Comply with Applicable Federal Regulations Concerning Construction Activities.	LTS
Impact WQ-5: Long-Term Temperature Effects That Would Cause Violations of Water Quality Standards or Adversely Affect Beneficial Uses in Shasta Lake or Its Tributaries	N-A	NA	NA	NI	No mitigation measures required.	NI
	CP1	Long-term	5 percent increase in the end-of-month storage on an annual basis compared to No-Action Alternative	LTS	No mitigation needed; thus, none proposed.	LTS
	CP2	Long-term	9 percent increase in the end-of-month storage on an annual basis compared to No-Action Alternative	LTS	No mitigation needed; thus, none proposed.	LTS
	CP3–CP5	Long-term	13 percent increase in the end-of-month storage on an annual basis compared to No-Action Alternative	LTS	No mitigation needed; thus, none proposed.	LTS

Table S-1. Summary of Impacts and Mitigation Measures (contd.)

Resource Topic/Impact	Alt[1]	Impact Duration[2]	Quantification/ Relative Magnitude of Impact[3]	LOS Before Mitigation[4]	Mitigation Measure	LOS After Mitigation[4]
WQ-6: Long-Term Metals Effects That Would Cause Violations of Water Quality Standards or Adversely Affect Beneficial Uses in Shasta Lake or Its Tributaries	N-A	NA	NA	NI	No mitigation measures required.	NI
	CP1–CP5	Long-term	–	PS	Mitigation Measure WQ-6: Prepare and Implement a Site-Specific Remediation Plan for Historic Mine Features Subject to Inundation in the Vicinity of the Bully Hill and Rising Star Mines.	LTS
Impact WQ-7: Temporary Construction-Related Sediment Effects on the Upper Sacramento River That Would Cause Violations of Water Quality Standards or Adversely Affect Beneficial Uses	N-A	NA	NA	NI	No mitigation measures required.	NI
	CP1–CP3	Temporary	–	PS	Mitigation Measure WQ-7 (CP1–CP3): Implement Mitigation Measure WQ-1: Prepare and Implement a Stormwater Pollution Prevention Plan That Minimizes the Potential Contamination of Surface Waters, and Comply with Applicable Federal Regulations Concerning Construction Activities.	LTS
	CP4	Temporary	Similar to CP1–CP3, but greater	PS	Mitigation Measure WQ-7 (CP4–CP5): Implement Mitigation Measure WQ-1: Prepare and Implement a Stormwater Pollution Prevention Plan That Minimizes the Potential Contamination of Surface Waters, and Comply with Applicable Federal Regulations Concerning Construction Activities and Gravel Augmentation BMPs.	LTS
	CP5	Temporary	Similar to CP4, but greater	PS	Mitigation Measure WQ-7 (CP4–CP5): Implement Mitigation Measure WQ-1: Prepare and Implement a Stormwater Pollution Prevention Plan That Minimizes the Potential Contamination of Surface Waters, and Comply with Applicable Federal Regulations Concerning Construction Activities and Gravel Augmentation BMPs.	LTS

Table S-1. Summary of Impacts and Mitigation Measures (contd.)

Resource Topic/Impact	Alt[1]	Impact Duration[2]	Quantification/ Relative Magnitude of Impact[3]	LOS Before Mitigation[4]	Mitigation Measure	LOS After Mitigation[4]
Impact WQ-8: Temporary Construction-Related Temperature Effects on the Upper Sacramento River That Would Cause Violations of Water Quality Standards or Adversely Affect Beneficial Uses	N-A	NA	NA	NI	No mitigation measures required.	NI
	CP1–CP5	Temporary	–	LTS	No mitigation needed; thus, none proposed.	LTS
Impact WQ-9: Temporary Construction-Related Metal Effects on the Upper Sacramento River That Would Cause Violations of Water Quality Standards or Adversely Affect Beneficial Uses	N-A	NA	NA	NI	No mitigation measures required.	NI
	CP1–CP5	Temporary	–	LTS	No mitigation needed; thus, none proposed.	LTS
Impact WQ-10: Long-Term Sediment Effects That Would Cause Violations of Water Quality Standards or Adversely Affect Beneficial Uses in the Upper Sacramento River	N-A	NA	NA	NI	No mitigation measures required.	NI
	CP1–CP5	Long-term	–	LTS	No mitigation needed; thus, none proposed.	LTS

Table S-1. Summary of Impacts and Mitigation Measures (contd.)

Resource Topic/Impact	Alt[1]	Impact Duration[2]	Quantification/ Relative Magnitude of Impact[3]	LOS Before Mitigation[4]	Mitigation Measure	LOS After Mitigation[4]
Impact WQ-11: Long-Term Temperature Effects That Would Cause Violations of Water Quality Standards or Adversely Affect Beneficial Uses in the Upper Sacramento River	N-A	NA	NA	NI	No mitigation measures required.	NI
	CP1	Long-term	Reduce temperature exceedences at Bend Bridge by 4 percent under existing conditions and 5 percent under future conditions	B	No mitigation needed; thus, none proposed.	B
	CP2	Long-term	Reduce temperature exceedences at Bend Bridge by 6 percent under existing conditions and 8 percent under future conditions	B	No mitigation needed; thus, none proposed.	B
	CP3, CP5	Long-term	Reduce temperature exceedences at Bend Bridge by 8 percent under existing conditions and 11 percent under future conditions	B	No mitigation needed; thus, none proposed.	B
	CP4	Long-term	Reduce temperature exceedences at Bend Bridge by 13 percent under existing conditions and 15 percent under future conditions	B	No mitigation needed; thus, none proposed.	B
Impact WQ-12: Long-Term Metals Effects That Cause Violations of Water Quality Standards or Adversely Affect Beneficial Uses in the Upper Sacramento River	N-A	NA	NA	NI	No mitigation measures required.	NI
	CP1–CP5	Long-term	–	PS	Mitigation Measure WQ-12: Implement Mitigation Measure WQ-6: Prepare and Implement a Site-Specific Remediation Plan for Historic Mine Features Subject to Inundation in the Vicinity of the Bully Hill and Rising Star Mines.	LTS

Table S-1. Summary of Impacts and Mitigation Measures (contd.)

Resource Topic/Impact	Alt[1]	Impact Duration[2]	Quantification/ Relative Magnitude of Impact[3]	LOS Before Mitigation[4]	Mitigation Measure	LOS After Mitigation[4]
Impact WQ-13: Temporary Construction-Related Sediment Effects on the Extended Study Area That Would Cause Violations of Water Quality Standards or Adversely Affect Beneficial Uses	N-A	NA	NA	NI	No mitigation measures required.	NI
	CP1–CP5	Temporary	–	LTS	No mitigation needed; thus, none proposed.	LTS
Impact WQ-14: Temporary Construction-Related Temperature Effects on the Extended Study Area That Cause Violations of Water Quality Standards or Adversely Affect Beneficial Uses	N-A	NA	NA	NI	No mitigation measures required.	NI
	CP1–CP5	Temporary	–	LTS	No mitigation needed; thus, none proposed.	LTS
Impact WQ-15: Temporary Construction-Related Metal Effects on the Extended Study Area That Would Cause Violations of Water Quality Standards or Adversely Affect Beneficial Uses	N-A	NA	NA	NI	No mitigation measures required.	NI
	CP1–CP5	Temporary	–	LTS	No mitigation needed; thus, none proposed.	LTS
Impact WQ-16: Long-Term Sediment Effects That Cause Violations of Water Quality Standards or Adversely Affect Beneficial Uses in the Extended Study Area	N-A	NA	NA	NI	No mitigation measures required.	NI
	CP1–CP5	Long-term	–	LTS	No mitigation needed; thus, none proposed.	LTS

Table S-1. Summary of Impacts and Mitigation Measures (contd.)

Resource Topic/Impact	Alt[1]	Impact Duration[2]	Quantification/ Relative Magnitude of Impact[3]	LOS Before Mitigation[4]	Mitigation Measure	LOS After Mitigation[4]
Impact WQ-17: Long-Term Temperature Effects That Cause Violations of Water Quality Standards or Adversely Affect Beneficial Uses in the Extended Study Area	N-A	NA	NA	NI	No mitigation measures required.	NI
	CP1–CP5	Long-term	–	LTS	No mitigation needed; thus, none proposed.	LTS
Impact WQ-18: Long-Term Metals Effects That Would Cause Violations of Water Quality Standards or Adversely Affect Beneficial Uses in the Extended Study Area	N-A	NA	NA	NI	No mitigation measures required.	NI
	CP1–CP5	Long-term	–	PS	Mitigation Measure WQ-18: Implement Mitigation Measure WQ-6: Prepare and Implement a Site-Specific Remediation Plan for Historic Mine Features Subject to Inundation in the Vicinity of the Bully Hill and Rising Star Mines.	LTS
Impact WQ-19a: Delta Salinity on the Sacramento River at Collinsville	N-A	NA	NA	NI	No mitigation measures required.	NI
	CP1–CP5	Long-term	<10% increases in salinity in extended study area (Collinsville)	LTS	No mitigation needed; thus, none proposed.	LTS
Impact WQ-19b: Delta Salinity on the San Joaquin River at Jersey Point	N-A	NA	NA	NI	No mitigation measures required.	NI
	CP1–CP5	Long-term	No increase in electrical conductivity in extended study area (Jersey Point)	LTS	No mitigation needed; thus, none proposed.	LTS
Impact WQ-19c: Delta Salinity on the Sacramento River at Emmaton	N-A	NA	NA	NI	No mitigation measures required.	NI
	CP1–CP5	Long-term	No more than 0.2% increase in electrical conductivity in extended study area (Emmaton)	LTS	No mitigation needed; thus, none proposed.	LTS
Impact WQ-19d: Delta Salinity on the Old River at Rock Slough	N-A	NA	NA	NI	No mitigation measures required.	NI
	CP1–CP5	Long-term	Chlorides not increased more than 1.2% in extended study area (Rock Slough)	LTS	No mitigation needed; thus, none proposed.	LTS

Table S-1. Summary of Impacts and Mitigation Measures (contd.)

Resource Topic/Impact	Alt[1]	Impact Duration[2]	Quantification/ Relative Magnitude of Impact[3]	LOS Before Mitigation[4]	Mitigation Measure	LOS After Mitigation[4]
Impact WQ-19e: Delta Water Quality on the Delta-Mendota Canal at Jones Pumping Plant	N-A	NA	NA	NI	No mitigation measures required.	NI
	CP1–CP5	Long-term	Electrical conductivity not changed, chlorides increased <1.0% in extended study area (Jones Pumping Plant)	LTS	No mitigation needed; thus, none proposed.	LTS
Impact WQ-19f: Delta Water Quality on the West Canal at the Mouth of the Clifton Court Forebay	N-A	NA	NA	LTS	No mitigation measures required.	LTS
	CP1–CP5	Long-term	Electrical conductivity not changed, chlorides increased <1.0% in extended study area (Clifton Court Forebay)	LTS	No mitigation needed; thus, none proposed.	LTS
Impact WQ-19g: Delta Salinity on the San Joaquin River at Vernalis	N-A	NA	NA	NI	No mitigation measures required.	NI
	CP1–CP5	Long-term	No increase in electrical conductivity in extended study area (Vernalis)	LTS	No mitigation needed; thus, none proposed.	LTS
Impact WQ-19h: Delta Salinity on the San Joaquin River at Brandt Bridge	N-A	NA	NA	NI	No mitigation measures required.	NI
	CP1–CP5	Long-term	No increase in electrical conductivity in extended study area (Brandt Bridge)	LTS	No mitigation needed; thus, none proposed.	LTS
Impact WQ-19i: Delta Salinity on the Old River near the Middle River	N-A	NA	NA	NI	No mitigation measures required.	NI
	CP1–CP5	Long-term	No increase in electrical conductivity in extended study area (Old River)	LTS	No mitigation needed; thus, none proposed.	LTS
Impact WQ-19j: Delta Salinity on the Old River at Tracy Road Bridge	N-A	NA	NA	NI	No mitigation measures required.	NI
	CP1–CP5	Long-term	No increase in electrical conductivity in extended study area (Tracy Road Bridge)	LTS	No mitigation needed; thus, none proposed.	LTS
Impact WQ-20: X2 Position	N-A	NA	NA	NI	No mitigation measures required.	NI
	CP1–CP5	Long-term	No increase in number of months in which X2 is out of compliance in extended study area (Delta)	LTS	No mitigation needed; thus, none proposed.	LTS

Table S-1. Summary of Impacts and Mitigation Measures (contd.)

Resource Topic/Impact	Alt[1]	Impact Duration[2]	Quantification/ Relative Magnitude of Impact[3]	LOS Before Mitigation[4]	Mitigation Measure	LOS After Mitigation[4]
Noise and Vibration						
Impact Noise-1: Exposure of Sensitive Receptors in the Primary Study Area to Project-Generated Construction Noise	N-A	NA	NA	LTS	No mitigation measures required.	LTS
	CP1–CP3	Short-term	Blasting activities at the dam – noise levels of 60 dBA at sensitive receptors downstream on the Sacramento River (7,000 feet away) On-site heavy duty construction equipment at other project sites – exterior noise levels at noise-sensitive receptors located within 75 – 7,000 feet of construction activity could exceed applicable standards (>50 dBA $L_{eq)}$	S	Mitigation Measure Noise-1: Implement Measures to Prevent Exposure of Sensitive Receptors to Temporary Construction Noise at Project Construction Sites.	LTS
	CP4	Short-term	Similar to CP1–CP3, but greater noise related to gravel augmentation	S	Mitigation Measure Noise-1: Implement Measures to Prevent Exposure of Sensitive Receptors to Temporary Construction Noise at Project Construction Sites.	LTS
	CP5	Short-term	Similar to CP4, but greater noise related to restoration at Reading Island	S	Mitigation Measure Noise-1: Implement Measures to Prevent Exposure of Sensitive Receptors to Temporary Construction Noise at Project Construction Sites.	LTS
Impact Noise-2: Exposure of Sensitive Receptors in the Primary Study Area to Project-Generated Vibration During Construction	N-A	NA	NA	LTS	No mitigation measures required.	LTS
	CP1–CP5	Short-term	–	LTS	No mitigation needed; thus, none proposed.	LTS

Table S-1. Summary of Impacts and Mitigation Measures (contd.)

Resource Topic/Impact	Alt[1]	Impact Duration[2]	Quantification/ Relative Magnitude of Impact[3]	LOS Before Mitigation[4]	Mitigation Measure	LOS After Mitigation[4]
Impact Noise-3: Exposure of Sensitive Receptors in the Primary Study Area to Project-Generated Mobile Source Noise During Operations	N-A	NA	NA	LTS	No mitigation measures required.	LTS
	CP1–CP5	Short-term and long-term	–	LTS	No mitigation needed; thus, none proposed.	LTS
Hazards and Hazardous Materials and Waste						
Impact Haz-1: Wildland Fire Risk (Shasta Lake and Vicinity and Upper Sacramento River)	N-A	NA	NA	NI	No mitigation measures required.	NI
	CP1	Short-term	– (36-month construction period)	PS	Mitigation Measure Haz-1: Coordinate and Assist Public Services Agencies to Reduce Fire Hazards.	LTS
	CP2	Short-term	Similar to CP1, but greater and longer duration (48-month construction period)	PS	Mitigation Measure Haz-1: Coordinate and Assist Public Services Agencies to Reduce Fire Hazards.	LTS
	CP3–CP5	Short-term	Similar to CP1 & CP2, but greater and longer duration (60-month construction period)	PS	Mitigation Measure Haz-1: Coordinate and Assist Public Services Agencies to Reduce Fire Hazards.	LTS

Table S-1. Summary of Impacts and Mitigation Measures (contd.)

Resource Topic/Impact	Alt[1]	Impact Duration[2]	Quantification/ Relative Magnitude of Impact[3]	LOS Before Mitigation[4]	Mitigation Measure	LOS After Mitigation[4]
Impact Haz-2: Release Potentially Hazardous Materials or Hazardous Waste (Shasta Lake and Vicinity and Upper Sacramento River)	N-A	NA	NA	NI	No mitigation measures required.	NI
	CP1	Short-term	– (36-month construction period)	PS	Mitigation Measure Haz-2: Reduce Potential for Release of Hazardous Materials and Waste.	LTS
	CP2	Short-term	Similar to CP1, but greater and longer duration (48-month construction period)	PS	Mitigation Measure Haz-2: Reduce Potential for Release of Hazardous Materials and Waste.	LTS
	CP3–CP5	Short-term	Similar to CP1 & CP2, but greater and longer duration (60-month construction period)	PS	Mitigation Measure Haz-2: Reduce Potential for Release of Hazardous Materials and Waste.	LTS
Impact Haz-3: Expose Workers to Hazardous Materials (Shasta Lake and Vicinity and Upper Sacramento River)	N-A	NA	NA	NI	No mitigation measures required.	NI
	CP1	Short-term	– (36-month construction period)	LTS	No mitigation needed; thus, none proposed.	LTS
	CP2	Short-term (48-month construction period)	Similar to CP1, but greater and longer duration (48-month construction period)	LTS	No mitigation needed; thus, none proposed.	LTS
	CP3–CP5	Short-term (60-month construction period)	Similar to CP1 & CP2, but greater and longer duration (60-month construction period)	LTS	No mitigation needed; thus, none proposed.	LTS
Impact Haz-4: Expose Sensitive Receptors to Hazardous Materials (Shasta Lake and Vicinity and Upper Sacramento River)	N-A	NA	NA	NI	No mitigation measures required.	NI
	CP1–CP5	Short-term (con-struction period)	–	PS	Mitigation Measure Haz-4: Reduce Potential for Exposure of Sensitive Receptors to Hazardous Materials or Waste.	LTS

Table S-1. Summary of Impacts and Mitigation Measures (contd.)

Resource Topic/Impact	Alt[1]	Impact Duration[2]	Quantification/ Relative Magnitude of Impact[3]	LOS Before Mitigation[4]	Mitigation Measure	LOS After Mitigation[4]
Impact Haz-5: Wildland Fire Risk (Lower Sacramento River, Delta, CVP/SWP Service Areas)	N-A	NA	NA	NI	No mitigation measures required.	NI
	CP1–CP5	Short-term	–	LTS	No mitigation needed; thus, none proposed.	LTS
Impact Haz-6: Release Potentially Hazardous Materials or Hazardous Waste (Lower Sacramento River, Delta, CVP/SWP Service Areas)	N-A	NA	NA	NI	No mitigation measures required.	NI
	CP1–CP5	Short-term	–	LTS	No mitigation needed; thus, none proposed.	LTS
Impact Haz-7: Expose Workers to Hazardous Materials (Lower Sacramento River, Delta, CVP/SWP Service Areas)	N-A	NA	NA	NI	No mitigation measures required.	NI
	CP1–CP5	Short-term	–	LTS	No mitigation needed; thus, none proposed.	LTS
Impact Haz-8: Expose Sensitive Receptors to Hazardous Materials (Lower Sacramento River, Delta, CVP/SWP Service Areas)	N-A	NA	NA	NI	No mitigation measures required.	NI
	CP1–CP5	Short-term	–	LTS	No mitigation needed; thus, none proposed.	LTS
Agriculture and Important Farmlands						
Impact Ag-1: Direct and Indirect Conversion of Important Farmland to Nonagricultural Uses and Cancellation of Williamson Act Contracts in the Vicinity of Shasta Lake	N-A	Permanent conversion	–	PS	No mitigation measures required.	SU
	CP1–CP5	NA	–	NI	No mitigation needed; thus, none proposed.	NI

Table S-1. Summary of Impacts and Mitigation Measures (contd.)

Resource Topic/Impact	Alt[1]	Impact Duration[2]	Quantification/ Relative Magnitude of Impact[3]	LOS Before Mitigation[4]	Mitigation Measure	LOS After Mitigation[4]
Impact Ag-2: Direct and Indirect Conversion of Forest Land to Nonforest Uses in the Vicinity of Shasta Lake	N-A	NA	NA	NI	No mitigation measures required.	NI
	CP1	Permanent conversion	1,051 acres of forest land affected by inundation and 107 acres of forest land affected by infrastructure relocation	S	No feasible mitigation is available to reduce impact.	SU
	CP2	Permanent conversion	1,440 acres of forest land affected by inundation and 116 acres of forest land affected by infrastructure relocation	S	No feasible mitigation is available to reduce impact.	SU
	CP3–CP5	Permanent conversion	2,068 acres of forest land affected by inundation and 133 acres of forest land affected by infrastructure relocation	S	No feasible mitigation is available to reduce impact.	SU
Impact Ag-3: Direct and Indirect Conversion of Important Farmland to Nonagricultural Uses and Cancellation of Williamson Act Contracts Along the Upper Sacramento River	N-A	Permanent conversion	–	PS	No mitigation measures required.	SU
	CP1	NA	–	LTS	No mitigation needed; thus, none proposed.	LTS
	CP2	NA	Similar to CP1, but greater	LTS	No mitigation needed; thus, none proposed.	LTS
	CP3–CP5	NA	Similar to CP1 & CP2, but greater	LTS	No mitigation needed; thus, none proposed.	LTS
Impact Ag-4: Direct and Indirect Conversion of Forest Land to Nonforest Uses Along the Upper Sacramento River	N-A	Permanent conversion	NA	LTS	No mitigation measures required.	LTS
	CP1	Permanent conversion	–	LTS	No mitigation needed; thus, none proposed.	LTS
	CP2	NA	Similar to CP1, but greater	LTS	No mitigation needed; thus, none proposed.	LTS
	CP3–CP5	NA	Similar to CP1 & CP2, but greater	LTS	No mitigation needed; thus, none proposed.	LTS

Table S-1. Summary of Impacts and Mitigation Measures (contd.)

Resource Topic/Impact	Alt[1]	Impact Duration[2]	Quantification/ Relative Magnitude of Impact[3]	LOS Before Mitigation[4]	Mitigation Measure	LOS After Mitigation[4]
Impact Ag-5: Direct and Indirect Conversion of Important Farmland to Nonagricultural Uses and Cancellation of Williamson Act Contracts in the Extended Study Area	N-A	Permanent conversion	–	PS	No mitigation measures required.	SU
	CP1–CP5	NA	–	LTS	No mitigation needed; thus, none proposed.	LTS
Impact Ag-6: Direct and Indirect Conversion of Forest Land to Nonforest Uses in the Extended Study Area	N-A	Permanent conversion	NA	LTS	No mitigation measures required.	LTS
	CP1–CP5	Permanent conversion	–	LTS	No mitigation needed; thus, none proposed.	LTS
Fisheries and Aquatic Ecosystems						
Impact Aqua-1: Effects on Nearshore, Warm-Water Habitat in Shasta Lake from Project Operations	N-A	Permanent	–	PS	No mitigation measures required.	PS
	CP1–CP5	Permanent	–	LTS	No mitigation needed; thus, none proposed.	LTS
Impact Aqua-2: Effects on Nearshore, Warm-Water Habitat in Shasta Lake from Project Construction	N-A	Temporary	NA	NI	No mitigation measures required.	NI
	CP1–CP5	Temporary	–	LTS	No mitigation needed; thus, none proposed.	LTS
Impact Aqua-3: Effects on Cold-Water Habitat in Shasta Lake	N-A	Long-term	–	PS	No mitigation measures required.	PS
	CP1–CP5	Long-term	–	B	No mitigation needed; thus, none proposed.	B

Table S-1. Summary of Impacts and Mitigation Measures (contd.)

Resource Topic/Impact	Alt[1]	Impact Duration[2]	Quantification/ Relative Magnitude of Impact[3]	LOS Before Mitigation[4]	Mitigation Measure	LOS After Mitigation[4]
Impact Aqua-4: Effects on Special-Status Aquatic Mollusks	N-A	Long-term	–	LTS	No mitigation measures required.	LTS
	CP1–CP5	Permanent		PS	Mitigation Measure Aqua-4: Implement Mitigation Measure Geo-2: Replace Lost Ecological Functions of Aquatic Habitats by Restoring Existing Degraded Aquatic Habitats in the Vicinity of the Impact.	LTS
Impact Aqua-5: Effects on Special-Status Fish Species	N-A	–	–	LTS	No mitigation measures required.	LTS
	CP1–CP5	–	–	LTS	No mitigation needed; thus, none proposed.	LTS
Impact Aqua-6: Creation or Removal of Barriers to Fish Between Tributaries and Shasta Lake	N-A	NA	NA	NI	No mitigation measures required.	NI
	CP1–CP5	Permanent	–	LTS	No mitigation needed; thus, none proposed.	LTS
Impact Aqua-7: Effects on Spawning and Rearing Habitat of Adfluvial Salmonids in Low-Gradient Tributaries to Shasta Lake	N-A	NA	NA	NI	No mitigation measures required.	NI
	CP1	Permanent	5.4 miles of low-gradient reaches	LTS	No mitigation needed; thus, none proposed.	LTS
	CP2	Permanent	7.4 miles of low-gradient reaches	LTS	No mitigation needed; thus, none proposed.	LTS
	CP3–CP5	Permanent	11 miles of low-gradient reaches	LTS	No mitigation needed; thus, none proposed.	LTS
Impact Aqua-8: Effects on Aquatic Connectivity in Non-Fish-Bearing Tributaries to Shasta Lake	N-A	NA	NA	NI	No mitigation measures required.	NI
	CP1	Permanent	12.6 miles of non-fish-bearing tributary habitat	LTS	No mitigation needed; thus, none proposed.	LTS
	CP2	Permanent	17.3 miles of non-fish-bearing tributary habitat	LTS	No mitigation needed; thus, none proposed.	LTS
	CP3–CP5	Permanent	24.0 miles of non-fish-bearing tributary habitat	LTS	No mitigation needed; thus, none proposed.	LTS

Table S-1. Summary of Impacts and Mitigation Measures (contd.)

Resource Topic/Impact	Alt[1]	Impact Duration[2]	Quantification/ Relative Magnitude of Impact[3]	LOS Before Mitigation[4]	Mitigation Measure	LOS After Mitigation[4]
Impact Aqua-9: Effects on Water Quality at Livingston Stone Hatchery	N-A	NA	NA	NI	No mitigation measures required.	NI
	CP1–CP5	NA	NA	NI	No mitigation needed; thus, none proposed.	NI
Impact Aqua-10: Loss or Degradation of Aquatic Habitat in the Upper Sacramento River During Construction Activities	N-A	NA	NA	NI	No mitigation measures required.	NI
	CP1–CP5	Temporary, long-term, or both	–	LTS	No mitigation needed; thus, none proposed.	LTS
Impact Aqua-11: Release and Exposure of Contaminants in the Upper Sacramento River During Construction Activities	N-A	NA	NA	NI	No mitigation measures required.	NI
	CP1–CP5	Temporary, long-term, or both	–	LTS	No mitigation needed; thus, none proposed.	LTS
Impact Aqua-12: Changes in Flow and Water Temperature in the Upper Sacramento River Resulting from Project Operation—Chinook Salmon	N-A	NA	NA	PS	No mitigation measures required.	PS
	CP1 & CP4	Long-term	–	B	No mitigation needed; thus, none proposed.	B
	CP2	Long-term	Similar to CP1 & CP4, but greater in magnitude	B	No mitigation needed; thus, none proposed.	B
	CP3 & CP5	Long-term	Similar to CP1, CP2 & CP4, but greater in magnitude	B	No mitigation needed; thus, none proposed.	B

Table S-1. Summary of Impacts and Mitigation Measures (contd.)

Resource Topic/Impact	Alt[1]	Impact Duration[2]	Quantification/ Relative Magnitude of Impact[3]	LOS Before Mitigation[4]	Mitigation Measure	LOS After Mitigation[4]
Impact Aqua-13: Changes in Flow and Water Temperature in the Upper Sacramento River Resulting from Project Operations—Steelhead, Green Sturgeon, Sacramento Splittail, American Shad, and Striped Bass	N-A	NA	–	PS	No mitigation measures required.	PS
	CP1	Long-term	–	LTS	No mitigation needed; thus, none proposed.	LTS
	CP2	Long-term	Similar to CP1, but greater in magnitude	LTS	No mitigation needed; thus, none proposed.	LTS
	CP3 & CP5	Long-term	Similar to CP1 & CP2, but greater in magnitude	LTS	No mitigation needed; thus, none proposed.	LTS
	CP4	Long-term	Similar to CP1–CP3 & CP5, but greater in magnitude	B	No mitigation needed; thus, none proposed.	B
Impact Aqua-14: Reduction in Ecologically Important Geomorphic Processes in the Upper Sacramento River Resulting from Reduced Frequency and Magnitude of Intermediate to High Flows	N-A	NA	NA	NI	No mitigation measures required.	NI
	CP1–CP5	Long-term	–	PS	Mitigation Measure Aqua-14: Implement Mitigation Measure Bot-7: Develop and Implement a Riverine Ecosystem Mitigation and Adaptive Management Plan to Avoid and Compensate for the Impact of Altered Flow Regimes on Riparian and Wetland Communities.	LTS
Impact Aqua-15: Changes in Flow and Water Temperatures in the Lower Sacramento River and Tributaries and Trinity River Resulting from Project Operation – Fish Species of Primary Management Concern	N-A	NA	NA	NI	No mitigation measures required.	NI
	CP1–CP5	Long-term	–	PS	Mitigation Measure Aqua-15: Maintain Flows in the Feather River, American River, and Trinity River Consistent with Existing Regulatory and Operational Requirements and Agreements.	LTS

Table S-1. Summary of Impacts and Mitigation Measures (contd.)

Resource Topic/Impact	Alt[1]	Impact Duration[2]	Quantification/ Relative Magnitude of Impact[3]	LOS Before Mitigation[4]	Mitigation Measure	LOS After Mitigation[4]
Impact Aqua-16: Reduction in Ecologically Important Geomorphic Processes in the Lower Sacramento River Resulting from Reduced Frequency and Magnitude of Intermediate to High Flows	N-A	NA	NA	NI	No mitigation measures required.	NI
	CP1–CP5	Long-term	–	PS	Mitigation Measure Aqua-16: Implement Mitigation Measure Bot-7: Develop and Implement a Riverine Ecosystem Mitigation and Adaptive Management Plan to Avoid and Compensate for the Impact of Altered Flow Regimes on Riparian and Wetland Communities.	LTS
Impact Aqua-17: Effects to Delta Fishery Habitat Resulting from Changes to Delta Outflow	N-A	NA	NA	NI	No mitigation measures required.	NI
	CP1–CP5	Long-term	–	LTS	No mitigation needed; thus, none proposed.	LTS
Impact Aqua-18: Effects to Delta Fishery Habitat Resulting from Changes to Delta Inflow	N-A	NA	NA	NI	No mitigation measures required.	NI
	CP1 & CP4	Long-term	–	LTS	No mitigation needed; thus, none proposed.	LTS
	CP2	Long-term	–	LTS	No mitigation needed; thus, none proposed.	LTS
	CP3 & CP5	Long-term	–	LTS	No mitigation needed; thus, none proposed.	LTS

Table S-1. Summary of Impacts and Mitigation Measures (contd.)

Resource Topic/Impact	Alt[1]	Impact Duration[2]	Quantification/ Relative Magnitude of Impact[3]	LOS Before Mitigation[4]	Mitigation Measure	LOS After Mitigation[4]
Impact Aqua-19: Effects to Delta Fisheries Resulting from Changes in Sacramento River Inflow	N-A	NA	NA	NI	No mitigation measures required.	NI
	CP1 & CP4	Long-term	–	LTS	No mitigation needed; thus, none proposed.	LTS
	CP2	Long-term	–	LTS	No mitigation needed; thus, none proposed.	LTS
	CP3 & CP5	Long-term	–	LTS	No mitigation needed; thus, none proposed.	LTS
Impact Aqua-20: Effects to Delta Fisheries Resulting from Changes in San Joaquin River Flow at Vernalis	N-A	NA	NA	NI	No mitigation measures required.	NI
	CP1 & CP2	Long-term	–	NI	No mitigation needed; thus, none proposed.	NI
	CP4	Long-term	–	LTS	No mitigation needed; thus, none proposed.	LTS
	CP3 & CP5	Long-term	–	LTS	No mitigation needed; thus, none proposed.	LTS
Impact Aqua-21: Reduction in Low Salinity Habitat Conditions Resulting from an Upstream Shift in X2 Location	N-A	NA	NA	NI	No mitigation measures required.	NI
	CP1 & CP4	Long-term	–	LTS	No mitigation needed; thus, none proposed.	LTS
	CP2	Long-term	–	LTS	No mitigation needed; thus, none proposed.	LTS
	CP3 & CP5	Long-term	–	LTS	No mitigation needed; thus, none proposed.	LTS

Table S-1. Summary of Impacts and Mitigation Measures (contd.)

Resource Topic/Impact	Alt[1]	Impact Duration[2]	Quantification/ Relative Magnitude of Impact[3]	LOS Before Mitigation[4]	Mitigation Measure	LOS After Mitigation[4]
Impact Aqua-22: Increase in Mortality of Species of Primary Management Concern as a Result of Increased Reverse Flows in Old and Middle Rivers	N-A	NA	NA	NI	No mitigation measures required.	NI
	CP1 & CP4	Long-term	–	PS	No mitigation proposed.	PS
	CP2	Long-term	–	PS	No mitigation proposed.	PS
	CP3 & CP5	Long-term	–	PS	No mitigation proposed.	PS
Impact Aqua-23: Increase in the Risk of Entrainment or Salvage of Species of Primary Management Concern at CVP and SWP Export Facilities Due to Changes in CVP and SWP Exports	N-A	NA	NA	NI	No mitigation measures required.	NI

Table S-1. Summary of Impacts and Mitigation Measures (contd.)

Resource Topic/Impact	Alt[1]	Impact Duration[2]	Quantification/ Relative Magnitude of Impact[3]	LOS Before Mitigation[4]	Mitigation Measure	LOS After Mitigation[4]
Impact Aqua-23: Increase in the Risk of Entrainment or Salvage of Species of Primary Management Concern at CVP and SWP Export Facilities Due to Changes in CVP and SWP Exports (contd.)	CP1 & CP4	Long-term	–	LTS for Chinook salmon, steelhead, and longfin smelt: PS for delta smelt, striped bass, and splittail	No mitigation proposed.	LTS
	CP2	Long-term	–	LTS for Chinook salmon, steelhead, and longfin smelt: PS for delta smelt, striped bass, and splittail	No mitigation proposed.	LTS
	CP3 & CP5	Long-term	–	LTS for Chinook salmon, steelhead, and longfin smelt: PS for delta smelt, striped bass, and splittail	No mitigation proposed.	LTS
Impact Aqua-24: Impacts on Aquatic Habitats and Fish Populations in the CVP and SWP Service Areas Resulting from Modifications to Existing Flow Regimes	N-A	NA	NA	NI	No mitigation measures required.	NI
	CP1–CP5	Long-term	–	LTS	No mitigation needed; thus, none proposed.	LTS

Table S-1. Summary of Impacts and Mitigation Measures (contd.)

Resource Topic/Impact	Alt[1]	Impact Duration[2]	Quantification/ Relative Magnitude of Impact[3]	LOS Before Mitigation[4]	Mitigation Measure	LOS After Mitigation[4]
Botanical Resources and Wetlands						
Impact Bot-1: Loss of Federally or State Listed Plant Species	N-A	NA	NA	NI	No mitigation measures required.	NI
	CP1–CP5	NA	NA	NI	No mitigation needed; thus, none proposed.	NI
Impact Bot-2: Loss of MSCS Covered Species	N-A	Permanent	NA	NI	No mitigation measures required.	NI
	CP1	Permanent	–	S	Mitigation Measure Bot-2: Acquire and Preserve Mitigation Lands; Avoid Populations; Relocate MSCS Plants; and Revegetate Affected Areas.	SU
	CP2	Permanent	Greater than CP1	S	Mitigation Measure Bot-2: Acquire and Preserve Mitigation Lands; Avoid Populations; Relocate MSCS Plants; and Revegetate Affected Areas.	SU
	CP3–CP5	Permanent	Greater than CP1 & CP2	S	Mitigation Measure Bot-2: Acquire and Preserve Mitigation Lands; Avoid Populations; Relocate MSCS Plants; and Revegetate Affected Areas.	SU

Table S-1. Summary of Impacts and Mitigation Measures (contd.)

Resource Topic/Impact	Alt[1]	Impact Duration[2]	Quantification/ Relative Magnitude of Impact[3]	LOS Before Mitigation[4]	Mitigation Measure	LOS After Mitigation[4]
Impact Bot-3: Loss of USFS Sensitive, BLM Sensitive, or CRPR Species	N-A	Permanent	NA	NI	No mitigation measures required.	NI
	CP1	Permanent	–	PS	Mitigation Measure Bot-3: Acquire and Preserve Mitigation Lands; Avoid Populations; Relocate USFS Sensitive, BLM Sensitive, and CRPR Plants and Revegetate Affected Areas.	SU
	CP2	Permanent	Greater than CP1	PS	Mitigation Measure Bot-3: Acquire and Preserve Mitigation Lands; Avoid Populations; Relocate USFS Sensitive, BLM Sensitive, and CRPR Plants and Revegetate Affected Areas.	SU
	CP3–CP5	Permanent	Greater than CP1 & CP2	PS	Mitigation Measure Bot-3: Acquire and Preserve Mitigation Lands; Avoid Populations; Relocate USFS Sensitive, BLM Sensitive, and CRPR Plants and Revegetate Affected Areas.	SU
Impact Bot-4: Loss of Jurisdictional Waters	N-A	Permanent	NA	NI	No mitigation measures required.	NI
	CP1	Permanent	–	S	Mitigation Measure Bot-4: Mitigate Loss of Jurisdictional Waters.	SU
	CP2	Permanent	Greater than CP1	S	Mitigation Measure Bot-4: Mitigate Loss of Jurisdictional Waters.	SU
	CP3–CP5	Permanent	Greater than CP1 & CP2	S	Mitigation Measure Bot-4: Mitigate Loss of Jurisdictional Waters.	SU

Table S-1. Summary of Impacts and Mitigation Measures (contd.)

Resource Topic/Impact	Alt[1]	Impact Duration[2]	Quantification/ Relative Magnitude of Impact[3]	LOS Before Mitigation[4]	Mitigation Measure	LOS After Mitigation[4]
Impact Bot-5: Loss of General Vegetation Habitats	N-A	Permanent	NA	NI	No mitigation measure required.	NI
	CP1	Permanent	–	PS	Mitigation Measure Bot-5: Acquire and Preserve Mitigation Lands for Loss of General Vegetation Habitats.	SU
	CP2	Permanent	Greater than CP1	PS	Mitigation Measure Bot-5: Acquire and Preserve Mitigation Lands for Loss of General Vegetation Habitats.	SU
	CP3–CP5	Permanent	Greater than CP1 & CP2	PS	Mitigation Measure Bot-5: Acquire and Preserve Mitigation Lands for Loss of General Vegetation Habitats.	SU
Impact Bot-6: Spread of Noxious and Invasive Weeds	N-A	NA	NA	NI	No mitigation measures required.	NI
	CP1	Long-term and/or permanent	–	PS	Mitigation Measure Bot-6: Develop a Weed Management Plan.	LTS
	CP2	Long-term and/or permanent	Greater than CP1	PS	Mitigation Measure Bot-6: Develop a Weed Management Plan.	LTS
	CP3–CP5	Long-term and/or permanent	Greater than CP1 & CP2	PS	Mitigation Measure Bot-6: Develop a Weed Management Plan.	LTS
Impact Bot-7: Altered Structure and Species Composition and Loss of Sensitive Plant Communities and Special-Status Plant Species Resulting from Altered Flow Regimes	N-A	Long-term	NA	LTS	No mitigation measures required.	LTS

Table S-1. Summary of Impacts and Mitigation Measures (contd.)

Resource Topic/Impact	Alt[1]	Impact Duration[2]	Quantification/ Relative Magnitude of Impact[3]	LOS Before Mitigation[4]	Mitigation Measure	LOS After Mitigation[4]
Impact Bot-7: Altered Structure and Species Composition and Loss of Sensitive Plant Communities and Special-Status Plant Species Resulting from Altered Flow Regimes (contd.)	CP1 & CP4	Long-term	–	S	Mitigation Measure Bot-7: Develop and Implement a Riverine Ecosystem Mitigation and Adaptive Management Plan to Avoid and Compensate for the Impact of Altered Flow Regimes on Riparian and Wetland Communities.	LTS
	CP2	Long-term	Greater than CP1 & CP4	S	Mitigation Measure Bot-7: Develop and Implement a Riverine Ecosystem Mitigation and Adaptive Management Plan to Avoid and Compensate for the Impact of Altered Flow Regimes on Riparian and Wetland Communities.	LTS
	CP3 & CP5	Long-term	Greater than CP1, CP2 & CP4	S	Mitigation Measure Bot-7: Develop and Implement a Riverine Ecosystem Mitigation and Adaptive Management Plan to Avoid and Compensate for the Impact of Altered Flow Regimes on Riparian and Wetland Communities.	LTS

Table S-1. Summary of Impacts and Mitigation Measures (contd.)

Resource Topic/Impact	Alt[1]	Impact Duration[2]	Quantification/ Relative Magnitude of Impact[3]	LOS Before Mitigation[4]	Mitigation Measure	LOS After Mitigation[4]
Impact Bot-8: Conflict with Approved Local or Regional Plans with Objectives of Riparian Habitat Protection or Watershed Management	N-A	Long-term	–	LTS	No mitigation measures required.	LTS
	CP1 & CP4	Long-term	–	PS	Mitigation Measure Bot-8: Implement Mitigation Measure Bot-7: Develop and Implement a Riverine Ecosystem Mitigation and Adaptive Management Plan to Avoid and Compensate for the Impact of Altered Flow Regimes on Riparian and Wetland Communities.	LTS
	CP2	Long-term	Greater than CP1 & CP4	PS	Mitigation Measure Bot-8: Implement Mitigation Measure Bot-7: Develop and Implement a Riverine Ecosystem Mitigation and Adaptive Management Plan to Avoid and Compensate for the Impact of Altered Flow Regimes on Riparian and Wetland Communities.	LTS
	CP3 & CP5	Long-term	Greater than CP1, CP2 & CP4	PS	Mitigation Measure Bot-8: Implement Mitigation Measure Bot-7: Develop and Implement a Riverine Ecosystem Mitigation and Adaptive Management Plan to Avoid and Compensate for the Impact of Altered Flow Regimes on Riparian and Wetland Communities.	LTS

Table S-1. Summary of Impacts and Mitigation Measures (contd.)

Resource Topic/Impact	Alt[1]	Impact Duration[2]	Quantification/ Relative Magnitude of Impact[3]	LOS Before Mitigation[4]	Mitigation Measure	LOS After Mitigation[4]
Impact Bot-9: Disturbance or Removal of Designated Critical Habitat for Special-Status Species	N-A	Long-term and/or permanent	–	LTS	No mitigation measures required.	LTS
	CP1 & CP4	Long-term and/or permanent	–	LTS	No mitigation needed; thus, none proposed.	LTS
	CP2	Long-term and/or permanent	Greater than CP1 & CP4	LTS	No mitigation needed; thus, none proposed.	LTS
	CP3 & CP5	Long-term and/or permanent	Greater than CP1, CP2 & CP4	LTS	No mitigation needed; thus, none proposed.	LTS
Impact Bot-10: Loss of Sensitive Plant Communities and Special-Status Plant Species Resulting from Induced Growth	N-A	Permanent	–	LTS	No mitigation measures required.	LTS
	CP1 & CP4	Permanent	–	LTS	No mitigation needed; thus, none proposed.	LTS
	CP2	Permanent	Greater than CP1 & CP4	LTS	No mitigation needed; thus, none proposed.	LTS
	CP3 & CP5	Permanent	Greater than CP1, CP2 & CP4	LTS	No mitigation needed; thus, none proposed.	LTS

Table S-1. Summary of Impacts and Mitigation Measures (contd.)

Resource Topic/Impact	Alt[1]	Impact Duration[2]	Quantification/ Relative Magnitude of Impact[3]	LOS Before Mitigation[4]	Mitigation Measure	LOS After Mitigation[4]
Impact Bot-11: Loss of Sensitive Natural Communities or Habitats Resulting from Implementing the Gravel Augmentation Program or the Reading Island Restoration Plan, Rehabilitating the Reading Island Boat Ramp, or Constructing a Handicap Fishing Access Area	N-A	NA	NA	NI	No mitigation measures required.	NI
	CP1–CP3	Long-term	–	NI	No mitigation needed; thus, none proposed.	NI
	CP4–CP5	Long-term	–	PS	Mitigation Measure Bot-11: Revegetate Disturbed Areas, Consult with DFG.	LTS
Impact Bot-12: Loss of Special-Status Plants Resulting from Implementing the Gravel Augmentation Program, Restoring Sacramento River Flow Through Anderson Slough, Rehabilitating the Reading Island Boat Ramp, or Constructing a Handicap Fishing Access Area	N-A	NA	NA	NI	No mitigation measures required.	NI
	CP1–CP3	Long-term	–	NI	No mitigation needed; thus, none proposed.	NI
	CP4–CP5	Long-term	–	PS	Mitigation Measure Bot-12: Conduct Preconstruction Surveys for Special-Status Plants and Avoid Special-Status Plant Populations During Construction.	LTS
Impact Bot-13: Spread of Noxious and Invasive Weeds Resulting from Implementing the Gravel Augmentation Program, Restoring Sacramento River Flow Through Anderson Slough, Rehabilitating the Reading Island Boat Ramp, or Constructing a Handicap Fishing Access Area	N-A	NA	NA	NI	No mitigation measures required.	NI
	CP1–CP3	Long-term	–	NI	No mitigation needed; thus, none proposed.	NI
	CP4–CP5	Long-term	–	PS	Mitigation Measure Bot-13: Implement Weed Management Measures and Revegetation.	LTS

Table S-1. Summary of Impacts and Mitigation Measures (contd.)

Resource Topic/Impact	Alt[1]	Impact Duration[2]	Quantification/ Relative Magnitude of Impact[3]	LOS Before Mitigation[4]	Mitigation Measure	LOS After Mitigation[4]
Impact Bot-14: Altered Structure and Species Composition and Loss of Sensitive Plant Communities and Special-Status Plant Species Resulting from Altered Flow Regimes on the Lower Sacramento River	N-A	Long-term	–	LTS	No mitigation measures required.	LTS
	CP1 & CP4	Long-term	–	S for lower Sacramento River; LTS for Delta	Mitigation Measure Bot-14: Implement Mitigation Measure Bot-7: Develop and Implement a Riverine Ecosystem Mitigation and Adaptive Management Plan to Avoid and Compensate for the Impact of Altered Flow Regimes on Riparian and Wetland Communities.	LTS
	CP2	Long-term	Greater than CP1 & CP4	S for lower Sacramento River; LTS for Delta	Mitigation Measure Bot-14: Implement Mitigation Measure Bot-7:Develop and Implement a Riverine Ecosystem Mitigation and Adaptive Management Plan to Avoid and Compensate for the Impact of Altered Flow Regimes on Riparian and Wetland Communities.	LTS
	CP3 & CP5	Long-term	Greater than CP1, CP2 & CP4	S for lower Sacramento River; LTS for Delta	Mitigation Measure Bot-14: Implement Mitigation Measure Bot-7:Develop and Implement a Riverine Ecosystem Mitigation and Adaptive Management Plan to Avoid and Compensate for the Impact of Altered Flow Regimes on Riparian and Wetland Communities.	LTS

Table S-1. Summary of Impacts and Mitigation Measures (contd.)

Resource Topic/Impact	Alt[1]	Impact Duration[2]	Quantification/ Relative Magnitude of Impact[3]	LOS Before Mitigation[4]	Mitigation Measure	LOS After Mitigation[4]
Impact Bot-15: Conflict with Approved Local or Regional Plans with Objectives of Riparian Habitat Protection or Watershed Management Along the Lower Sacramento River	N-A	Long-term	–	PS	No mitigation measures required.	PS
	CP1 & CP4	Long-term	–	PS	Mitigation Measure Bot-15: Implement Mitigation Measure Bot-7: Develop and Implement a Riverine Ecosystem Mitigation and Adaptive Management Plan to Avoid and Compensate for the Impact of Altered Flow Regimes on Riparian and Wetland Communities.	LTS
	CP2	Long-term	Greater than CP1 & CP4	PS	Mitigation Measure Bot-15: Implement Mitigation Measure Bot-7: Develop and Implement a Riverine Ecosystem Mitigation and Adaptive Management Plan to Avoid and Compensate for the Impact of Altered Flow Regimes on Riparian and Wetland Communities.	LTS
	CP3 & CP5	Long-term	Greater than CP1, CP2 & CP4	PS	Mitigation Measure Bot-15: Implement Mitigation Measure Bot-7: Develop and Implement a Riverine Ecosystem Mitigation and Adaptive Management Plan to Avoid and Compensate for the Impact of Altered Flow Regimes on Riparian and Wetland Communities.	LTS

Table S-1. Summary of Impacts and Mitigation Measures (contd.)

Resource Topic/Impact	Alt[1]	Impact Duration[2]	Quantification/ Relative Magnitude of Impact[3]	LOS Before Mitigation[4]	Mitigation Measure	LOS After Mitigation[4]
Impact Bot-16: Loss of Sensitive Plant Communities and Special-Status Plant Species Resulting from Induced Growth Along the Lower Sacramento River and in the Delta	N-A	Long-term	–	LTS	No mitigation measures required.	LTS
	CP1 & CP4	Long-term	–	LTS	No mitigation needed; thus, none proposed.	LTS
	CP2	Long-term	Greater than CP1 & CP4	LTS	No mitigation needed; thus, none proposed.	LTS
	CP3 & CP5	Long-term	Greater than CP1, CP2 & CP4	LTS	No mitigation needed; thus, none proposed.	LTS
Impact Bot-17: Altered Structure and Species Composition and Loss of Sensitive Plant Communities and Special-Status Plant Species Resulting from Altered Flow Regimes in the CVP/SWP Service Areas	N-A	Long-term	–	LTS	No mitigation measures required.	LTS
	CP1 & CP4	Long-term	–	LTS	No mitigation needed; thus, none proposed.	LTS
	CP2	Long-term	Greater than CP1 & CP4	LTS	No mitigation needed; thus, none proposed.	LTS
	CP3 & CP5	Long-term	Greater than CP1, CP2 & CP4	LTS	No mitigation needed; thus, none proposed.	LTS
Impact Bot-18: Conflict with Approved Local or Regional Plans with Objectives of Riparian Habitat Protection or Watershed Management in the CVP/SWP Service Areas	N-A	Long-term	–	LTS	No mitigation measures required.	LTS
	CP1 & CP4	Long-term	–	LTS	No mitigation needed; thus, none proposed.	LTS
	CP2	Long-term	Greater than CP1 & CP4	LTS	No mitigation needed; thus, none proposed.	LTS
	CP3 & CP5	Long-term	Greater than CP1, CP2 & CP4	LTS	No mitigation needed; thus, none proposed.	LTS

Table S-1. Summary of Impacts and Mitigation Measures (contd.)

Resource Topic/Impact	Alt[1]	Impact Duration[2]	Quantification/ Relative Magnitude of Impact[3]	LOS Before Mitigation[4]	Mitigation Measure	LOS After Mitigation[4]
Impact Bot-19: Loss of Sensitive Plant Communities and Special-Status Plant Species Resulting from Induced Growth in the CVP/SWP Service Areas	N-A	Permanent	–	LTS	No mitigation measures required.	LTS
	CP1 & CP4	Permanent	–	LTS	No mitigation needed; thus, none proposed.	LTS
	CP2	Permanent	Greater than CP1 & CP4	LTS	No mitigation needed; thus, none proposed.	LTS
	CP3 & CP5	Permanent	Greater than CP1, CP2 & CP4	LTS	No mitigation needed; thus, none proposed.	LTS
Wildlife Resources						
Impact Wild-1: Take and Loss of Habitat for the Shasta Salamander	N-A	Long-term	–	NI	No mitigation measures required.	NI
	CP1	Short-term and long-term	–	S	Mitigation Measure Wild-1: Avoid, Relocate, and Acquire Mitigation Lands for Shasta Salamander.	SU
	CP2	Short-term and long-term	Similar to CP1, but greater	S	Mitigation Measure Wild-1: Avoid, Relocate, and Acquire Mitigation Lands for Shasta Salamander.	SU
	CP3–CP5	Short-term and permanent	Similar to CP1 & CP2, but greater	S	Mitigation Measure Wild-1: Avoid, Relocate, and Acquire Mitigation Lands for Shasta Salamander.	SU

Table S-1. Summary of Impacts and Mitigation Measures (contd.)

Resource Topic/Impact	Alt[1]	Impact Duration[2]	Quantification/ Relative Magnitude of Impact[3]	LOS Before Mitigation[4]	Mitigation Measure	LOS After Mitigation[4]
Impact Wild-2: Impact on the Foothill Yellow-Legged Frog and Tailed Frog and Their Habitat	N-A	Long-term	–	NI	No mitigation measures required.	NI
	CP1	Short-term and permanent	52 acres	PS	Mitigation Measure Wild-2: Avoid, Relocate, and Acquire Mitigation Lands for Foothill Yellow-Legged Frog and Tailed Frog.	SU
	CP2	Short-term and permanent	64 acres	PS	Mitigation Measure Wild-2: Avoid, Relocate, and Acquire Mitigation Lands for Foothill Yellow-Legged Frog and Tailed Frog.	SU
	CP3–CP5	Short-term and permanent	96 acres	PS	Mitigation Measure Wild-2: Avoid, Relocate, and Acquire Mitigation Lands for Foothill Yellow-Legged Frog and Tailed Frog.	SU
Impact Wild-3: Impact on the Northwestern Pond Turtle and Its Habitat	N-A	Long-term	–	NI	No mitigation measures required.	NI
	CP1	Short-term and permanent	52 acres	PS	Mitigation Measure Wild-3: Avoid, Relocate, and Acquire Mitigation Lands for Northwestern Pond Turtle.	SU
	CP2	Short-term and permanent	64 acres	PS	Mitigation Measure Wild-3: Avoid, Relocate, and Acquire Mitigation Lands for Northwestern Pond Turtle.	SU
	CP3–CP5	Short-term and permanent	96 acres	PS	Mitigation Measure Wild-3: Avoid, Relocate, and Acquire Mitigation Lands for Northwestern Pond Turtle.	SU

Table S-1. Summary of Impacts and Mitigation Measures (contd.)

Resource Topic/Impact	Alt[1]	Impact Duration[2]	Quantification/ Relative Magnitude of Impact[3]	LOS Before Mitigation[4]	Mitigation Measure	LOS After Mitigation[4]
Impact Wild-4: Impact on the American Peregrine Falcon	N-A	Long-term	–	NI	No mitigation measures required.	NI
	CP1–CP5	Short-term	Loss of nests	PS	Mitigation Measure Wild-4: Conduct Preconstruction Surveys for the American Peregrine Falcon and Establish Buffers.	LTS
Impact Wild-5: Take and Loss of Habitat for the Bald Eagle	N-A	Long-term	–	NI	No mitigation measures required.	NI
	CP1	Long-term	Inundation of nest trees, increase of prey habitat in primary study area	S	Mitigation Measure Wild-5: Acquire and Preserve Mitigation Lands; Conduct Protocol-Level Surveys for the Bald Eagle and Establish Buffers.	SU
	CP2	Long-term	Similar to CP1, but greater	S	Mitigation Measure Wild-5: Acquire and Preserve Mitigation Lands; Conduct Protocol-Level Surveys for the Bald Eagle and Establish Buffers.	SU
	CP3–CP5	Long-term	Similar to CP1 & CP2, but greater	S	Mitigation Measure Wild-5: Acquire and Preserve Mitigation Lands; Conduct Protocol-Level Surveys for the Bald Eagle and Establish Buffers.	SU

Table S-1. Summary of Impacts and Mitigation Measures (contd.)

Resource Topic/Impact	Alt[1]	Impact Duration[2]	Quantification/ Relative Magnitude of Impact[3]	LOS Before Mitigation[4]	Mitigation Measure	LOS After Mitigation[4]
Impact Wild-6: Take and Loss of Nesting and Foraging Habitat for the Northern Spotted Owl	N-A	Long-term	–	NI	No mitigation measures required.	NI
	CP1	Short-term and permanent	Loss of nests and habitat (3,116 acres)	PS	Mitigation Measure Wild-6: Acquire and Preserve Mitigation Lands; Conduct Protocol-Level Surveys for the Northern Spotted Owl and Establish Buffers.	SU
	CP2	Short-term and permanent	Loss of nests and habitat (3,429 acres)	PS	Mitigation Measure Wild-6: Acquire and Preserve Mitigation Lands; Conduct Protocol-Level Surveys for the Northern Spotted Owl and Establish Buffers.	SU
	CP3–CP5	Short-term and permanent	Loss of nests and habitat (3,909 acres)	PS	Mitigation Measure Wild-6: Acquire and Preserve Mitigation Lands; Conduct Protocol-Level Surveys for the Northern Spotted Owl and Establish Buffers.	SU
Impact Wild-7: Impact on the Purple Martin and Its Habitat	N-A	Long-term	–	NI	No mitigation measures required.	NI
	CP1	Short-term and long-term	Loss of nests (10–11) and nest trees in primary study area	S	Mitigation Measure Wild-7: Conduct a Preconstruction Survey for Purple Martin and Establish Buffers.	SU
	CP2	Short-term and long-term	Similar to CP1, but greater loss of nest trees	S	Mitigation Measure Wild-7: Conduct a Preconstruction Survey for Purple Martin and Establish Buffers.	SU
	CP3–CP5	Short-term and long-term	Similar to CP1 &CP2, but greater loss of nest trees	S	Mitigation Measure Wild-7: Conduct a Preconstruction Survey for Purple Martin and Establish Buffers.	SU

Table S-1. Summary of Impacts and Mitigation Measures (contd.)

Resource Topic/Impact	Alt[1]	Impact Duration[2]	Quantification/ Relative Magnitude of Impact[3]	LOS Before Mitigation[4]	Mitigation Measure	LOS After Mitigation[4]
Impact Wild-8: Impacts on the Willow Flycatcher, Vaux's Swift, Yellow Warbler, and Yellow-Breasted Chat and Their Foraging and Nesting Habitat	N-A	Long-term	–	NI	No mitigation measures required.	NI
	CP1	Short-term and permanent	Loss of nests and habitat for Vaux's Swift (3,156 acres) and Willow Flycatcher, Yellow Warbler, and Yellow-Breasted Chat (36 acres)	PS	Mitigation Measure Wild-8: Acquire and Preserve Mitigation Lands; Conduct a Preconstruction Survey for the Willow Flycatcher, Vaux's Swift, Yellow Warbler, and Yellow-Breasted Chat and Establish Buffers.	SU
	CP2	Short-term and permanent	Loss of nests and habitat for Vaux's Swift (3,514 acres) and Willow Flycatcher, Yellow Warbler, and Yellow-Breasted Chat (50 acres)	PS	Mitigation Measure Wild-8: Acquire and Preserve Mitigation Lands; Conduct a Preconstruction Survey for the Willow Flycatcher, Vaux's Swift, Yellow Warbler, and Yellow-Breasted Chat and Establish Buffers.	SU
	CP3–CP5	Short-term and permanent	Loss of nests and habitat for Vaux's Swift (3,978 acres) Willow Flycatcher, Yellow Warbler, and Yellow-Breasted Chat (69 acres)	PS	Mitigation Measure Wild-8: Acquire and Preserve Mitigation Lands; Conduct a Preconstruction Survey for the Willow Flycatcher, Vaux's Swift, Yellow Warbler, and Yellow-Breasted Chat and Establish Buffers.	SU

Table S-1. Summary of Impacts and Mitigation Measures (contd.)

Resource Topic/Impact	Alt[1]	Impact Duration[2]	Quantification/ Relative Magnitude of Impact[3]	LOS Before Mitigation[4]	Mitigation Measure	LOS After Mitigation[4]
Impact Wild-9: Impacts on the Long-Eared Owl, Northern Goshawk, Cooper's Hawk, Great Blue Heron, and Osprey and Their Foraging and Nesting Habitat	N-A	Long-term	–	NI	No mitigation measures required.	NI
	CP1	Short-term and permanent	Loss of nests and 2,458 acres of Long-Eared Owl and Northern Goshawk habitat and 3,533 acres of Cooper's Hawk and Great Blue Herod habitat	PS	Mitigation Measure Wild-9: Acquire and Preserve Mitigation Lands; Conduct a Preconstruction Survey for the Long-Eared Owl, Northern Goshawk, Cooper's Hawk, and Great Blue Heron and Establish Buffers.	SU
	CP2	Short-term and permanent	Loss of nests and 2,958 acres of Long-Eared Owl and Northern Goshawk habitat and 3,956 acres of Cooper's Hawk and Great Blue Herod habitat	PS	Mitigation Measure Wild-9: Acquire and Preserve Mitigation Lands; Conduct a Preconstruction Survey for the Long-Eared Owl, Northern Goshawk, Cooper's Hawk, and Great Blue Heron and Establish Buffers.	SU
	CP3–CP5	Short-term and permanent	Loss of nests and 3,444 acres of Long-Eared Owl and Northern Goshawk habitat and 4,603 acres of Cooper's Hawk and Great Blue Herod habitat	PS	Mitigation Measure Wild-9: Acquire and Preserve Mitigation Lands; Conduct a Preconstruction Survey for the Long-Eared Owl, Northern Goshawk, Cooper's Hawk, and Great Blue Heron and Establish Buffers.	SU

Table S-1. Summary of Impacts and Mitigation Measures (contd.)

Resource Topic/Impact	Alt[1]	Impact Duration[2]	Quantification/ Relative Magnitude of Impact[3]	LOS Before Mitigation[4]	Mitigation Measure	LOS After Mitigation[4]
Impact Wild-10: Take and Loss of Habitat for the Pacific Fisher	N-A	Long-term	–	NI	No mitigation measures required.	NI
	CP1	Short-term and permanent	Construction-related mortality and loss of habitat (2,498 acres)	PS	Mitigation Measure Wild-10: Acquire and Preserve Mitigation Lands; Conduct Preconstruction Surveys for the Pacific Fisher and Establish Buffers.	SU
	CP2	Short-term and permanent	Construction-related mortality and loss of habitat (2,778 acres)	PS	Mitigation Measure Wild-10: Acquire and Preserve Mitigation Lands; Conduct Preconstruction Surveys for the Pacific Fisher and Establish Buffers.	SU
	CP3–CP5	Short-term and permanent	Construction-related mortality and loss of habitat (3,135 acres)	PS	Mitigation Measure Wild-10: Acquire and Preserve Mitigation Lands; Conduct Preconstruction Surveys for the Pacific Fisher and Establish Buffers.	SU

Table S-1. Summary of Impacts and Mitigation Measures (contd.)

Resource Topic/Impact	Alt[1]	Impact Duration[2]	Quantification/ Relative Magnitude of Impact[3]	LOS Before Mitigation[4]	Mitigation Measure	LOS After Mitigation[4]
Impact Wild-11: Impacts on Special-Status Bats (Pallid Bat, Spotted Bat, Western Red Bat, Western Mastiff Bat, Townsend's Big-Eared Bat, Long-Eared Myotis, and Yuma Myotis), the American Marten, and Ringtails and Their Habitat	N-A	Long-term	–	NI	No mitigation measures required.	NI
	CP1	Short-term and permanent	Construction-related mortality and loss of habitat (6,550+ acres) in primary study area	PS	Mitigation Measure Wild-11: Acquire and Preserve Mitigation Lands; Conduct a Preconstruction Survey for Special-Status Bats, American Marten, and Ringtails and Establish Buffers.	SU
	CP2	Short-term and long-term	Construction-related mortality and loss of habitat (7,288+ acres)	PS	Mitigation Measure Wild-11: Acquire and Preserve Mitigation Lands; Conduct a Preconstruction Survey for Special-Status Bats, American Marten, and Ringtails and Establish Buffers.	SU
	CP3–CP5	Short-term and long-term	Construction-related mortality and loss of habitat (8,030+ acres)	PS	Mitigation Measure Wild-11: Acquire and Preserve Mitigation Lands; Conduct a Preconstruction Survey for Special-Status Bats, American Marten, and Ringtails and Establish Buffers.	SU
Impact Wild-12: Impacts on Special-Status Terrestrial Mollusks (Shasta Sideband, Wintu Sideband, Shasta Chaparral, and Shasta Hesperian) and Their Habitat	N-A	Long-term	–	NI	No mitigation measures required.	NI
	CP1	Short-term and permanent	Ground-disturbing activities, inundation of habitat	S	Mitigation Measure Wild-12: Avoid Suitable Habitat; Acquire and Preserve Mitigation Lands for Special-Status Terrestrial Mollusks.	SU
	CP2	Short-term and permanent	Similar to CP1, but greater (larger area of inundation)	S	Mitigation Measure Wild-12: Avoid Suitable Habitat; Acquire and Preserve Mitigation Lands for Special-Status Terrestrial Mollusks.	SU
	CP3–CP5	Short-term and permanent	Similar to CP1 & CP2, but greater (larger area of inundation)	S	Mitigation Measure Wild-12: Avoid Suitable Habitat; Acquire and Preserve Mitigation Lands for Special-Status Terrestrial Mollusks.	SU

Table S-1. Summary of Impacts and Mitigation Measures (contd.)

Resource Topic/Impact	Alt[1]	Impact Duration[2]	Quantification/ Relative Magnitude of Impact[3]	LOS Before Mitigation[4]	Mitigation Measure	LOS After Mitigation[4]
Impact Wild-13: Permanent Loss of General Wildlife Habitat	N-A	Permanent	–	NI	No mitigation measures required.	NI
	CP1	Permanent	Inundation of habitat	PS	Mitigation Measure Wild-13: Acquire and Preserve Mitigation Lands for Permanent Loss of General Wildlife Habitat.	SU
	CP2	Permanent	Similar to CP1, but greater (larger area of inundation)	PS	Mitigation Measure Wild-13: Acquire and Preserve Mitigation Lands for Permanent Loss of General Wildlife Habitat.	SU
	CP3–CP5	Permanent	Similar to CP1 & CP2, but greater (larger area of inundation)	PS	Mitigation Measure Wild-13: Acquire and Preserve Mitigation Lands for Permanent Loss of General Wildlife Habitat.	SU
Impact Wild-14: Impacts on Other Birds of Prey (Red-Tailed Hawk and Red-Shouldered Hawk) and Migratory Bird Species (American Robin, Anna's Hummingbird) and Their Foraging and Nesting Habitat	N-A	Short-term and long-term	–	NI	No mitigation measures required.	NI
	CP1	Short-term and long-term	–	PS	Mitigation Measure Wild-14: Conduct Preconstruction Surveys for Other Nesting Raptors and Migratory Birds and Establish Buffers.	SU
	CP2	Short-term and long-term	Similar to CP1, but greater (larger area of inundation)	PS	Mitigation Measure Wild-14: Conduct Preconstruction Surveys for Other Nesting Raptors and Migratory Birds and Establish Buffers.	SU
	CP3–CP5	Short-term and long-term	Similar to CP1 & CP2, but greater (larger area of inundation)	PS	Mitigation Measure Wild-14: Conduct Preconstruction Surveys for Other Nesting Raptors and Migratory Birds and Establish Buffers.	SU

Table S-1. Summary of Impacts and Mitigation Measures (contd.)

Resource Topic/Impact	Alt[1]	Impact Duration[2]	Quantification/ Relative Magnitude of Impact[3]	LOS Before Mitigation[4]	Mitigation Measure	LOS After Mitigation[4]
Impact Wild-15: Loss of Critical Deer Winter and Fawning Range	N-A	Short-term and long-term	–	NI	No mitigation measures required.	NI
	CP1	Short-term and long-term	–	PS	Mitigation Measure Wild-15: Acquire and Preserve Mitigation Lands for Permanent Loss of Critical Deer Wintering and Fawning Range.	SU
	CP2	Short-term and long-term	Similar to CP1, but greater (larger area of inundation)	PS	Mitigation Measure Wild-15: Acquire and Preserve Mitigation Lands for Permanent Loss of Critical Deer Wintering and Fawning Range.	SU
	CP3–CP5	Short-term and long-term	Similar to CP1 & CP2, but greater (larger area of inundation)	PS	Mitigation Measure Wild-15: Acquire and Preserve Mitigation Lands for Permanent Loss of Critical Deer Wintering and Fawning Range.	SU
Impact Wild-16: Take and Loss of California Red-Legged Frog	N-A	Long-term	–	NI	No mitigation measures required.	NI
	CP1–CP5	Long-term	[TBD]	[TBD]	[TBD]	[TBD]

Table S-1. Summary of Impacts and Mitigation Measures (contd.)

Resource Topic/Impact	Alt[1]	Impact Duration[2]	Quantification/ Relative Magnitude of Impact[3]	LOS Before Mitigation[4]	Mitigation Measure	LOS After Mitigation[4]
Impact Wild-17: Impacts on Riparian-Associated Special-Status Wildlife Resulting from Modifications to the Existing Flow Regime in the Primary Study Area	N-A	Long-term	–	LTS	No mitigation measures required.	LTS
	CP1, CP4	Long-term	CP4 identical to CP1	PS	Mitigation Measure Wild-17: Implement Mitigation Measure Bot-7: Develop and Implement a Riverine Ecosystem Mitigation and Adaptive Management Plan to Avoid and Compensate for the Impact of Altered Flow Regimes on Riparian and Wetland Communities.	LTS
	CP2	Long-term	CP2 similar to CP1 but greater in magnitude	PS	Mitigation Measure Wild-17: Implement Mitigation Measure Bot-7: Develop and Implement a Riverine Ecosystem Mitigation and Adaptive Management Plan to Avoid and Compensate for the Impact of Altered Flow Regimes on Riparian and Wetland Communities.	LTS
	CP3–CP5	Long-term	CP3 & CP5 similar to CP1–CP2, but greater in magnitude;	PS	Mitigation Measure Wild-17: Implement Mitigation Measure Bot-7: Develop and Implement a Riverine Ecosystem Mitigation and Adaptive Management Plan to Avoid and Compensate for the Impact of Altered Flow Regimes on Riparian and Wetland Communities.	LTS

Table S-1. Summary of Impacts and Mitigation Measures (contd.)

Resource Topic/Impact	Alt[1]	Impact Duration[2]	Quantification/ Relative Magnitude of Impact[3]	LOS Before Mitigation[4]	Mitigation Measure	LOS After Mitigation[4]
Impact Wild-18: Impacts on Bank Swallow in the Primary Study Area Resulting from Modifications of Geomorphic Processes	N-A	Long-term	–	LTS	No mitigation measures required.	LTS
	CP1, CP4	Long-term	CP4 identical to CP1	LTS	No mitigation needed; thus, none proposed.	LTS
	CP2	Long-term	CP2 similar to CP1 but greater in magnitude	LTS	No mitigation needed; thus, none proposed.	LTS
	CP3–CP5	Long-term	CP3 & CP5 similar to CP1–CP2, but greater in magnitude	LTS	No mitigation needed; thus, none proposed.	LTS
Impact Wild-19: Disturbance or Removal of Vernal Pool Habitat for Special-Status Wildlife from Changes in Flow Regime	N-A	Long-term	–	LTS	No mitigation measures required.	LTS
	CP1, CP4	Long-term	CP4 identical to CP1	LTS	No mitigation needed; thus, none proposed.	LTS
	CP2	NA	CP2 similar to CP1 but greater in magnitude	LTS	No mitigation needed; thus, none proposed.	LTS
	CP3–CP5	Long-term	CP3 & CP5 similar to CP1–CP2, but greater in magnitude	LTS	No mitigation needed; thus, none proposed.	LTS

Table S-1. Summary of Impacts and Mitigation Measures (contd.)

Resource Topic/Impact	Alt[1]	Impact Duration[2]	Quantification/ Relative Magnitude of Impact[3]	LOS Before Mitigation[4]	Mitigation Measure	LOS After Mitigation[4]
Impact Wild-20: Consistency with Local and Regional Plans with Goals of Promoting Riparian Habitat in the Primary Study Area	N-A	Long-term	–	LTS	No mitigation measures required.	LTS
	CP1, CP4	Long-term	CP4 identical to CP1	PS	Mitigation Measure Wild-20: Implement Mitigation Measure Bot-7: Develop and Implement a Riverine Ecosystem Mitigation and Adaptive Management Plan to Avoid and Compensate for the Impact of Altered Flow Regimes on Riparian and Wetland Communities.	LTS
	CP2	Long-term	CP2 similar to CP1 but greater in magnitude	PS	Mitigation Measure Wild-20: Implement Mitigation Measure Bot-7: Develop and Implement a Riverine Ecosystem Mitigation and Adaptive Management Plan to Avoid and Compensate for the Impact of Altered Flow Regimes on Riparian and Wetland Communities.	LTS
	CP3–CP5	Long-term	CP3 & CP5 similar to CP1–CP2, but greater in magnitude	PS	Mitigation Measure Wild-20: Implement Mitigation Measure Bot-7: Develop and Implement a Riverine Ecosystem Mitigation and Adaptive Management Plan to Avoid and Compensate for the Impact of Altered Flow Regimes on Riparian and Wetland Communities.	LTS

Table S-1. Summary of Impacts and Mitigation Measures (contd.)

Resource Topic/Impact	Alt[1]	Impact Duration[2]	Quantification/ Relative Magnitude of Impact[3]	LOS Before Mitigation[4]	Mitigation Measure	LOS After Mitigation[4]
Impact Wild-21: Impacts on Riparian-Associated Special-Status Wildlife Resulting from the Gravel Augmentation Program	N-A	Long-term	–	NI	No mitigation measures required.	NI
	CP1–CP3	Long-term	–	NI	No mitigation needed; thus, none proposed.	NI
	CP4–CP5	Long-term	–	PS	Mitigation Measure Wild-21: Conduct Preconstruction Surveys for Elderberry Shrubs, Northwestern Pond Turtle, and Nesting Riparian Raptors and Other Nesting Birds. Avoid Removal or Degradation of Elderberry Shrubs and Avoid Vegetation Removal near Active Nest Sites.	LTS
Impact Wild-22: Impacts on Riparian-Associated Special-Status Wildlife Species Resulting from Restoration of Reading Island	N-A	Long-term	–	NI	No mitigation measures required.	NI
	CP1–CP3	Long-term	–	NI	No mitigation measures required.	NI
	CP4–CP5	Long-term	–	PS	Mitigation Measure Wild-22: Implement Mitigation Measure Wild-21: Conduct Preconstruction Surveys for Elderberry Shrubs, Northwestern Pond Turtle, and Nesting Riparian Raptors and Other Nesting Birds. Avoid Removal or Degradation of Elderberry Shrubs and Avoid Vegetation Removal near Active Nest Sites.	LTS

Table S-1. Summary of Impacts and Mitigation Measures (contd.)

Resource Topic/Impact	Alt[1]	Impact Duration[2]	Quantification/ Relative Magnitude of Impact[3]	LOS Before Mitigation[4]	Mitigation Measure	LOS After Mitigation[4]
Impact Wild-23: Impacts on Riparian-Associated and Aquatic Special-Status Wildlife Resulting from Modifications to Existing Flow Regimes in the Lower Sacramento River and Delta	N-A	Long-term	–	LTS	No mitigation measures required.	LTS
	CP1, CP4	Long-term	CP4 identical to CP1	PS	Mitigation Measure Wild-23: Implement Mitigation Measure Bot-7: Develop and Implement a Riverine Ecosystem Mitigation and Adaptive Management Plan to Avoid and Compensate for the Impact of Altered Flow Regimes on Riparian and Wetland Communities.	LTS
	CP2	Long-term	CP2 similar to CP1 but greater in magnitude	PS	Mitigation Measure Wild-23: Implement Mitigation Measure Bot-7: Develop and Implement a Riverine Ecosystem Mitigation and Adaptive Management Plan to Avoid and Compensate for the Impact of Altered Flow Regimes on Riparian and Wetland Communities.	LTS
	CP3–CP5	Long-term	CP3 & CP5 similar to CP1-CP2, but greater in magnitude	PS	Mitigation Measure Wild-23: Implement Mitigation Measure Bot-7: Develop and Implement a Riverine Ecosystem Mitigation and Adaptive Management Plan to Avoid and Compensate for the Impact of Altered Flow Regimes on Riparian and Wetland Communities.	LTS

Table S-1. Summary of Impacts and Mitigation Measures (contd.)

Resource Topic/Impact	Alt[1]	Impact Duration[2]	Quantification/ Relative Magnitude of Impact[3]	LOS Before Mitigation[4]	Mitigation Measure	LOS After Mitigation[4]
Impact Wild-24: Impacts on Bank Swallow Along the Lower Sacramento River Resulting from Modifications of Geomorphic Processes	N-A	Long-term	–	LTS	No mitigation measures required.	LTS
	CP1, CP4	Long-term	CP4 identical to CP1	LTS	No mitigation needed; thus, none proposed.	LTS
	CP2	Long-term	CP2 similar to CP1 but greater in magnitude	LTS	No mitigation needed; thus, none proposed.	LTS
	CP3–CP5	Long-term	CP3 & CP5 similar to CP1-CP2, but greater in magnitude	LTS	No mitigation needed; thus, none proposed.	LTS
Impact Wild-25: Disturbance or Removal of Vernal Pool Habitat for Special-Status Wildlife Along the Lower Sacramento River and in the Delta from Changes in Flow Regime of the Sacramento River and Affected Tributaries, and Changes in Seasonal Water Availability	N-A	Long-term	–	LTS	No mitigation measures required.	LTS
	CP1, CP4	Long-term	CP4 identical to CP1	LTS	No mitigation needed; thus, none proposed.	LTS
	CP2	Long-term	CP2 similar to CP1 but greater in magnitude	LTS	No mitigation needed; thus, none proposed.	LTS
	CP3–CP5	Long-term	CP3 & CP5 similar to CP1-CP2, but greater in magnitude	LTS	No mitigation needed; thus, none proposed.	LTS

Table S-1. Summary of Impacts and Mitigation Measures (contd.)

Resource Topic/Impact	Alt[1]	Impact Duration[2]	Quantification/ Relative Magnitude of Impact[3]	LOS Before Mitigation[4]	Mitigation Measure	LOS After Mitigation[4]
Impact Wild-26: Consistency with Local and Regional Plans with Goals of Promoting Riparian Habitat Along the Lower Sacramento River and in the Delta	N-A	Long-term	–	LTS	No mitigation measures required.	LTS
	CP1, CP4	Long-term	CP4 identical to CP1	PS	Mitigation Measure Wild-26: Implement Mitigation Measure Bot-7: Develop and Implement a Riverine Ecosystem Mitigation and Adaptive Management Plan to Avoid and Compensate for the Impact of Altered Flow Regimes on Riparian and Wetland Communities.	LTS
	CP2	Long-term	CP2 similar to CP1 but greater in magnitude	PS	Mitigation Measure Wild-26: Implement Mitigation Measure Bot-7: Develop and Implement a Riverine Ecosystem Mitigation and Adaptive Management Plan to Avoid and Compensate for the Impact of Altered Flow Regimes on Riparian and Wetland Communities.	LTS
	CP3–CP5	Long-term	CP3 & CP5 similar to CP1-CP2, but greater in magnitude	PS	Mitigation Measure Wild-26: Implement Mitigation Measure Bot-7: Develop and Implement a Riverine Ecosystem Mitigation and Adaptive Management Plan to Avoid and Compensate for the Impact of Altered Flow Regimes on Riparian and Wetland Communities.	LTS

Table S-1. Summary of Impacts and Mitigation Measures (contd.)

Resource Topic/Impact	Alt[1]	Impact Duration[2]	Quantification/ Relative Magnitude of Impact[3]	LOS Before Mitigation[4]	Mitigation Measure	LOS After Mitigation[4]
Impact Wild-27: Impacts on Riparian-Associated or Aquatic Special-Status Wildlife in the CVP/SWP Service Areas Resulting from Modifications to Existing Flow Regimes	N-A	Long-term	–	LTS	No mitigation measures required.	LTS
	CP1, CP4	Long-term	CP4 identical to CP1	LTS	No mitigation needed; thus, none proposed.	LTS
	CP2	Long-term	CP2 similar to CP1 but greater in magnitude	LTS	No mitigation needed; thus, none proposed.	LTS
	CP3–CP5	Long-term	CP3 & CP5 similar to CP1 and CP2, but greater	LTS	No mitigation needed; thus, none proposed.	LTS
Cultural Resources						
Impact Culture-1: Disturbance or Destruction of Archaeological and Historical Resources Due to Construction or Inundation	N-A	Long-term	–	NI	No mitigation measures required.	NI
	CP1	Long-term	355 localities potentially containing historic-era remains within inundation area	S	Mitigation Measure Culture-1: Comply with Section 106 of the NHPA.	LTS
	CP2	Long-term	371 localities potentially containing historic-era remains within inundation area	S	Mitigation Measure Culture-1: Comply with Section 106 of the NHPA.	LTS
	CP3–CP5	Long-term	391 localities potentially containing historic-era remains within inundation area	S	Mitigation Measure Culture-1: Comply with Section 106 of the NHPA.	LTS
Impact Culture-2: Inundation of Traditional Cultural Properties and Sacred Sites	N-A	Long-term	–	NI	No mitigation measures required.	NI
	CP1–CP5	Long-term	–	SU	No feasible mitigation available to reduce impact.	SU
Impact Culture-3: Disturbance or Destruction of Archaeological and Historical Resources near the Upper Sacramento River Due to Construction	N-A	Long-term	–	NI	No mitigation measures required.	NI
	CP1-CP3	Long-term		NI	No mitigation needed; thus, none proposed.	NI
	CP4–CP5	Long-term	–	S	Mitigation Measure Culture-3: Implement Mitigation Measure Culture-1: Comply with Section 106 of the NHPA.	LTS

Table S-1. Summary of Impacts and Mitigation Measures (contd.)

Resource Topic/Impact	Alt[1]	Impact Duration[2]	Quantification/ Relative Magnitude of Impact[3]	LOS Before Mitigation[4]	Mitigation Measure	LOS After Mitigation[4]
Indian Trust Assets						
No impacts to ITAs were identified						
Socioeconomics, Population, and Housing						
Impact Socio-1 (No-Action): Potential for Reduced Employment Opportunities for Lower Sacramento River and Delta Area Residents Impact Socio-1 (CP1-CP5) Short-Term Increase in Population and Housing Demand in the Primary Study Area Resulting from Construction-Related Activities	N-A	Temporary	Potential periodic water and power supply disruptions	PS	No mitigation measures required.	PS
	CP1–CP5	Short-term	–	LTS	No mitigation needed; thus, none proposed.	LTS
Impact Socio-2 (No-Action): Potential for Temporary Disruptions in Business and Industrial Activity in the Lower Sacramento River and Delta Area Impact Socio-2 (CP1–CP5): Short-Term Increases in Direct, Indirect, and Induced Employment in the Primary Study Area Related to Construction Activities	N-A	Temporary	Potential periodic water or power supply disruptions	PS	No mitigation measures required.	PS
	CP1	Temporary	450 new construction jobs, 580 new indirect jobs, and 790 induced jobs	B	No mitigation needed; thus, none proposed.	B
	CP2	Temporary	370 new direct construction jobs, 480 new indirect jobs, and 650 induced jobs	B	No mitigation needed; thus, none proposed.	B
	CP3–CP4	Short-term	350 new direct construction jobs, 450 new indirect jobs, and 610 induced jobs	B	No mitigation needed; thus, none proposed.	B
	CP5	Short-term	350 new direct construction jobs, 450 new indirect jobs, and 620 induced jobs	B	No mitigation needed; thus, none proposed.	B

Table S-1. Summary of Impacts and Mitigation Measures (contd.)

Resource Topic/Impact	Alt[1]	Impact Duration[2]	Quantification/ Relative Magnitude of Impact[3]	LOS Before Mitigation[4]	Mitigation Measure	LOS After Mitigation[4]
Impact Socio-3 (No-Action): Potential for Reduced Employment Opportunities for Residents Within the CVP and SWP Service Areas Impact Socio-3 (CP1–CP5): Potential for Temporary Reduction in the Labor Force of Related Industrial Sectors in the Primary Study Area as a Result of Direct Construction-Related Employment	N-A	Temporary	Potential water or power supply disruptions	PS	No mitigation measures required.	PS
	CP1–CP5	Temporary	–	LTS	No mitigation needed; thus, none proposed.	LTS
Impact Socio-4 (No-Action): Potential for Temporary Disruptions in Business and Industrial Activity in the CVP and SWP Service Areas Impact Socio-4 (CP1–CP5): Short-Term Increases in Direct, Indirect, and Induced Personal Income Paid to Employees in the Primary Study Area Hired for Construction-Related Activities	N-A	Temporary	Potential water or power supply disruptions	PS	No mitigation measures required.	PS
	CP1	Short-term	$183.5 million in personal annual incomes in the local economic study area	B	No mitigation needed; thus, none proposed.	B
	CP2	Short-term	$152 million in personal annual incomes	B	No mitigation needed; thus, none proposed.	B
	CP3	Short-term	$141.6 million in personal annual incomes	B	No mitigation needed; thus, none proposed.	B
	CP4	Short-term	$142.4 million in personal annual incomes	B	No mitigation needed; thus, none proposed.	B
	CP5	Short-term	$142.9 million in personal annual incomes	B	No mitigation needed; thus, none proposed.	B

Table S-1. Summary of Impacts and Mitigation Measures (contd.)

Resource Topic/Impact	Alt[1]	Impact Duration[2]	Quantification/ Relative Magnitude of Impact[3]	LOS Before Mitigation[4]	Mitigation Measure	LOS After Mitigation[4]
Impact Socio-5: Short-Term Increases in Sales and Profits for Businesses in the Primary Study Area that Support the Construction Industry	N-A	Short-term	NA	NA	No mitigation measures required.	NA
	CP1	Short-term	– (36-month construction period)	B	No mitigation needed; thus, none proposed.	B
	CP2	Short-term	Similar to CP1, but more beneficial (48-month construction period)	B	No mitigation needed; thus, none proposed.	B
	CP3–CP5	Short-term	Similar to CP1 & CP2, but more beneficial (60-month construction period)	B	No mitigation needed; thus, none proposed.	B
Impact Socio-6: Short-Term Increase in State and Local Sales Tax Revenues in the Primary Study Area from Construction-Related Personal Income and Purchases	N-A	Short-term	NA	NA	No mitigation measures required.	NA
	CP1	Short-term	$550.7 million in total personal income, with almost $378.4 million in direct income and approximately $172.3 million in indirect and induced income during the construction period	B	No mitigation needed; thus, none proposed.	B
	CP2	Short-term	Similar to, but more beneficial than CP1	B	No mitigation needed; thus, none proposed.	B
	CP3–CP5	Short-term	Similar to, but more beneficial than CP1 & CP2	B	No mitigation needed; thus, none proposed.	B
Impact Socio-7: Long-Term Reduction in the Adverse Economic Effects of Flooding in the Primary Study Area	N-A	Long-term	NA	NA	No mitigation measures required.	NA
	CP1	Long-term	–	B	No mitigation needed; thus, none proposed.	B
	CP2	Long-term	Similar to, but more beneficial than CP1	B	No mitigation needed; thus, none proposed.	B
	CP3–CP5	Long-term	Similar to, but more beneficial than CP1 & CP2	B	No mitigation needed; thus, none proposed.	B
Impact Socio-8: Long-Term Increases in Direct Employment in the Primary Study Area Related to Project Operations	N-A	Long-term	NA	NA	No mitigation measures required.	NA
	CP1–CP5	Long-term	Two or more new maintenance-related positions for the Shasta Dam facilities	B	No mitigation needed; thus, none proposed.	B

Table S-1. Summary of Impacts and Mitigation Measures (contd.)

Resource Topic/Impact	Alt[1]	Impact Duration[2]	Quantification/ Relative Magnitude of Impact[3]	LOS Before Mitigation[4]	Mitigation Measure	LOS After Mitigation[4]
Impact Socio-9: Potential Temporary Increase in Indirect Employment in Construction-Related Businesses of the Lower Sacramento River and Delta	N-A	Temporary	NA	NA	No mitigation measures required.	NA
	CP1	Temporary	–	B	No mitigation needed; thus, none proposed.	B
	CP2	Temporary	Similar to CP1, but more beneficial than CP1	B	No mitigation needed; thus, none proposed.	B
	CP3–CP5	Temporary	Similar to, but more beneficial than CP1 & CP2	B	No mitigation needed; thus, none proposed.	B
Impact Socio-10: Short-Term Increases in Sales and Profits for Businesses in the Lower Sacramento River and Delta Area That Support the Construction Industry	N-A	Short-term	NA	NA	No mitigation measures required.	NA
	CP1	Short-term	– (36-month construction period)	B	No mitigation needed; thus, none proposed.	B
	CP2	Short-term	Similar to CP1, but more beneficial (48-month construction period)	B	No mitigation needed; thus, none proposed.	B
	CP3–CP5	Short-term	Similar to CP1 & CP2, but more beneficial (60-month construction period)	B	No mitigation needed; thus, none proposed.	B
Impact Socio-11: Short-Term Increase in State Sales and Income Tax Revenues in the Lower Sacramento River and Delta Area from Construction-Related Personal Income and Purchases	N-A	Short-term	NA	NA	No mitigation measures required.	NA
	CP1	Short-term	–	B	No mitigation needed; thus, none proposed.	B
	CP2	Short-term	Similar to CP1, but more beneficial (48-month construction period)	B	No mitigation needed; thus, none proposed.	B
	CP3–CP5	Short-term	Similar to CP1 & CP2, but more beneficial (60-month construction period)	B	No mitigation needed; thus, none proposed.	B

Table S-1. Summary of Impacts and Mitigation Measures (contd.)

Resource Topic/Impact	Alt[1]	Impact Duration[2]	Quantification/ Relative Magnitude of Impact[3]	LOS Before Mitigation[4]	Mitigation Measure	LOS After Mitigation[4]
Impact Socio-12: Long-Term Reduction in the Adverse Economic Effects of Flooding in the Lower Sacramento River and Delta Area	N-A	Long-term	NA	NA	No mitigation measures required.	NA
	CP1	Long-term	–	B	No mitigation needed; thus, none proposed.	B
	CP2	Long-term	Similar to CP1, but more beneficial	B	No mitigation needed; thus, none proposed.	B
	CP3–CP5	Long-term	Similar to CP1 & CP2, but more beneficial	B	No mitigation needed; thus, none proposed.	B
Impact Socio-13: Short-Term Increases in Sales and Profits for Businesses in the CVP and SWP Service Areas That Support the Construction Industry	N-A	Short-term	NA	NA	No mitigation measures required.	NA
	CP1	Short-term	– (36-month construction period)	B	No mitigation needed; thus, none proposed.	B
	CP2	Short-term	Similar to CP1, but more beneficial (48-month construction period)	B	No mitigation needed; thus, none proposed.	B
	CP3–CP5	Short-term	Similar to CP1 & CP2, but more beneficial (60-month construction period)	B	No mitigation needed; thus, none proposed.	B
Impact Socio-14: Potential Temporary Reduction in Shasta Project Water or Hydropower Supplied to the CVP and SWP Service Areas During Construction	N-A	Temporary	NA	NA	No mitigation measures required.	NA
	CP1–CP2	Temporary	–	PS	Mitigation Measure Socio-14: Secure Replacement Water or Hydropower During Project Construction.	LTS
	CP3–CP5	Temporary	–	PS	Mitigation Measure Socio-14: Secure Replacement Water or Hydropower During Project Construction.	LTS

Table S-1. Summary of Impacts and Mitigation Measures (contd.)

Resource Topic/Impact	Alt[1]	Impact Duration[2]	Quantification/ Relative Magnitude of Impact[3]	LOS Before Mitigation[4]	Mitigation Measure	LOS After Mitigation[4]
Impact Socio-15: Short-Term Increase in State Sales and Income Tax Revenues in the CVP and SWP Service Areas from Construction-Related Personal Income and Purchases	N-A	Short-term	NA	NA	No mitigation measures required.	NA
	CP1	Temporary	–	B	No mitigation needed; thus, none proposed.	B
	CP2	Temporary	Similar to CP1, but more beneficial (48-month construction period)	B	No mitigation needed; thus, none proposed.	B
	CP3–CP5	Temporary	Similar to CP1 & CP2, but more beneficial (60-month construction period)	B	No mitigation needed; thus, none proposed.	B
Impact Socio-16: Long-Term Increase in Agricultural Income and Jobs in the CVP and SWP Service Areas as a Result of Improved Water Availability and Reliability	N-A	Long-term	NA	NA	No mitigation measures required.	NA
	CP1	Long-term	–	B	No mitigation needed; thus, none proposed.	B
	CP2	Long-term	Similar to CP1, but more beneficial	B	No mitigation needed; thus, none proposed.	B
	CP3–CP5	Long-term	Similar to CP1 & CP2, but more beneficial	B	No mitigation needed; thus, none proposed. No mitigation needed; thus, none proposed.	B
Impact Socio-17: Reduction in Risk of Potential Water and Power Shortages (and Related Economic Activity) in the CVP and SWP Service Areas as a Result of Long-Term Improvements to Water and Power Supply Reliability	N-A	Long-term	NA	NA	No mitigation measures required.	NA
	CP1–CP2	Long-term	–	B	No mitigation needed, thus none proposed.	B
	CP3–CP5	Long-term	–	B	No mitigation needed; thus, none proposed.	B

Table S-1. Summary of Impacts and Mitigation Measures (contd.)

Resource Topic/Impact	Alt[1]	Impact Duration[2]	Quantification/ Relative Magnitude of Impact[3]	LOS Before Mitigation[4]	Mitigation Measure	LOS After Mitigation[4]
Land Use Planning						
Impact LU-1: Disrupt Existing Land Uses (Shasta Lake and Vicinity and Upper Sacramento River)	N-A	NA	NA	NI	No mitigation measures required.	NI
	CP1	Short-term and long-term	–	PS	Mitigation Measure LU-1: Minimize and/or Avoid Temporary Disruptions to Local Communities.	SU
	CP2	Short-term and long-term	Similar to CP1 but greater	PS	Mitigation Measure LU-1: Minimize and/or Avoid Temporary Disruptions to Local Communities.	SU
	CP3–CP5	Short-term and long-term	Similar to CP1 & CP2 but greater	PS	Mitigation Measure LU-1: Minimize and/or Avoid Temporary Disruptions to Local Communities.	SU
Impact LU-2: Conflict with Existing Land Use Goals and Policies of Affected Jurisdictions (Shasta Lake and Vicinity and Upper Sacramento River)	N-A	NA	NA	NI	No mitigation measures required.	NI
	CP1	Short-term and long-term	–	PS	Mitigation Measure LU-2: Minimize and/or Avoid Conflicts with Land Use Goals and Policies.	SU
	CP2	Short-term and long-term	Similar to CP1 but greater	PS	Mitigation Measure LU-2: Minimize and/or Avoid Conflicts with Land Use Goals and Policies.	SU
	CP3–CP5	Short-term and long-term	Similar to CP1 & CP2 but greater	PS	Mitigation Measure LU-2: Minimize and/or Avoid Conflicts with Land Use Goals and Policies.	SU
Impact LU-3: Disrupt Existing Land Uses (Lower Sacramento River, Delta, CVP/SWP Service Areas)	N-A	NA	NA	NI	No mitigation measures required.	NI
	CP1–CP3	Short-term and long-term	–	NI	No mitigation needed; thus, none proposed.	NI
	CP4–CP5	Short-term and long-term	–	LTS	No mitigation needed; thus, none proposed.	LTS

Table S-1. Summary of Impacts and Mitigation Measures (contd.)

Resource Topic/Impact	Alt[1]	Impact Duration[2]	Quantification/ Relative Magnitude of Impact[3]	LOS Before Mitigation[4]	Mitigation Measure	LOS After Mitigation[4]
Impact LU-4: Conflict with Existing Land Use Goals and Policies of Affected Jurisdictions (Lower Sacramento River, Delta, CVP/SWP Service Areas)	N-A	NA	NA	NI	No mitigation measures required.	NI
	CP1–CP3	Short-term and long-term	–	NI	No mitigation needed; thus, none proposed.	NI
	CP4–CP5	Short-term and long-term	–	LTS	No mitigation needed; thus, none proposed.	LTS
Recreation and Public Access						
Impact Rec-1 (No-Action): Increased Use of Shasta Lake Recreation Facilities and Demand for Recreation Opportunities on Shasta Lake and in the Vicinity Impact Rec-1 (CP1–CP5): Seasonal Inundation of Shasta Lake Recreation Facilities or Portions of Recreation Facilities and Public Access at Pool Elevations Above the Current Full Pool Elevation	N-A	Long-term	–	LTS	No mitigation measures required.	LTS
	CP1	Permanent	99 facilities and infrastructure elements	LTS	Mitigation Measure Rec-1: Modify and Relocate Recreation Facilities Inundated by Increases in Shasta Lake Full Pool Elevation.	LTS
	CP2	Permanent	122 facilities and infrastructure elements	LTS	Mitigation Measure Rec-1: Modify and Relocate Recreation Facilities Inundated by Increases in Shasta Lake Full Pool Elevation.	LTS
	CP3–CP5	Permanent	163 facilities and infrastructure elements	LTS	Mitigation Measure Rec-1: Modify and Relocate Recreation Facilities Inundated by Increases in Shasta Lake Full Pool Elevation.	LTS

Table S-1. Summary of Impacts and Mitigation Measures (contd.)

Resource Topic/Impact	Alt[1]	Impact Duration[2]	Quantification/ Relative Magnitude of Impact[3]	LOS Before Mitigation[4]	Mitigation Measure	LOS After Mitigation[4]
Impact Rec-2 (No-Action): Increased Use and Demand for Recreation Opportunities on the Upper Sacramento River Impact Rec-2 (CP1– CP5): Temporary Construction-Related Disruption of Recreation Access and Activities at and near Shasta Dam	N-A	Long-term	–	LTS	No mitigation measure required.	LTS
	CP1	Short-term	– (36-month construction period)	PS	Mitigation Measure Rec-2: Provide Information About and Improve Alternate Recreation Access and Opportunities to Mitigate the Temporary Loss of Recreation Access and Opportunities During Construction at Shasta Dam.	LTS
	CP2	Short-term	Similar to CP1, but greater duration (48-month construction period)	PS	Mitigation Measure Rec-2: Provide Information About and Improve Alternate Recreation Access and Opportunities to Mitigate the Temporary Loss of Recreation Access and Opportunities During Construction at Shasta Dam.	LTS
	CP3 CP5	Short-term	Similar to CP1 & CP2, but greater duration (60-month construction period)	PS	Mitigation Measure Rec-2: Provide Information About and Improve Alternate Recreation Access and Opportunities to Mitigate the Temporary Loss of Recreation Access and Opportunities During Construction at Shasta Dam.	LTS

Table S-1. Summary of Impacts and Mitigation Measures (contd.)

Resource Topic/Impact	Alt[1]	Impact Duration[2]	Quantification/ Relative Magnitude of Impact[3]	LOS Before Mitigation[4]	Mitigation Measure	LOS After Mitigation[4]
Impact Rec-3 (No-Action): Increased Use and Demand for Recreation Opportunities on the Lower Sacramento River and in the Delta Impact Rec-3 (CP1–CP5): Effects on Boating and Other Recreation Use and Enjoyment of Shasta Lake as a Result of Changes in the Annual Drawdown of the Reservoir	N-A	Long-term	–	LTS	No mitigation measures required.	LTS
	CP1	Long-term	–	LTS	No mitigation needed; thus, none proposed.	LTS
	CP2	Long-term	Similar to CP1, but greater	LTS	No mitigation needed; thus, none proposed.	LTS
	CP3–CP5	Long-term	Similar to CP1 & CP2, but greater	LTS	No mitigation needed; thus, none proposed.	LTS
Impact Rec-4 (No-Action): Increased Use and Demand for Recreation Opportunities in the CVP and SWP Service Areas Impact Rec-4 (CP1–CP5): Increased Hazards to Boaters and Other Recreationists at Shasta Lake from Standing Timber and Stumps Remaining in Untreated Areas of the Inundation Zone	N-A	Long-term	–	LTS	No mitigation measures required.	LTS
	CP1 & CP4	Long-term	–	S	Mitigation Measure Rec-4: Provide Information to Shasta Lake Visitors About Potential Safety Hazards in Newly Inundated Areas from Standing Timber and Stumps.	LTS
	CP2	Long-term	Similar to CP1, but greater	S	Mitigation Measure Rec-4: Provide Information to Shasta Lake Visitors About Potential Safety Hazards in Newly Inundated Areas from Standing Timber and Stumps.	LTS
	CP3 & CP5	Long-term	Similar to CP1 & CP2, but greater	S	Mitigation Measure Rec-4: Provide Information to Shasta Lake Visitors About Potential Safety Hazards in Newly Inundated Areas from Standing Timber and Stumps.	LTS

Table S-1. Summary of Impacts and Mitigation Measures (contd.)

Resource Topic/Impact	Alt[1]	Impact Duration[2]	Quantification/ Relative Magnitude of Impact[3]	LOS Before Mitigation[4]	Mitigation Measure	LOS After Mitigation[4]
Impact Rec-5 (CP1–CP5): Seasonal Inundation of Portions of Recreation Facilities or Informal River Access Sites as a Result of Increased River Flows	N-A	NA	NA	NI	No mitigation measures required.	NI
	CP1	Long-term	–	LTS	No mitigation needed; thus, none proposed.	LTS
	CP2	Long-term	Similar to CP1, but greater	LTS	No mitigation needed; thus, none proposed.	LTS
	CP3–CP5	Long-term	Similar to CP1 & CP2, but greater	LTS	No mitigation needed; thus, none proposed.	LTS
Impact Rec-6 (CP1–CP5): Increased Difficulty for Boaters in Using the Sacramento River as a Result of Increased River Flows	N-A	NA	NA	NI	No mitigation measures required.	NI
	CP1 & CP4	Long-term	–	LTS	No mitigation needed; thus, none proposed.	LTS
	CP2	Long-term	Similar to CP1, but greater	LTS	No mitigation needed; thus, none proposed.	LTS
	CP3 & CP5	Long-term	Similar to CP1 & CP2, but greater	LTS	No mitigation needed; thus, none proposed.	LTS
Impact Rec-7 (CP1–CP5): Increased Difficulty for Swimmers and Waders in Using the Sacramento River as a Result of Increased River Flows	N-A	NA	NA	NI	No mitigation measures required.	NI
	CP1 & CP4	Long-term	–	LTS	No mitigation needed; thus, none proposed.	LTS
	CP2	Long-term	Similar to CP1, but greater	LTS	No mitigation needed; thus, none proposed.	LTS
	CP3 & CP5	Long-term	Similar to CP1 & CP2, but greater	LTS	No mitigation needed; thus, none proposed.	LTS

Table S-1. Summary of Impacts and Mitigation Measures (contd.)

Resource Topic/Impact	Alt[1]	Impact Duration[2]	Quantification/ Relative Magnitude of Impact[3]	LOS Before Mitigation[4]	Mitigation Measure	LOS After Mitigation[4]
Impact Rec-8 (CP1–CP5): Increased Usability of the Sacramento River for Boating and Water-Contact Recreation as a Result of Decreased River Flows	N-A	NA	NA	NI	No mitigation measures required.	NI
	CP1 & CP4	Long-term	–	LTS	No mitigation needed; thus, none proposed.	LTS
	CP2	Long-term	Similar to CP1, but greater	LTS	No mitigation needed; thus, none proposed.	LTS
	CP3 & CP5	Long-term	Similar to CP1 & CP2, but greater	LTS	No mitigation needed; thus, none proposed.	LTS
Impact Rec-9 (CP1–CP5): Enhanced Angling Opportunities in the Upper Sacramento River as a Result of Improved Flows and Reduced Water Temperatures	N-A	NA	NA	NI	No mitigation measures required.	NI
	CP1	Long-term	–	B	No mitigation needed; thus, none proposed.	B
	CP2	Long-term	Similar to CP1, but greater	B	No mitigation needed; thus, none proposed.	B
	CP3 & CP5	Long-term	Similar to CP1 & CP2, but greater	B	No mitigation needed; thus, none proposed.	B
	CP4	Long-term	Similar to CP1–CP3 & CP5, but greater	B	No mitigation needed; thus, none proposed.	B
Impact Rec-10 (CP1–CP5): Disruption of Sacramento River Boating and Access Resulting from the Gravel Augmentation Program	N-A	NA	NA	NI	No mitigation measures required.	NI
	CP1–CP3	Short-term	–	NI	No mitigation needed; thus, none proposed.	NI
	CP4–CP5	Short-term	–	LTS	No mitigation needed; thus, none proposed.	LTS

Table S-1. Summary of Impacts and Mitigation Measures (contd.)

Resource Topic/Impact	Alt[1]	Impact Duration[2]	Quantification/ Relative Magnitude of Impact[3]	LOS Before Mitigation[4]	Mitigation Measure	LOS After Mitigation[4]
Impact Rec-11 (CP1–CP5): Changes in Usability of Reading Island Fishing Access Boat Ramp and Enhanced Recreation at Reading Island	N-A	NA	NA	NI	No mitigation measures required.	NI
	CP1–CP3	Long-term	–	NI	No mitigation needed; thus, none proposed.	NI
	CP4–CP5	Long-term	–	B	No mitigation needed; thus, none proposed.	B
Impact Rec-12 (CP1–CP5): Seasonal Inundation of Portions of River Recreation Facilities or Informal River Access Sites on the Lower Sacramento River and Rivers Below CVP and SWP Reservoirs as a Result of Increased River Flows	N-A	NA	NA	NI	No mitigation measures required.	NI
	CP1 & CP4	Long-term	–	LTS	No mitigation needed; thus, none proposed.	LTS
	CP2	Long-term	Similar to CP1, but greater	LTS	No mitigation needed; thus, none proposed.	LTS
	CP3 & CP5	Long-term	Similar to CP1 & CP2, but greater	LTS	No mitigation needed; thus, none proposed.	LTS
Impact Rec-13 (CP1–CP5): Increased Difficulty for Boaters in Using the Lower Sacramento River and Rivers Below CVP and SWP Reservoirs as a Result of Increased River Flows	N-A	NA	NA	NI	No mitigation measures required.	NI
	CP1 & CP4	Long-term	–	LTS	No mitigation needed; thus, none proposed.	LTS
	CP2	Long-term	Similar to CP1, but greater	LTS	No mitigation needed; thus, none proposed.	LTS
	CP3 & CP5	Long-term	Similar to CP1 & CP2, but greater	LTS	No mitigation needed; thus, none proposed.	LTS

Table S-1. Summary of Impacts and Mitigation Measures (contd.)

Resource Topic/Impact	Alt[1]	Impact Duration[2]	Quantification/ Relative Magnitude of Impact[3]	LOS Before Mitigation[4]	Mitigation Measure	LOS After Mitigation[4]
Impact Rec-14 (CP1–CP5): Increased Difficulty for Swimmers and Waders in Using the Sacramento River and Rivers Below CVP and SWP Reservoirs as a Result of Increased River Flows	N-A	NA	NA	NI	No mitigation measures required.	NI
	CP1 & CP4	Long-term	–	LTS	No mitigation needed; thus, none proposed.	LTS
	CP2	Long-term	Similar to CP1, but greater	LTS	No mitigation needed; thus, none proposed.	LTS
	CP3 & CP5	Long-term	Similar to CP1 & CP2, but greater	LTS	No mitigation needed; thus, none proposed.	LTS
Impact Rec-15 (CP1–CP5): Increased Difficulty for Boaters and Anglers in Using the Sacramento River and Rivers Below CVP and SWP Reservoirs as a Result of Decreased River Flows	N-A	NA	NA	NI	No mitigation measures required.	NI
	CP1 & CP4	Long-term	–	PS	Mitigation Measure Rec-15: Implement Mitigation Measure Aqua-15: Maintain Flows in the Feather River, American River, and Trinity River Consistent with Existing Regulatory and Operational Requirements and Agreements.	LTS
	CP2	Long-term	Similar to but potentially greater than CP1	PS	Mitigation Measure Rec-15: Implement Mitigation Measure Aqua-15: Maintain Flows in the Feather River, American River, and Trinity River Consistent with Existing Regulatory and Operational Requirements and Agreements.	LTS
	CP3 & CP5	Long-term	Similar to but potentially greater than CP1 & CP2	PS	Mitigation Measure Rec-15: Implement Mitigation Measure Aqua-15: Maintain Flows in the Feather River, American River, and Trinity River Consistent with Existing Regulatory and Operational Requirements and Agreements.	LTS

Table S-1. Summary of Impacts and Mitigation Measures (contd.)

Resource Topic/Impact	Alt[1]	Impact Duration[2]	Quantification/ Relative Magnitude of Impact[3]	LOS Before Mitigation[4]	Mitigation Measure	LOS After Mitigation[4]
Aesthetics and Visual Resources						
Impact Vis-1: Consistency with Guidelines for Visual Resources in the STNF LRMP (Shasta Lake and Vicinity and Upper Sacramento River)	N-A	Short-term and long-term	NA	NI	No mitigation measures required.	NI
	CP1–CP5	Short-term and long-term	Degraded visual character and quality of primary study area	SU	No feasible mitigation is available to reduce impact.	SU
Impact Vis-2: Degradation and/or Obstruction of a Scenic View from Key Observation Points (Shasta Lake and Vicinity and Upper Sacramento River)	N-A	Short-term	NA	NI	No mitigation measures required.	NI
	CP1	Short-term	Scenic views obstructed or degraded in primary study area	SU	No feasible mitigation available to reduce impact.	SU
	CP2	Short-term	Similar to CP1, but greater (acres, miles, duration)	SU	No feasible mitigation available to reduce impact.	SU
	CP3–CP5	Short-term	Similar to CP1& CP2, but greater (acres, miles, duration)	SU	No feasible mitigation available to reduce impact.	SU
Impact Vis-3: Generation of Increased Daytime Glare and/or Nighttime Lighting (Shasta Lake and Vicinity and Upper Sacramento River)	N-A	Short-term and long-term	NA	NI	No mitigation measures required.	NI
	CP1	Short-term and long-term	Increased glare in primary study area	S	Mitigation Measure Vis-3: Minimize or Avoid Visual Impacts of Daytime Glare and Nighttime Lighting.	SU
	CP2	Short-term and long-term	Similar to CP1, but greater (amount, duration)	S	Mitigation Measure Vis-3: Minimize or Avoid Visual Impacts of Daytime Glare and Nighttime Lighting.	SU
	CP3–CP5	Short-term and long-term	Similar to CP1 & CP2, but greater (amount, duration)	S	Mitigation Measure Vis-3: Minimize or Avoid Visual Impacts of Daytime Glare and Nighttime Lighting.	SU

Table S-1. Summary of Impacts and Mitigation Measures (contd.)

Resource Topic/Impact	Alt[1]	Impact Duration[2]	Quantification/ Relative Magnitude of Impact[3]	LOS Before Mitigation[4]	Mitigation Measure	LOS After Mitigation[4]
Impact Vis-4: Consistency with Federal and State Scenic Highway Requirements (Shasta Lake and Vicinity and Upper Sacramento River)	N-A	Permanent	NA	NI	No mitigation measures required.	NI
	CP1	Permanent	Visible from SR 151.	LTS	No mitigation needed; thus, none proposed.	LTS
	CP2	Permanent	Similar to CP1, but greater vegetation removal would be visible	LTS	No mitigation needed; thus, none proposed.	LTS
	CP3–CP5	Permanent	Similar to CP1 & CP2, but greater vegetation removal would be visible	LTS	No mitigation needed; thus, none proposed.	LTS
Transportation and Traffic						
Impact Trans-1: Short-Term and Long-Term Increases in Traffic in the Primary Study Area in Relation to the Existing Traffic Load and Capacity of the Street System	N-A	NA	NA	LTS	No mitigation measures required.	LTS
	CP1	Long-term	Increase of 148 one-way trips per day throughout the primary study area	LTS	Mitigation Measure Trans-1: Prepare and Implement a Traffic Control and Safety Assurance Plan.	LTS
		Short-term	Approximately 83 round trips per day by haul trucks and 900 round trips per day (36-month construction period)	PS	Mitigation Measure Trans-1: Prepare and Implement a Traffic Control and Safety Assurance Plan.	LTS
	CP2	Long-term	Increase of 251 one-way trips per day throughout the primary study area	LTS	Mitigation Measure Trans-1: Prepare and Implement a Traffic Control and Safety Assurance Plan.	LTS
		Short-term	Similar to CP1, but over a longer period (48-month construction period)	PS	Mitigation Measure Trans-1: Prepare and Implement a Traffic Control and Safety Assurance Plan.	LTS
	CP3–CP5	Long-term	Increase of 398 one-way trips per day throughout the primary study area	LTS	Mitigation Measure Trans-1: Prepare and Implement a Traffic Control and Safety Assurance Plan.	LTS
		Short-term	Similar to CP1 & CP2, but over a longer period (60-month construction period)	PS	Mitigation Measure Trans-1: Prepare and Implement a Traffic Control and Safety Assurance Plan.	LTS

Table S-1. Summary of Impacts and Mitigation Measures (contd.)

Resource Topic/Impact	Alt[1]	Impact Duration[2]	Quantification/ Relative Magnitude of Impact[3]	LOS Before Mitigation[4]	Mitigation Measure	LOS After Mitigation[4]
Impact Trans-2: Adverse Effects on Access to Local Streets or Adjacent Uses in the Primary Study Area	N-A	NA	NA	LTS	No mitigation measures required.	LTS
	CP1	Permanent and/or temporary	Road closures and detours or partial road closures, or a combination of both, at Shasta Lake	PS	Mitigation Measure Trans-2: Implement Mitigation Measure Trans-1: Prepare and Implement a Traffic Control and Safety Assurance Plan.	LTS
	CP2	Permanent and/or temporary	Similar to CP1, but over a longer period	PS	Mitigation Measure Trans-2: Implement Mitigation Measure Trans-1: Prepare and Implement a Traffic Control and Safety Assurance Plan.	LTS
	CP3–CP5	Permanent and/or temporary	Similar to CP1 and CP2, but over a longer period	PS	Mitigation Measure Trans-2: Implement Mitigation Measure Trans-1: Prepare and Implement a Traffic Control and Safety Assurance Plan.	LTS
Impact Trans-3: Hazards in the Primary Study Area Caused by a Design Feature	N-A	NA	NA	LTS	No mitigation measures required.	LTS
	CP1	Permanent	Relocated road segments and vehicular and railroad bridges would be designed to current engineering design standards	B	No mitigation needed; thus, none proposed.	B
	CP2	Permanent	Similar to CP1, but more road segments and bridges would be replaced	B	No mitigation needed; thus, none proposed.	B
	CP3–CP5	Permanent	Similar to CP1 and CP2, but more road segments & bridges would be replaced	B	No mitigation needed; thus, none proposed.	B

Table S-1. Summary of Impacts and Mitigation Measures (contd.)

Resource Topic/Impact	Alt[1]	Impact Duration[2]	Quantification/ Relative Magnitude of Impact[3]	LOS Before Mitigation[4]	Mitigation Measure	LOS After Mitigation[4]
Impact Trans-4: Adverse Effects on Emergency Access in the Primary Study Area	N-A	NA	NA	LTS	No mitigation measures required.	LTS
	CP1	Temporary	– (36-month construction period)	PS	Mitigation Measure Trans-4: Implement Mitigation Measure Trans-1: Prepare and Implement a Traffic Control and Safety Assurance Plan.	LTS
	CP2	Temporary	Similar to CP1, but for a longer period (48-month construction period)	PS	Mitigation Measure Trans-4: Implement Mitigation Measure Trans-1: Prepare and Implement a Traffic Control and Safety Assurance Plan.	LTS
	CP3	Temporary	Similar to CP1 & CP2, but for a longer period (60-month construction period)	PS	Mitigation Measure Trans-4: Implement Mitigation Measure Trans-1: Prepare and Implement a Traffic Control and Safety Assurance Plan.	LTS
	CP4–CP5	Temporary	Similar to CP3, but with gravel augmentation	PS	Mitigation Measure Trans-4: Implement Mitigation Measure Trans-1: Prepare and Implement a Traffic Control and Safety Assurance Plan.	LTS
Impact Trans-5: Accelerated Degradation of Surface Transportation Facilities in the Primary Study Area	N-A	NA	NA	LTS	No mitigation measures required.	LTS
	CP1	Permanent	– (36-month construction period)	PS	Mitigation Measure Trans-5: Identify and Repair Roadway Segments Damaged by the Project.	LTS
	CP2	Permanent	Similar to CP1, but greater (48-month construction period)	PS	Mitigation Measure Trans-5: Identify and Repair Roadway Segments Damaged by the Project.	LTS
	CP3–CP5	Permanent	Similar to CP1 & CP2, but greater. (60-month construction period)	PS	Mitigation Measure Trans-5: Identify and Repair Roadway Segments Damaged by the Project.	LTS

Table S-1. Summary of Impacts and Mitigation Measures (contd.)

Resource Topic/Impact	Alt[1]	Impact Duration[2]	Quantification/ Relative Magnitude of Impact[3]	LOS Before Mitigation[4]	Mitigation Measure	LOS After Mitigation[4]
Impact Trans-6 (No-Action): Temporary Increase in Traffic in the Extended Study Area in Relation to the Existing Traffic Load and Capacity of the Street System	N-A	Temporary	–	LTS	No mitigation measures required.	LTS
	CP1–CP5	Temporary	NA	NA	No mitigation needed; thus, none proposed.	NA
Impact Trans-7 (No-Action): Adverse Effects on Access to Local Streets or Adjacent Uses in the Extended Study Area	N-A	Temporary	–	LTS	No mitigation measures required.	LTS
	CP1–CP5	Temporary	NA	NA	No mitigation needed; thus, none proposed.	NA
Impact Trans-8 (No-Action): Hazards in the Extended Study Area Caused by a Design Feature	N-A	Temporary	–	LTS	No mitigation measures required.	LTS
	CP1–CP5	Temporary	NA	NA	No mitigation needed; thus, none proposed.	NA
Impact Trans-9 (No-Action): Adverse Effects on Emergency Access in the Extended Study Area	N-A	Temporary	–	LTS	No mitigation measures required.	LTS
	CP1–CP5	Temporary	NA	NA	No mitigation needed; thus, none proposed.	NA
Impact Trans-10 (No-Action): Accelerated Degradation of Surface Transportation Facilities in the Extended Study Area	N-A	Temporary	–	LTS	No mitigation measures required.	LTS
	CP1–CP5	Temporary	NA	NA	No mitigation needed; thus, none proposed.	NA

Table S-1. Summary of Impacts and Mitigation Measures (contd.)

Resource Topic/Impact	Alt[1]	Impact Duration[2]	Quantification/ Relative Magnitude of Impact[3]	LOS Before Mitigation[4]	Mitigation Measure	LOS After Mitigation[4]
Utilities and Service Systems						
Impact Util-1: Damage or Disruption of Public Utility and Service Systems Infrastructure (Shasta Lake and Vicinity and Upper Sacramento River)	N-A	NA	NA	NI	No mitigation measures required.	NI
	CP1	Short-term	Abandon & relocate 31,000 feet of power lines, 35,000 feet of telecommunications lines (36-month construction period)	PS	Mitigation Measure Util-1: Implement Procedures to Avoid Damage to or Temporary Disruption of Service.	LTS
	CP2	Short-term	Abandon & relocate 36,000 feet of power lines, 37,000 feet of telecommunications lines (48-month construction period)	PS	Mitigation Measure Util-1: Implement Procedures to Avoid Damage to or Temporary Disruption of Service.	LTS
	CP3–CP5	Short-term	Abandon & relocate 38,500 feet of power lines, 40,000 feet of telecommunications lines (60-month construction period)	PS	Mitigation Measure Util-1: Implement Procedures to Avoid Damage to or Temporary Disruption of Service.	LTS
Impact Util-2: Utility Infrastructure Relocation or Modification (Shasta Lake and Vicinity and Upper Sacramento River)	N-A	NA	NA	NI	No mitigation measures required.	NI
	CP1	Short-term	Abandon & relocate 31,000 feet of power lines, 35,000 feet of telecommunications lines (36-month construction period)	PS	Mitigation Measure Util-2: Adopt Measures to Minimize Infrastructure Relocation Impacts.	LTS
	CP2	Short-term	Abandon & relocate 36,000 feet of power lines, 37,000 feet of telecommunications lines (48-month construction period)	PS	Mitigation Measure Util-2: Adopt Measures to Minimize Infrastructure Relocation Impacts.	LTS
	CP3–CP5	Short-term	Abandon & relocate 38,500 feet of power lines, 40,000 feet of telecommunications lines (60-month construction period)	PS	Mitigation Measure Util-2: Adopt Measures to Minimize Infrastructure Relocation Impacts.	LTS

Table S-1. Summary of Impacts and Mitigation Measures (contd.)

Resource Topic/Impact	Alt[1]	Impact Duration[2]	Quantification/ Relative Magnitude of Impact[3]	LOS Before Mitigation[4]	Mitigation Measure	LOS After Mitigation[4]
Impact Util-3: Short-Term Increase in Solid Waste Generation (Shasta Lake and Vicinity and Upper Sacramento River)	N-A	NA	NA	NI	No mitigation measures required.	NI
	CP1	Short-term	176,627 cubic yards of solid waste	LTS	No mitigation needed; thus, none proposed.	LTS
	CP2	Short-term	188,584 cubic yards of solid waste	LTS	No mitigation needed; thus, none proposed.	LTS
	CP3–CP5	Short-term	194,195 cubic yards of solid waste	LTS	No mitigation needed; thus, none proposed.	LTS
Impact Util-4: Increases in Solid Waste Generation from Increased Recreational Opportunities (Shasta Lake and Vicinity and Upper Sacramento River)	N-A	NA	NA	NI	No mitigation measures required.	NI
	CP1	Short-term	–	LTS	No mitigation needed; thus, none proposed.	LTS
	CP2	Short-term	Similar to CP1 but greater	LTS	No mitigation needed; thus, none proposed.	LTS
	CP3–CP5	Short-term	Similar to but greater than CP1 & CP2	LTS	No mitigation needed; thus, none proposed.	LTS
Impact Util-5: Increased Demand for Water Treatment and Distribution Facilities Resulting from Increases in Water Supply (Shasta Lake and Vicinity and Upper Sacramento River)	N-A	NA	NA	NI	No mitigation measures required.	NI
	CP1–CP5	Long-term	–	NA(RS)	No mitigation needed; thus, none proposed.	NA(RS)
Impact Util-6: Damage or Disruption of Public Utility and Service Systems Infrastructure (Lower Sacramento River, Delta, CVP/SWP Service Areas)	N-A	NA	NA	NA	No mitigation measures required.	NA
	CP1–CP3	Short-term	NA	NI	No mitigation needed; thus, none proposed.	NI
	CP4–CP5	Short-term	–	LTS	No mitigation measures required.	LTS

Table S-1. Summary of Impacts and Mitigation Measures (contd.)

Resource Topic/Impact	Alt[1]	Impact Duration[2]	Quantification/ Relative Magnitude of Impact[3]	LOS Before Mitigation[4]	Mitigation Measure	LOS After Mitigation[4]
Impact Util-7: Utility Infrastructure Relocation or Modification (Lower Sacramento River, Delta, CVP/SWP Service Areas)	N-A	NA	NA	NA	No mitigation measures required.	NA
	CP1–CP5	Short-term	NA	NI	No mitigation needed; thus, none proposed.	NI
Impact Util-8: Short-Term Increase in Solid Waste Generation (Lower Sacramento River, Delta, CVP/SWP Service Areas)	N-A	NA	NA	NA	No mitigation measures required.	NA
	CP1–CP3	Short-term	NA	NI	No mitigation needed; thus, none proposed.	NI
	CP4–CP5	Short-term	–	LTS	No mitigation needed; thus, none proposed.	LTS
Impact Util-9: Increases in Solid Waste Generation from Increased Recreational Opportunities (Lower Sacramento River, Delta, CVP/SWP Service Areas)	N-A	NA	NA	NA	No mitigation measures required.	NA
	CP1–CP5	Long-term	NA	NI	No mitigation needed; thus, none proposed.	NI
Impact Util-10: Increased Demand for Water Treatment and Distribution Facilities Resulting from Increases in Water Supply (Lower Sacramento River, Delta, CVP/SWP Service Areas)	N-A	NA	NA	NA	No mitigation measures required.	NA
	CP1–CP5	Long-term	NA	NA(RS)	No mitigation needed; thus, none proposed.	NA(RS)

Table S-1. Summary of Impacts and Mitigation Measures (contd.)

Resource Topic/Impact	Alt[1]	Impact Duration[2]	Quantification/ Relative Magnitude of Impact[3]	LOS Before Mitigation[4]	Mitigation Measure	LOS After Mitigation[4]
Public Services						
Impact PS-1: Disruption of Public Services (Shasta Lake and Vicinity and Upper Sacramento River)	N-A	NA	NA	NI	No mitigation measures required.	NI
	CP1	Short-term	(36-month construction period)	PS	Mitigation Measure PS-1: Coordinate and Assist Public Services Agencies.	LTS
	CP2	Short-term	Similar to CP1, but greater duration & area (48-month construction period)	PS	Mitigation Measure PS-1: Coordinate and Assist Public Services Agencies.	LTS
	CP3–CP5	Short-term	Similar to CP1 & CP2, but greater duration & area (60-month construction period)	PS	Mitigation Measure PS-1: Coordinate and Assist Public Services Agencies.	LTS
Impact PS-2: Degraded Level of Public Services (Shasta Lake and Vicinity and Upper Sacramento River)	N-A	NA	NA	NI	No mitigation measures required.	NI
	CP1	Short-term	– (36-month construction period)	PS	PS-2: Provide Support to Public Services Agencies.	LTS
	CP2	Short-term	Similar to CP1, but greater duration (48-month construction period)	PS	PS-2: Provide Support to Public Services Agencies.	LTS
	CP3–CP5	Short-term	Similar to CP1 & CP2, but greater duration (60-month construction period)	PS	PS-2: Provide Support to Public Services Agencies.	LTS
Impact PS-3: Relocation of Public Service Facilities (Shasta Lake and Vicinity and Upper Sacramento River)	N-A	NA	No impact	NI	No mitigation measures required.	NI
	CP1	Long-term	–	LTS	No mitigation needed; thus, none proposed.	LTS
	CP2	Long-term	Greater than CP1	LTS	No mitigation needed; thus, none proposed.	LTS
	CP3–CP5	Long-term	Greater than CP1 & CP2	LTS	No mitigation needed; thus, none proposed.	LTS

Table S-1. Summary of Impacts and Mitigation Measures (contd.)

Resource Topic/Impact	Alt[1]	Impact Duration[2]	Quantification/ Relative Magnitude of Impact[3]	LOS Before Mitigation[4]	Mitigation Measure	LOS After Mitigation[4]
Impact PS-4: Short-Term Disruption of Public Services (Lower Sacramento River, Delta, CVP/SWP Service Areas)	N-A	NA	No impact	NI	No mitigation measures required.	NI
	CP1–CP3	Short-term	–	NI	No mitigation needed; thus, none proposed.	NI
	CP4-CP5	Short-term	–	LTS	No mitigation needed; thus, none proposed.	LTS
Impact PS-5: Degraded Levels of Public Services (Lower Sacramento River, Delta, CVP/SWP Service Areas)	N-A	NA	No impact	NI	No mitigation measures required.	NI
	CP1–CP5	Short-term	–	LTS	No mitigation needed; thus, none proposed.	LTS
Impact PS-6: Relocation of Public Services Facilities (Lower Sacramento River, Delta, CVP/SWP Service Areas)	N-A	NA	No impact	NI	No mitigation measures required.	NI
	CP1–CP5	Long-term	–	NI	No mitigation needed; thus, none proposed.	NI
Power and Energy						
Impact Hydro-1: Decrease in Shasta Powerplant Energy Generation	N-A, CP1–CP5	Long-term	>5% decrease in long-term monthly average hydropower generation in primary study area at a level of recurrence that would substantially affect the power market	PS	No feasible mitigation proposed to reduce impact.	PS
Impact Hydro-2: Decrease in CVP and SWP Powerplant Energy Generation	N-A, CP1–CP5	Long-term	>5% decrease in long-term monthly average hydropower generation in CVP and SWP service areas at a level of recurrence that would substantially affect the power market	PS	No feasible mitigation proposed to reduce impact.	PS
Impact Hydro-3: Increase in CVP and SWP Pumping Plant Energy	N-A, CP1–CP5	Long-term	>5% increase in long-term monthly average power consumption in CVP and SWP service areas at a level of recurrence that would substantially affect the power market	PS	No feasible mitigation proposed to reduce impact.	PS

Table S-1. Summary of Impacts and Mitigation Measures (contd.)

Resource Topic/Impact	Alt[1]	Impact Duration[2]	Quantification/ Relative Magnitude of Impact[3]	LOS Before Mitigation[4]	Mitigation Measure	LOS After Mitigation[4]
Impact Hydro-4: Decrease in CVP and SWP Net Energy Generation	N-A, CP1–CP5	Long-term	>5% decrease in long-term monthly average net energy generation in CVP and SWP Service Areas at a level of recurrence that would substantially affect the power market.	PS	No feasible mitigation proposed to reduce impact.	PS
Impact Hydro-5: Decrease in Pit 7 Powerplant Net Energy Generation	N-A	NA	NA	NI	No mitigation measures required.	NI
	CP1	Long-term	<5% decrease in net energy generation in Pit 7 Powerplant	LTS	No mitigation needed; thus, none proposed.	LTS
	CP2–CP5	Long-term	>5% decrease in net energy generation in Pit 7 Powerplant	PS	No feasible mitigation proposed to reduce impact.	PS
Environmental Justice						
Impact EJ-1: Potential Disproportionate Effect on Minority and Low-Income Populations in the Vicinity of Shasta Lake	N-A	NA	NA	NDHA	No mitigation measures required.	NDHA
	CP1–CP5	Short-term	–	NDHA	No mitigation needed; thus, none proposed.	NDHA
Impact EJ-2: Potential Disproportionate Effect on Native American Populations in the Vicinity of Shasta Lake	N-A	NA	NA	NDHA	No mitigation measures required.	NDHA
	CP1–CP5	Short-term and long-term	–	DHA	No feasible mitigation available to reduce impact.	DHA
Impact EJ-3: Potential Disproportionate Effect on Minority and Low-Income Populations in the Upper Sacramento River Area	N-A	Long-term	NA	NDHA	No mitigation measures required.	NDHA
	CP1–CP5	Long-term	–	NDHA	No mitigation needed; thus, none proposed.	NDHA

Table S-1. Summary of Impacts and Mitigation Measures (contd.)

Resource Topic/Impact	Alt[1]	Impact Duration[2]	Quantification/ Relative Magnitude of Impact[3]	LOS Before Mitigation[4]	Mitigation Measure	LOS After Mitigation[4]
Impact EJ-4: Potential Disproportionate Effect on Minority and Low-Income Populations in the Lower Sacramento River and Delta Area	N-A	NA	NA	NDHA	No mitigation measures required.	NDHA
	CP1–CP5	Long-term	–	NDHA	No mitigation needed; thus, none proposed.	NDHA
Impact EJ-5: Potential Disproportionate Effect on Minority and Low-Income Populations in the CVP/SWP Service Areas	N-A	NA	NA	NDHA	No mitigation measures required.	NDHA
	CP1–CP5	Long-term	–	NDHA	No mitigation needed; thus, none proposed.	NDHA
Wild and Scenic River Considerations for McCloud River						
Impact WASR-1: McCloud River's Eligibility for Listing as a Federal Wild and Scenic River	N-A	NA	NA	NI	No mitigation measures required.	NI
	CP1	Long-term	18 percent of Segment 4 would be periodically inundated	SU	No feasible mitigation available to reduce impact.	SU
	CP2	Long-term	21 percent of Segment 4 would be periodically inundated	SU	No feasible mitigation available to reduce impact.	SU
	CP3–CP5	Long-term	39 percent increase over the current transition reach), inundating larger portion of the lower McCloud River and Segment 4	SU	No feasible mitigation available to reduce impact.	SU
Impact WASR-2: Conflict with STNF LRMP or CRMP	N-A	NA	NA	NI	No mitigation measures required.	NI
	CP1–CP5	Long-term	Increased inundation would conflict with the STNF Land and Resource Management Plan and CRMP	SU	No feasible mitigation available to reduce impact.	SU

Table S-1. Summary of Impacts and Mitigation Measures (contd.)

Resource Topic/Impact	Alt[1]	Impact Duration[2]	Quantification/ Relative Magnitude of Impact[3]	LOS Before Mitigation[4]	Mitigation Measure	LOS After Mitigation[4]
Impact WASR-3: Conflict with the California Public Resources Code, Section 5093.542	N-A	NA	NA	NI	No mitigation measures required.	NI
	CP1	Long-term	Would affect about 2 percent of the lower McCloud River	SU	No feasible mitigation available to reduce impact.	SU
	CP2	Long-term	Would affect about 2.3 percent of the lower McCloud River	SU	No feasible mitigation available to reduce impact.	SU
	CP3–CP5	Long-term	Would affect about 3 percent of the lower McCloud River	SU	No feasible mitigation available to reduce impact.	SU

Notes:

[1] Alt = alternative. N-A = No-Action Alternative. CP = Comprehensive Plan.

[2] NA = not applicable. Short-term = construction-related or otherwise persisting from one to several years. Long-term = persisting for years to decades. Permanent = persisting at least years to decades and effectively irreversible.

[3] NA = not applicable. "–" = the least impact among the action alternatives or an impact that is comparable in type and magnitude to the least impact among the alternatives.

[4] LOS = level of significance. B = beneficial. NA = not applicable. NI = no impact. LTS = less than significant. PS = potentially significant. S = significant. SU = significant and unavoidable. NDHA = not disproportionately high and adverse. DHA = disproportionately high and adverse. RS = remote and speculative.

Key:

BLM = U.S. Bureau of Land Management
BMP = best management practice
cfs = cubic feet per second
CO = carbon monoxide
CO_2e = carbon dioxide equivalent
CP = Comprehensive Plan
CRMP = Coordinated Resources Management Plan
CRPR = California Rare Plant Rank
CVP = Central Valley Project
dBA = A-weighted decibels
Delta = Sacramento–San Joaquin Delta
DFG = California Department of Fish and Game
GHG = greenhouse gas
ITA = Indian Trust Assets
lb = pound
L_{eq} = equivalent noise level
LRMP = land and resource management plan
MSCS = Multi-Species Conservation Strategy
NHPA = National Historic Preservation Act
NO_X = oxides of nitrogen
PM = particulate matter
PM_{10} = respirable particulate matter with an aerodynamic resistance diameter of 10 micrometers or less
$PM_{2.5}$ = respirable particulate matter with an aerodynamic resistance diameter of 2.5 micrometers or less
ROG = reactive organic gas
SR = State Route
STNF = Shasta-Trinity National Forest
SWP = State Water Project
TBD = to be determined
USFS = U.S. Forest Service
X2 = distance in kilometers from the Golden Gate Bridge to the location where salinity concentration is 2 parts per thousand

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Appendices

Glossary of Terms

Plan Formulation Appendix

Engineering Summary Appendix

Economic Valuation Appendix

Modeling Appendix

Real Estate Appendix

Climate Change Projection Appendix: Summary of Potential Climate Change Projections and Impacts on the Study Area Resources

Physical Resources Appendix
- Geologic Technical Report
- Hydrology, Hydraulics, and Water Management Technical Report
- Water Quality Technical Report

Biological Resources Appendix
- Fisheries and Aquatic Ecosystems Technical Report
- Botanical Resources Technical Report
- Wildlife Resources Technical Report

Cultural Resources Appendix
- Cultural Technical Report (sensitive; not for public distribution)

Socioeconomics Appendix
- Socioeconomics, Population, and Housing Technical Report
- Power and Energy Technical Report

Fish and Wildlife Coordination Act Report Appendix

Abbreviations and Acronyms

°C	degree Celsius
°F	degrees Fahrenheit
AB	Assembly Bill
ABA	Americans with Disabilities Act
ACID	Anderson-Cottonwood Irrigation District
ADA	Americans with Disabilities Act
AFRP	Anadromous Fish Restoration Program
AFS	anadromous fish survival
APE	area of potential effect
AQAP	air quality attainment plan
ARB	Air Resources Board
BA	Biological Assessment
BAMM	best available mitigation measure
Banks	SWP Harvey O. Banks Pumping Plant
Basin Plan	*Water Quality Plan for the Sacramento and San Joaquin River Basins*
Bay Area	San Francisco Bay Area
Bay-Delta	San Francisco Bay/Sacramento-San Joaquin River Delta
BDCP	Bay Delta Conservation Plan
BLM	U.S. Bureau of Land Management
BMP	best management practice
BO	Biological Opinion
BVWD	Bella Vista Water District
CAA	Clean Air Act
Cal/EPA	California Environmental Protection Agency
Cal/OSHA	California Occupational Safety and Health Administration
CALFED	CALFED Bay-Delta Program
Cal-IPC	California Invasive Plant Council
Caltrans	California Department of Transportation
CBC	California Building Standards Code
CCAA	California Clean Air Act
CCCSD	Clear Creek Community Services District
CCR	California Code of Regulations
CCSD	Centerville Community Services District
CCWD	Contra Costa Water District
CDF	California Department of Forestry and Fire Protection

CDFA	California Department of Food and Agriculture
CEQ	Council on Environmental Quality
CEQA	California Environmental Quality Act
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CESA	California Endangered Species Act
CFR	Code of Federal Regulations
cfs	cubic feet per second
CHP	California Highway Patrol
CNDDB	California Natural Diversity Database
CNEL	community noise equivalent level
CNPS	California Native Plant Society
CO	carbon monoxide
CO_2	carbon dioxide
CO_2e	carbon dioxide equivalent
COA	Coordinated Operations Agreement
CP	Comprehensive Plan
CRMP	coordinated resource management plan
CRPR	California Rare Plant Rank
CSA	Community Service Area
CVFPP	Central Valley Flood Protection Plan
CVP	Central Valley Project
CVPIA	Central Valley Project Improvement Act
CVPM	Central Valley Production Model
CVRWQCB	Central Valley Regional Water Quality Control Board
CWA	Clean Water Act
CWHR	California Wildlife Habitat Relationship
CWP	cold-water pool
D-1641	SWRCB Water Right Decision 1641
dB	decibel
dBA	A-weighted decibel
dBA/DD	dBA per doubling of distance
DCC	Delta Cross Channel
DEIS	Draft Environmental Impact Statement
Delta	Sacramento–San Joaquin River Delta
DFG	California Department of Fish and Game
diesel PM	diesel particulate matter
DO	dissolved oxygen

DOC	California Department of Conservation
DSM2	Delta Simulation Model 2
DWR	California Department of Water Resources
E/I	export/inflow
EC	electrical conductivity
EIR	environmental impact report
EIS	environmental impact statement
EPA	U.S. Environmental Protection Agency
ERPP	Ecosystem Restoration Program Plan
ESA	Federal Endangered Species Act
EWA	Environmental Water Account
FCWA	Fish and Wildlife Coordination Act
Federal WSRA	Federal Wild and Scenic Rivers Act
FEIS	Final Environmental Impact Statement
FERC	Federal Energy Regulatory Commission
FLPMA	Federal Land Policy and Management Act of 1976
FSZ	Farmland Security Zone
FTA	Federal Transit Administration
FWCA	Fish and Wildlife Coordination Act
GAMA	Groundwater Ambient Monitoring and Assessment
GHG	greenhouse gas
GIS	geographic information systems
GWh	gigawatt-hour
GWP	global warming potential
H&H	hydrology, hydraulics, and water management
HAP	hazardous air pollutant
HMBP	Hazardous Materials Business Plan
hp	horsepower
Hz	Hertz
I-5	Interstate 5
IMPLAN	IMpact analysis for PLANning
in/sec	inches per second
ITA	Indian Trust Assets
ITE	Institute of Transportation Engineers
Jones	C. W. “Bill” Jones Pumping Plant
JPOD	Joint Point of Diversion
KCSA	Keswick County Service Area
km	kilometer

KOP	key observation point
kV	kilovolt
lb/day	pounds per day
L_{dn}	day-night noise level
L_{eq}	equivalent noise level
L_{max}	maximum noise level
L_{min}	minimum noise level
LRMP	Land and Resource Management Plan
LSR	Late Successional Reserve
LTG	LongTermGen
L_x	statistical descriptor
M&I	municipal and industrial
MAF	million acre-feet
MBTA	Migratory Bird Treaty Act
MCV	*A Manual of California Vegetation*
mg/L	milligrams per liter
MGCSD	Mountain Gate Community Services District
mgd	million gallons per day
mmhos/cm	millimhos per centimeter
MMT	million metric tons
MOA	memorandum of agreement
MOU	memorandum of understanding
MSCS	Multi-Species Conservation Strategy
msl	mean sea level
MT	metric ton
MW	megawatt
MWh	megawatt-hours
NAHC	Native American Heritage Commission
NDOI	Net Delta Outflow Index
NEHRPA	National Earthquake Hazards Reduction Program Act
NEPA	National Environmental Policy Act
NFS	National Forest System
NGVD29	National Geodetic Vertical Datum of 1929
NHPA	National Historic Preservation Act
NMFS	National Marine Fisheries Service
NO_2	nitrogen dioxide
NO_X	oxides of nitrogen
NPDES	National Pollutant Discharge Elimination System

NPL	National Priorities List
NRA	National Recreation Area
NRCS	U.S. Department of Agriculture Natural Resources Conservation Service
NRDC	Natural Resources Defense Council
NRHP	National Register of Historic Places
NSR	North State Resources, Inc.
NSVAB	Northern Sacramento Valley Air Basin
NWP	Nationwide Permit
OCAP	Operations Criteria and Plan
OES	California Office of Emergency Services
OHV	off-highway vehicle
OHWM	ordinary high-water mark
OPR	Governor's Office of Planning and Research
ORV	outstandingly remarkable value
OSHA	Occupational Safety and Health Administration
PCB	polychlorinated biphenyl
PCT	Project Coordination Team
PDEIS	Preliminary Draft Environmental Impact Statement
PG&E	Pacific Gas and Electric Company
$PM_{2.5}$	fine particulate matter with an aerodynamic resistance diameter of 2.5 micrometers or less
PM_{10}	respirable particulate matter with an aerodynamic resistance diameter of 10 micrometers or less
PPV	peak particle velocity
PRC	Public Resources Code
PUD	Public Utilities District
RABA	Redding Area Bus Authority
RBDD	Red Bluff Diversion Dam
RCD	resource conservation district
RCRA	Resource Conservation and Recovery Act
RD-1641	SWRCB Revised Water Right Decision 1641
Reclamation	U.S. Department of the Interior, Bureau of Reclamation
Reporting Rule	Greenhouse Gas Reporting Rule
RHJV	Riparian Habitat Joint Venture
RM	river-mile
RMP	resource management plan
RMS	root mean squared
ROD	Record of Decision

ROG	reactive organic gas
ROS	Recreation Opportunity Spectrum
ROW	right-of-way
RPA	reasonable and prudent alternative
RV	recreational vehicle
RWQCB	regional water quality control board
SAFCA	Sacramento Area Flood Control Agency
SB	Senate Bill
SCAQMD	Shasta County Air Quality Management District
SCFD	Shasta County Fire Department
SCSD	Shasta Community Service District
SCSO	Shasta County Sheriff's Office
SCWA	Shasta County Water Agency
SDIP	South Delta Improvements Program
SDWA	Safe Drinking Water Act
SEL	single-event (impulsive) noise level
Shasta-Trinity LRMP	*Shasta-Trinity National Forest Land and Resource Management Plan*
SHPO	California State Historic Preservation Officer
Sierra Nevada Region	Sierra Nevada Customer Service Region
SIP	State Implementation Plan
SLC	State Lands Commission
SLWRI	Shasta Lake Water Resources Investigation
SMARA	Surface Mining and Reclamation Act of 1975
SMM	standard mitigation measures
SO_2	sulfur dioxide
SR	State Route
SRA	shaded riverine aquatic
SRCA	Sacramento River Conservation Area
SRNWR	Sacramento River National Wildlife Refuge
SRTTG	Sacramento River Temperature Task Group
SRWRS	Sacramento River Water Reliability Study
State	State of California
STATSGO	State Soil Geographic Database
STNF	Shasta-Trinity National Forest
STNF LRMP	*Shasta-Trinity National Forest Land and Resource Management Plan*
SVAB	Sacramento Valley Air Basin
SVI	Sacramento Valley Index

SWP	State Water Project
SWP Power	SWP Power CA
SWPPP	storm water pollution prevention plan
SWRCB	State Water Resources Control Board
TAC	toxic air contaminants
TAF	thousand acre-feet
TCD	temperature control device
TCFD	Tehama County Fire Department
TCP	Traditional Cultural Properties
TDS	total dissolved solids
TMDL	total maximum daily load
TNC	The Nature Conservancy
UPRR	Union Pacific Railroad
USACE	U.S. Army Corps of Engineers
USC	U.S. Code
USFS	U.S. Forest Service
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
VAU	visual assessment unit
VdB	vibration decibel
VOC	volatile organic compound
VQO	visual quality objective
WDR	waste discharge requirement
Western	Western Area Power Administration
WOMT	Water Operations Management Team
WQCP	Water Quality Control Plan
WSEL	water surface elevation
WSR	water supply reliability
WSRA	Wild and Scenic Rivers Act
WUI	wildland-urban interface
WWTP	wastewater treatment plant
X2	distance in kilometers from the Golden Gate Bridge to the location where salinity concentration is 2 parts per thousand

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Chapter 1
Introduction

This Preliminary Draft Environmental Impact Statement (PDEIS) has been prepared as part of the Shasta Lake Water Resources Investigation (SLWRI) to evaluate the potential environmental, cultural, and socioeconomic effects of implementing the proposed action to modify the existing Shasta Dam and Reservoir. The SLWRI is led by the U.S. Department of the Interior, Bureau of Reclamation (Reclamation), Mid-Pacific Region, and includes this PDEIS and the accompanying Draft of the *Shasta Lake Water Resources Investigation Feasibility Report* (Feasibility Report) and appendices. Reclamation is serving as the Federal lead agency for compliance with the National Environmental Policy Act (NEPA). Under NEPA, a cooperating agency is any Federal agency, other than the lead agency, that has jurisdiction by law or special expertise with respect to any environmental impact involved in an action requiring an environmental impact statement (EIS). Cooperating agencies for the SLWRI, pursuant to NEPA, are U.S. Forest Service (USFS), Colusa Indian Community Council of the Cachil Dehe Band of Wintun Indians, U.S. Army Corps of Engineers, and U.S. Department of the Interior, Bureau of Indian Affairs. This document has also been prepared in accordance with the California Environmental Quality Act (CEQA) and may be used by State of California (State) permitting agencies that would be involved in reviewing and approving the project.

In conducting the SLWRI, Reclamation determined that expanding the capacity of Shasta Lake by modifying Shasta Dam would (1) increase survival of anadromous fish in the Sacramento River, and (2) improve water supply reliability for agricultural, municipal and industrial (M&I), and environmental water users; these are the two primary purposes of the SLWRI. In addition, implementing the proposed action would address other related resource needs.

1.1 Background

Reclamation was established in 1902 to assist in meeting the increasing water demands of the West. Today, Reclamation is the largest water provider in the country and the second largest producer of hydroelectric power in the western United States. Reclamation's Mid-Pacific Region is responsible for managing the Central Valley Project (CVP), which stores and delivers about 20 percent of the State's developed water — 7 million acre-feet (MAF) — to more than 250 water contractors throughout California.

Shasta Dam and Shasta Lake were constructed from September 1938 to June 1945. Shasta Dam was fully operable in April 1949, following World War II. During this period (circa 1945 – 1949), approximately 37 miles of the Union Pacific Railroad main line and 21 miles of U.S. Highway 99 (now Interstate 5 (I-5)) were relocated around the reservoir. Reclamation currently operates Shasta Dam and Shasta Lake in conjunction with other facilities to manage floodwater, irrigation water supply, M&I water supply, hydropower generation, and maintenance of navigation flows. The Central Valley Project Improvement Act (CVPIA) added "fish and wildlife mitigation, protection, and restoration" as a priority equal to water supply, and added "fish and wildlife enhancement" as a priority equal to hydropower generation.

1.1.1 SLWRI Authorization

Public Law 96-375 (October 3, 1980) provides feasibility study authority for the SLWRI and allows the Secretary of the Interior to do the following:

> *…engage in feasibility studies relating to enlarging Shasta Dam and Reservoir, Central Valley Project, California or to the construction of a larger dam on the Sacramento River, California, to replace the present structure.*

Section 103(c), "Authorizations for Federal Activities Under Applicable Law," of the CALFED Bay-Delta Authorization Act (Public Law 108-361, October 25, 2004), authorizes the Secretary of the Interior to carry out the activities described in paragraphs (1) through (10) of Subsection (d), which include the following:

> *...(1)(A)(i) planning and feasibility studies for projects to be pursued with project-specific study for enlargement of (1) the Shasta Dam in Shasta County.*

Also, Section 103(a)(1) of Public Law 108-361 (October 25, 2004) states the following:

> *The Record of Decision is approved as a general framework for addressing the CALFED Bay-Delta Program, including its components relating to water storage, ecosystem restoration, water supply reliability (including new firm yield), conveyance, water use efficiency, water quality, water transfers, watersheds, the Environmental Water Account, levee stability, governance, and science.*

The CALFED Bay-Delta Program (CALFED) Programmatic Record of Decision (ROD) (CALFED 2000a) called for the Secretary of the Interior to do the following:

> *…engage in feasibility studies for the purpose of determining the potential costs, benefits, environmental impacts, and feasibility of using the Sacramento River for conveying water from the enlarged Shasta Dam and Reservoir or the larger dam to points of use downstream from the dam.*

Other Federal legislation influences the SLWRI. Two laws of special note are Public Law 89-336 (November 8, 1965) and Public Law 102-575 (October 30, 1992). Public Law 89-336 created the Whiskeytown-Shasta-Trinity National Recreation Area, which includes Shasta Dam and Reservoir. Public Law 102-575, the CVPIA, directed numerous changes to operation of the CVP. Among these changes was adding fish and wildlife protection, restoration, and enhancement as a project purpose, which resulted in substantial changes to water supply deliveries, river flows, and related environmental conditions in the study area. To minimize impacts to CVP water contractors, the CVPIA also directed the Secretary of the Interior to develop a least-cost plan to increase the yield of the CVP by the amount dedicated to fish and wildlife purposes.

1.1.2 Major Previous Studies and Reports

Major previous Reclamation studies and reports investigating potential enlargement of Shasta Dam and Reservoir include the *Enlarged Shasta Lake Investigation Preliminary Findings Report* (1983), *Shasta Dam and Reservoir Enlargement, Appraisal Assessment of the Potential for Enlarging Shasta Dam and Reservoir* (1999), *Strategic Agency and Public Involvement Plan* (2003), *Mission Statement Milestone Report* (2003), *Initial Alternatives Information Report* (2004), *Environmental Scoping Report* (2006), and *Plan Formulation Report* (2007).

1.2 Purpose and Need for Proposed Action and Project Objectives

NEPA regulations require a statement of "the underlying purpose and need to which the agency is responding in proposing the alternatives, including the proposed action" (40 Code of Federal Regulations 1502.13), described in Section 1.2.1. The State CEQA Guidelines require a clearly written statement of objectives, including the underlying purpose of a project (Section 15124(b)), described in Section 1.2.2.

1.2.1 Purpose and Need for Proposed Action

The purpose of the proposed action is to improve operational flexibility of the Sacramento-San Joaquin Delta (Delta) watershed system through modifying the existing Shasta Dam and Reservoir to increase water supply reliability and anadromous fish populations in the upper Sacramento River. Specifically, the purpose of the proposed action is to accomplish all of the following:

- Promote increased survival of anadromous fish populations in the upper Sacramento River, primarily upstream from the location of the Red Bluff Diversion Dam (RBDD).

- Increase water supplies and water supply reliability for agricultural, M&I, and environmental purposes to help meet current and future water demands.

- To the extent possible, through meeting these objectives, include features that conserve and restore ecosystem resources in the Shasta Lake area and along the upper Sacramento River, reduce flood damage along the Sacramento River, increase hydropower capabilities at Shasta Dam, maintain and increase recreation opportunities at Shasta Lake, and maintain or improve water quality conditions in the Sacramento River downstream from Shasta Dam and in the Delta.

The need for the proposed action is described below and summarized from the 2007 Reclamation *Shasta Lake Water Resources Investigation Plan Formulation Report*, the 2004 Reclamation *Shasta Lake Water Resources Investigation Initial Alternatives Information Report*, and the Plan Formulation Appendix.

Anadromous Fish Survival

The Sacramento River system is unique in California in that it supports four separate runs of Chinook salmon: fall-, late fall-, winter-, and spring-run. The adult populations of the four runs of salmon and other important fish species that spawn in the upper Sacramento River have considerably declined over the last 40 years (DFG 2010). Several fish species in the upper Sacramento River have been listed under the Federal Endangered Species Act: Sacramento River winter-run Chinook salmon (endangered), Central Valley spring-run Chinook salmon (threatened), Central Valley steelhead (threatened), and the Southern Distinct Population Segment of North American green sturgeon (threatened). Two of these species are also listed under the California Endangered Species Act: Sacramento River winter-run Chinook salmon (endangered) and Central Valley spring-run Chinook salmon (threatened).

Unsuitable water temperatures in the upper Sacramento River, especially in dry and critically dry years, is a critical factor affecting the abundance of Chinook salmon and steelhead in the river. Releases of cold water stored behind Shasta Dam can improve seasonal water temperatures in the Sacramento River for anadromous fish, particularly winter-run Chinook salmon, during critical periods. Prolonged droughts depleting the cold-water storage in Shasta Reservoir could extirpate the entire Sacramento River winter-run Chinook salmon population (NMFS 2009a). Under current conditions, even 2 consecutive years of drought could reduce Shasta Reservoir cold-water storage to levels insufficient to support the Sacramento River winter-run Chinook spawning and incubation season. This could result in complete year-class

failure, virtually eliminating all of a single year's spawning and incubating winter-run Chinook in the Sacramento River (NMFS 2009a).

Various Federal, State, and local projects are addressing factors contributing to declines in anadromous fish populations. Recovery actions range from changing the timing and magnitude of reservoir releases to changing the temperature of released water. In May 1990, the State Water Resources Control Board issued Order 90-5, which included temperature objectives for the Sacramento River to protect winter-run Chinook salmon. The 1993 and 2004 National Marine Fisheries Service (NMFS) Biological Opinions (BO) for Sacramento River winter-run Chinook salmon reinforced this order and established certain operating parameters for Shasta Reservoir. The State Water Resources Control Board action and the NMFS BOs set surrogate or minimum flows in the river downstream from Keswick Dam primarily to affect water temperatures during key periods. In addition to flow requirements, structural changes have been made at Shasta Dam to change the temperature of released water, such as construction of the temperature control device, which was completed in 1997.

However, implementing requirements in the Trinity River ROD (as amended) may reduce water temperature improvements provided by the temperature control device at Shasta Dam. One of the major elements of the Trinity River ROD is reducing the average annual export of Trinity River water from 74 percent to 52 percent of the flow (Reclamation 2000). This reduces flow from the Trinity River basin into Keswick Reservoir, and then into the Sacramento River. Because water diverted from the Trinity River is generally cooler than flows released from Shasta Dam, implementing the Trinity River ROD offsets some of the benefits derived from the temperature control device.

Despite the efforts described above, a residual need remains for generally cooler water in the Sacramento River, especially in dry and critically dry water years. Additional actions are needed to continue reducing water temperatures in the Sacramento River at critical life stages of and improve habitat conditions for anadromous fish species.

Also, future effects of climate change on operations and conditions at Shasta Lake, and in the upper Sacramento River, could potentially result in changes to water temperature, flow, and ultimately, fish survival. Most importantly, it is expected that climate change may result in increased water temperatures downstream from Shasta Dam, particularly in summer months, and more frequent wet and drought (particularly extended drought) years. Increased water temperatures and extended drought periods may compound the threats to anadromous fish in the Sacramento River. Climate change could also result in reduced end-of-September carryover storage volumes, resulting in lower lake levels for a portion of the year, and a smaller cold-water pool, resulting in warmer water temperature and reduced water quality within Shasta Reservoir.

Water Supply Reliability

California's water supply system faces critical challenges with demands exceeding supplies for agricultural, M&I, and environmental water uses across the State. The 2009 California Department of Water Resources (DWR) *California Water Plan Update* concludes that California is facing one of the most significant water crises in its history; drought impacts are growing, ecosystems are declining, water quality is diminishing, and climate change is affecting statewide hydrology. Compounding these issues, Reclamation's *Water Supply and Yield Study* (2008a) describes dramatic increases in statewide population, land use changes, regulatory requirements, and limitations on storage and conveyance facilities, further straining available water supplies and infrastructure to meet water demands. Furthermore, projected unmet water demands are expected to increase competition for water supplies among agricultural, M&I, and environmental uses.

Projecting accurate and quantified water supply and shortages in California is complex; there are numerous variables and, just as important, numerous opinions regarding these variables. Reclamation's *Water Supply and Yield Study* (2008a) estimates current statewide water supply shortages at 2.3 MAF and 4.2 MAF for average and dry years, respectively. Without further investment in water management and infrastructure, future statewide shortages are expected to increase to approximately 4.9 MAF and 6.1 MAF in average and dry years, respectively, by 2030 (Reclamation 2008a). Representative demands for dry and average years were based on water use data from the 2005 *California Water Plan Update* (DWR), adjusted for population growth, increasing urban water use, and reductions in irrigated acreage and environmental flow due to insufficient water supplies.

A major factor in California's future water picture is population growth. California's population is expected to increase by just over 60 percent by 2050 (DOF 2010) and could force some of the existing water supplies currently identified for agricultural uses to be redirected to urban uses. Because some portion of increased population growth in the Central Valley would occur on lands currently used for irrigated agriculture, water that would have been needed for these lands for irrigation would instead be used to meet urban demands. However, this would only partially offset the required agricultural-to-urban water conversion needed to sustain projected urban water demands, since much of the growth would occur on nonirrigated agricultural lands. Even if all of the urban growth in the Central Valley would occur on lands currently under irrigation, this would only account for up to about 40 percent of expected future conversion needs, and additional agricultural-to-urban water conversion would be required to help sustain urban growth primarily in other areas of the State.

Another potentially significant factor affecting water supply reliability is climate change. Potential impacts due to climate change are many and complex (DWR 2006), varying through time and geographic location across the State (Reclamation 2011). Changes in geographic distribution, timing, and intensity

of precipitation are projected for the Central Valley (Reclamation 2011), which could broadly impact rainfall runoff relationships important for flood management and water supply. A reduction in total system storage is also anticipated as a result of climate change. Precipitation held in snowpack makes up a significant quantity of total annual supplies needed for urban, M&I, and many environmental uses. It is expected that in the future, climate change may significantly reduce water held in snowpack in the Sierra Nevada Mountains (DWR 2009). Additionally, when climate change is considered in projections of change in water demand, annual water demand is higher than under a repeat of historical climate (DWR 2009). During drought periods, expected supplies could be further reduced, and expected shortages would be significantly greater.

Also, CVP and State Water Project (SWP) flexibility has diminished with population growth and increased environmental and ecosystem commitments and requirements (Reclamation 2008a). For example, the CVPIA, implemented in 1993, dedicated 800 thousand acre-feet of CVP water supplies to the environment as well as additional water supplies for wildlife refuges. This had the greatest impact on dry year agricultural water deliveries, with CVP delivery capability for agricultural users, both north and south of the Delta, reduced by about 50 percent (Reclamation 2008a). Complicating this issue is the variability associated with water resources in California. Precipitation in California is seasonably, temporally, and spatially variable and agricultural, M&I, and environmental water users have variable needs for quantity, quality, timing, and place of use.

California's water systems face the threat of too much water during floods, and too little water to meet demands during dry and critical water years. Chronic water shortages have led to increases in groundwater usage, which has led to groundwater overdraft in many regions across the State. Groundwater overdraft can cause permanent declines in groundwater levels, long-term reductions in groundwater supplies, land subsidence, decreases in water quality, a greater potential for salt water intrusion, and lasting environmental impacts. Challenges are greatest during drought years, when water supplies are less available (DWR 2009).

An integrated portfolio of solutions, regional and statewide, is needed to meet future water supply needs. Even with major efforts by multiple agencies to address the complex water resources issues in the State, demands are expected to exceed supplies in the future. The 2008 *Water Supply and Yield Study* (Reclamation) stated that a "variety of storage and conveyance projects and water management actions have the potential to help fill [the] gap" between water supply and demand in California. The *2009 California Water Plan Update* (DWR) concluded that California must invest in reliable, high-quality, and affordable water conservation, efficient water management, and development of water supplies to protect public health, and improve California's economy, environment, and standard of living. Water management flexibility and adaptability will become even more necessary in the future to

meet the challenges associated with increasing population, environmental needs, and climate change. Even so, to avoid major impacts to the economy, overall environment, and standard of living in California, actions to conserve existing supplies and optimize the use of existing facilities will be needed. Additionally, development of additional water sources and increased storage and delivery capability are critical for providing reliable water supplies for expanding M&I uses and to maintain adequate supplies for agricultural and environmental purposes.

Other Resources

Reclamation has identified other resource needs that could be addressed through modification of Shasta Dam and Reservoir. Escalating demands on statewide electricity production, continuing modification of natural aquatic and riparian habitats in the Sacramento River system, increasing threats of potential flooding in the Sacramento River system, and greater demands for recreational opportunities are all potential local, regional, or statewide problems exacerbated by California's population growth in general and particularly in the Sacramento Valley. The SLWRI provides opportunities to address these other resource needs, as well as the primary SLWRI objectives of increased anadromous fish survival and water supply reliability.

1.2.2 Project Objectives

To address the identified purpose and need described above, two primary project (i.e., planning) objectives were developed for the SLWRI. Five secondary project objectives were developed to take advantage of other beneficial project opportunities.

Primary Project Objectives

Primary project objectives are those which specific alternatives are formulated to address. Primary project objectives developed for the SLWRI are as follows:

- Increase the survival of anadromous fish populations in the Sacramento River, primarily upstream from the RBDD.

- Increase water supply and water supply reliability for agricultural, M&I, and environmental purposes to help meet current and future water demands, with a focus on enlarging Shasta Dam and Reservoir.

The primary project objectives are considered to have coequal priority, with each pursued to the maximum practicable extent without adversely affecting the other.

Secondary Project Objectives

Secondary project objectives are actions, operations, or features that should be considered in the plan formulation process, but only to the extent possible through pursuit of the primary project objectives. Five secondary project objectives were developed for the SLWRI:

- Conserve, restore, and enhance ecosystem resources in the Shasta Lake area and along the upper Sacramento River
- Reduce flood damage along the Sacramento River
- Develop additional hydropower generation capabilities at Shasta Dam
- Maintain and increase recreation opportunities at Shasta Lake
- Maintain or improve water quality conditions in the Sacramento River downstream from Shasta Dam and in the Delta

1.3 Setting and Location

Shasta Dam and Shasta Lake are located on the upper Sacramento River in Northern California, approximately 9 miles northwest of Redding in Shasta County (Figure 1-1). The SLWRI includes both a primary and extended study area because of the potential influence of the proposed modification of Shasta Dam and Reservoir and subsequent system operations and water deliveries on resources over a large geographic area. The primary study area includes the following:

- Shasta Dam and Shasta Lake
- Lower reaches of three primary tributaries flowing into Shasta Lake (Sacramento, McCloud, and Pit rivers) and all smaller tributaries flowing into the lake
- Trinity and Lewiston Reservoirs
- Sacramento River between Shasta Dam and the RBDD facilities, including tributaries at their confluence

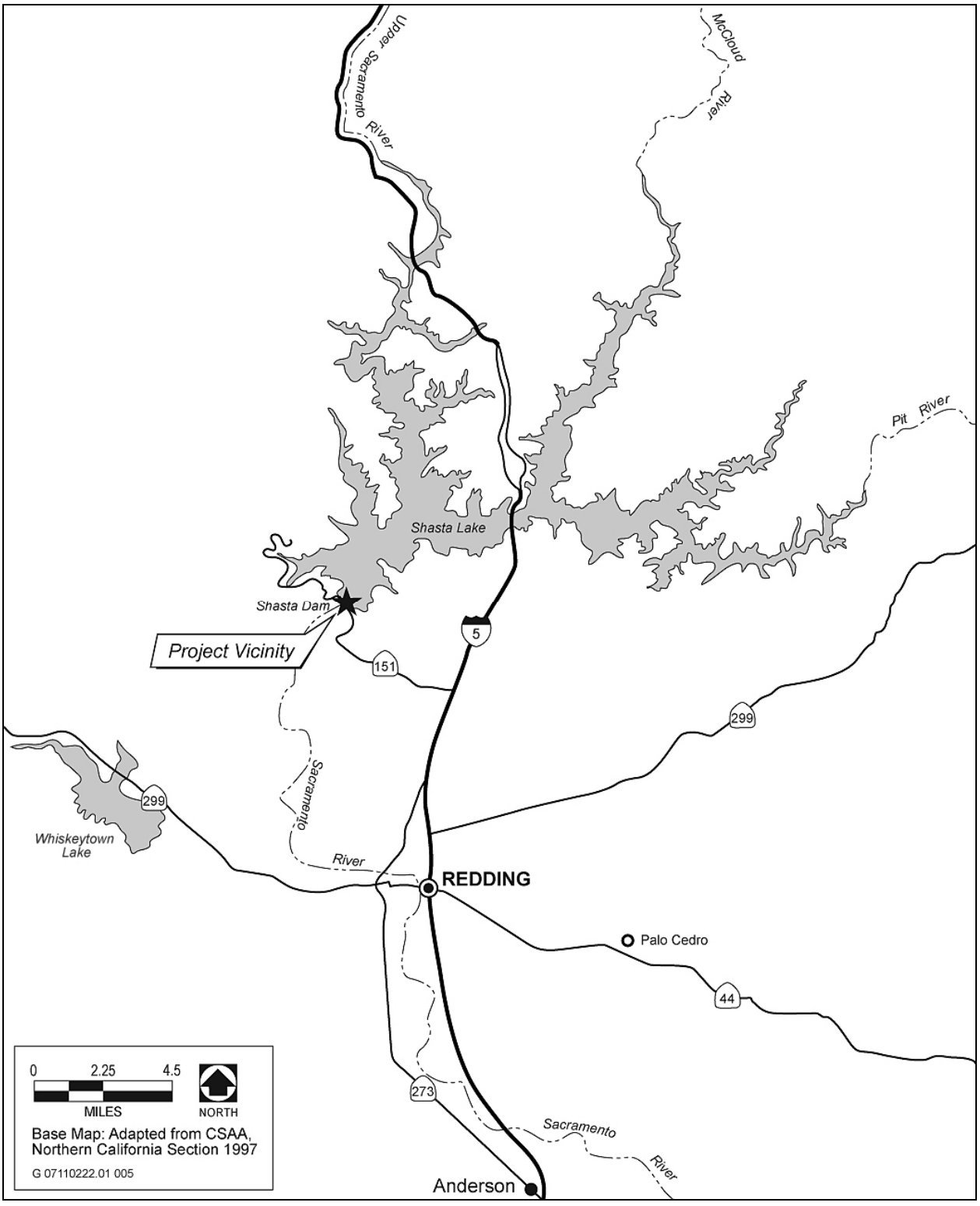


Figure 1-1. Shasta Dam and Shasta Lake Vicinity

The extended study area includes the following:

- Sacramento River downstream from the RBDD facilities, including portions of major tributaries, namely the American and Feather river basins downstream from CVP/SWP facilities
- Delta
- San Joaquin River basin at and downstream from CVP facilities (Friant and New Melones reservoirs)
- Facilities and water service areas of the CVP and SWP

The SLWRI study area includes other areas of California with resource programs or projects that could potentially be directly or indirectly influenced by modifying Shasta Dam and Reservoir. As discussed above, this area is represented by the Sacramento and San Joaquin rivers and the Delta system, plus the entirety of the CVP and SWP facilities and water service areas. For analyses of each resource that may be directly or indirectly affected by the project, this study area is subdivided into specific geographic areas, as described in the following sections.

1.3.1 Primary Study Area

The primary study area includes Shasta Dam and Reservoir, the lower portions of all contributing major and minor tributaries affected by increasing storage in Shasta Lake, and the Sacramento River downstream to the location of the RBDD. The RBDD is directly adjacent to the Red Bluff Pumping Plant (RBPP), which is currently under construction. Figure 1-2 shows the portion of the primary study area downstream from Shasta Dam.

Shasta Dam

Shasta Dam and Shasta Lake deliver about 55 percent of the total annual water supply used by the CVP. Shasta Dam is 602 feet tall (533 feet above the streambed). Upon construction, Shasta Dam was the second tallest and second largest concrete dam in the world. It was exceeded only by Hoover Dam (located in Clark County, Nevada) in height and by Grand Coulee Dam (located in Grant County, Washington) in volume and surface area (Reclamation 2004a).

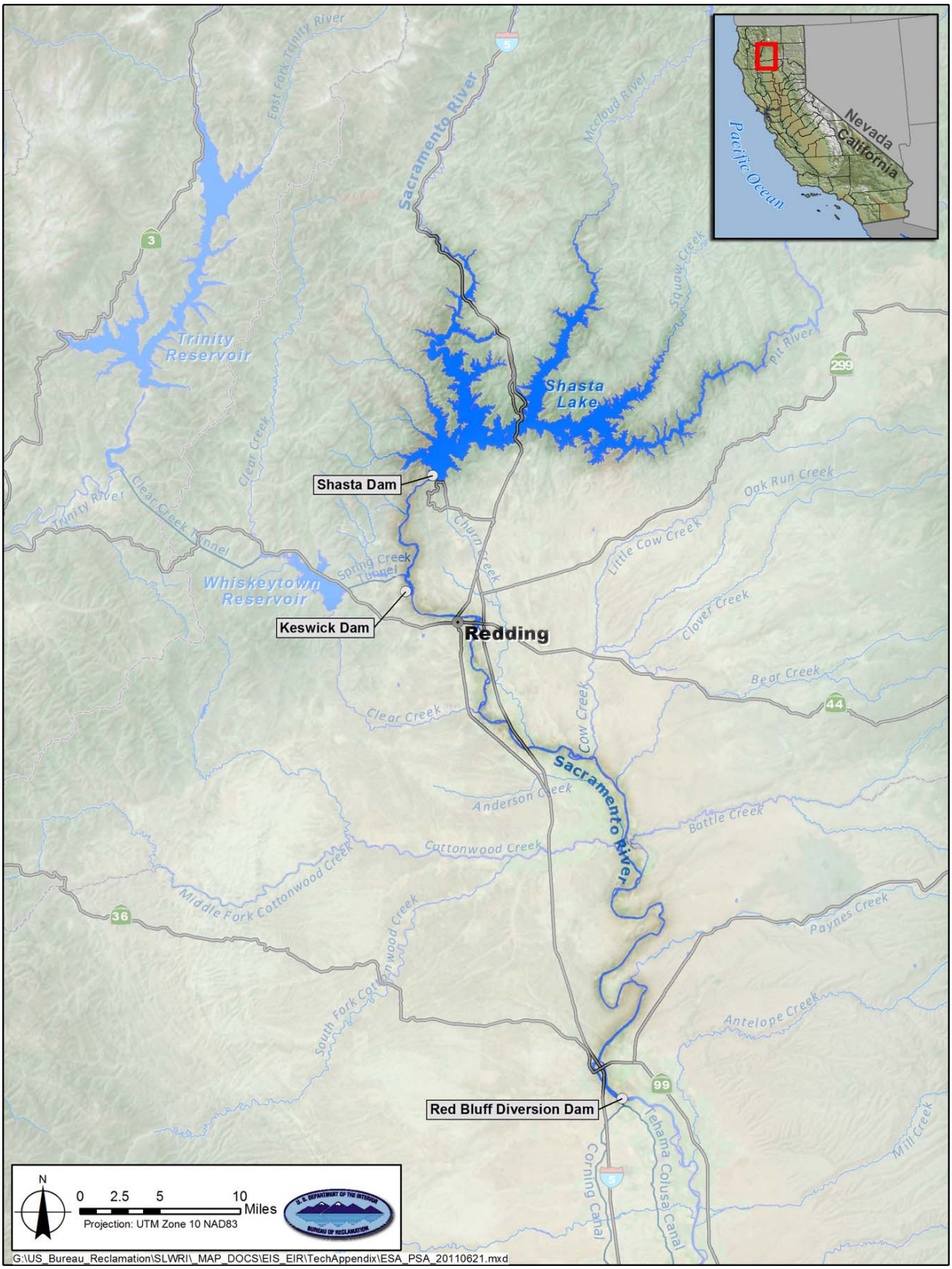


Figure 1-2. Primary Study Area – Shasta Lake Area and Sacramento River from Shasta Dam to Red Bluff Diversion Dam

Shasta Lake and Vicinity

Created by Shasta Dam, Shasta Lake is the largest reservoir in California with a surface area of approximately 29,500 acres, a volume of 4.55 MAF, and approximately 400 miles of shoreline. Offering a wide variety of water-based recreational opportunities, Shasta Lake is considered a premier lake for houseboating. Eleven resorts and numerous Shasta-Trinity National Forest campgrounds and boat ramps provide boating and fishing access; bank and boat fishing occurs year-round. Recreation at the reservoir is managed by the USFS consistent with the *Shasta-Trinity Land and Resource Management Plan* (USFS 1995) and guidelines established for the Whiskeytown-Shasta-Trinity National Recreation Area. Shasta Lake is also home to a wide variety of wildlife species, including resident bald eagles and osprey.

The reservoir's watershed receives a substantial amount of precipitation relative to the rest of California; only a limited region in the State's far northwest corner receives more. The three major tributaries to Shasta Lake are the Sacramento, McCloud, and Pit rivers. Many smaller tributary creeks and streams (both seasonal and perennial) flow into these major tributaries and the reservoir itself. The major tributaries are described in more detail below.

Sacramento River The Sacramento River drains an area of approximately 430 square miles. Its headwaters include portions of Mount Shasta and the Trinity and Klamath mountains. The Sacramento River flows south from its headwaters for about 40 miles before entering Shasta Lake.

McCloud River The McCloud River drains an area of approximately 600 square miles. Its headwaters are at Colby Meadows near Bartle, California. The McCloud River flows southwesterly from its headwaters for about 50 miles to its terminus at Shasta Lake.

Pit River The Pit River watershed is located in northeastern California and southeastern Oregon. The north and south forks of the Pit River drain the northern portion of the watershed. The North Fork Pit River originates at the outlet of Goose Lake, and the South Fork originates in the south Warner Mountains at Moon Lake in Lassen County. The Pit River is joined by the Fall River in Shasta County and has 21 named tributaries, totaling approximately 1,050 miles of perennial streams and encompassing approximately 4,700 square miles.

Trinity and Lewiston Reservoirs Trinity and Lewiston reservoirs impound the upper Trinity River approximately 60 and 67 miles, respectively, southwest of the headwaters near Mount Eddy (USFS 2005). Trinity Reservoir has a watershed of approximately 105,600 acres and a usable storage capacity of approximately 2,438,000 acre-feet. Flow into Lewiston Reservoir, with a capacity of approximately 14,700 acre-feet, is completely regulated by releases from Trinity Dam (USFS 2005). At Lewiston Dam, a portion of Trinity River

flows are diverted to the Sacramento River basin through the Clear Creek Tunnel.

Upper Sacramento River — Shasta Dam to Red Bluff Diversion Dam

This portion of the study area includes an approximately 65-mile-long stretch of the Sacramento River corridor from Shasta Dam to the RBDD facilities, including tributaries at their confluence. The Sacramento River corridor within this reach also includes Reading Island and areas proposed for gravel augmentation. Communities located along this stretch of the river are Redding, Anderson, and Red Bluff. The northern portion of this reach is located in Shasta County and the southern portion is in Tehama County.

Shasta Dam, Keswick Dam, Anderson-Cottonwood Irrigation District Dam, and the RBDD are located on the Sacramento River in this area. Urban, residential, industrial, and agricultural land uses predominate along the upper Sacramento River between Shasta Dam and the RBDD.

1.3.2 Extended Study Area

The extended study area for the project includes the RBDD south (downstream along the Sacramento River) to the Delta. It also includes the San Francisco Bay/Sacramento-San Joaquin Delta (Bay-Delta) area and portions of the American and Feather river basins, the San Joaquin River basin, and the CVP and SWP facilities and water service areas (Figure 1-3).

Sacramento River from Red Bluff Diversion Dam to Delta

The segment of the extended study area between the RBDD facilities and the Delta includes the Sacramento River, tributaries at their confluence, and portions of major tributaries that may be affected by the project, namely, the Feather and American rivers. The Yuba River is a major tributary to the Feather River, but the Yuba River is not considered part of this segment of the extended study area for two reasons: it is geographically separated from the Sacramento River, and its watershed has no CVP or SWP facilities that could be indirectly affected by increased storage at Shasta Lake. Lake Oroville is a major DWR SWP facility on the Feather River, and Folsom Lake is a major Reclamation CVP facility on the American River.

The reach of the middle Sacramento River between Red Bluff and Colusa is approximately 100 miles.

The Sacramento River Hydrologic Region, as defined by DWR, is the main water supply for much of California's urban and agricultural areas. Annual runoff averages about 22.4 MAF, which is nearly one-third of California's total runoff. M&I and agricultural supplies to the Sacramento Valley region are about 8 MAF, with groundwater providing approximately 2.5 MAF of that total. Much of the remainder of the runoff in the Sacramento River watershed goes to dedicated in-channel flows that support various environmental requirements, including instream flow and Delta salinity requirements (DWR 2003).



Figure 1-3. Central Valley Project and State Water Project Water Service Areas

Sacramento-San Joaquin Delta

Surface water resources in the Delta are influenced by the interaction of tributary inflows, tides, Delta hydrodynamics, local Delta diversions and exports, and water transfers. The Delta receives runoff from a watershed that includes more than 40 percent of California's land area and covers approximately 750,000 acres. Tributaries that discharge directly into the Delta include the Sacramento, San Joaquin, Mokelumne, Cosumnes, and Calaveras rivers. Existing surface water conditions in the Delta are the result of the many changes that have occurred as the Delta and its watershed have been developed over the past 150 years.

Tides move water twice daily from San Francisco Bay into the Delta. The location of the mixing zone between freshwater from the Delta and saline water from the bay varies with the amount of Delta outflow and tides. Saltwater intrusion into the Delta during summer is controlled by tides, freshwater inflows from reservoir releases, and Delta pumping. Average incoming and outgoing Delta tidal flow is approximately 170,000 cubic feet per second and average net Delta outflow is about 30,000 cubic feet per second, or about 21 MAF per year, measured at Chipps Island.

San Joaquin River Basin to Delta

The San Joaquin River basin includes the Central Valley south of the Delta. This area is drier than the Sacramento Valley, and flows into the Delta from the San Joaquin River are considerably less than those from the Sacramento River. The river is also subject to extreme variations in flow and water quality.

The San Joaquin River watershed above Vernalis (the point at which the river enters the Delta) is 13,356 square miles. Inflows from the Merced (farthest upstream), Tuolumne, and Stanislaus rivers contribute more than 60 percent of the flows in the San Joaquin River, as measured at Vernalis.

The major rivers of the San Joaquin system have contributed an average of about 5.5 MAF to Delta inflow, with an annual range of 1.1 to 15 MAF. Historical unimpaired flows on the Stanislaus, Tuolumne, Merced, and San Joaquin rivers averaged a total of 5.6 MAF. Numerous dams, reservoirs, and diversions are located on these rivers and others in the San Joaquin system. New Melones Reservoir is located on the Stanislaus River and is part of Reclamation's CVP system.

Central Valley Project Facilities and Water Service Areas

The CVP supplies irrigation water to the Sacramento and San Joaquin valleys; domestic water to cities and industries in Sacramento County and the east and South San Francisco Bay area; and water to fish hatcheries and wildlife refuges throughout the Central Valley. The CVP delivers approximately 7 MAF of water per year. CVP facilities include 20 dams and reservoirs with a combined storage capacity of more than 11 MAF, 39 pumping plants, 2 pumping-generating plants, 11 powerplants, and more than 500 miles of major canals and

aqueducts. CVP divisions comprise Trinity River, Shasta Lake, Sacramento River, American River, Delta, West San Joaquin, San Felipe, East Side, and Friant.

The CVP has three primary storage facilities in Northern California: Shasta Dam and Shasta Lake, Trinity Dam and Clair Engle Lake, and Folsom Dam and Folsom Lake. Major storage facilities south of the Delta are New Melones Reservoir on the Stanislaus River, Millerton Lake on the San Joaquin River, and San Luis Reservoir, which is a pumped-storage reservoir on the west side of the San Joaquin Valley, and is shared with the SWP.

The Delta-Mendota Canal is the main conveyance facility of the CVP. This canal conveys water from the C. W. "Bill" Jones Pumping Plant (formerly known as the Tracy Pumping Plant) in the south Delta near Byron to agricultural lands in the San Joaquin Valley. Water not delivered directly is diverted from the Delta-Mendota Canal at the O'Neill Pumping Plant into O'Neill Forebay. The water then flows along the San Luis Canal to CVP contractors in the San Joaquin Valley or is lifted into San Luis Reservoir through the Gianelli Pumping/Generating Plant for later use. The majority of the remaining water continues to the southern Central Valley, with some water being diverted to Santa Clara County.

State Water Project Facilities and Water Service Areas

The SWP is the largest state-built, multipurpose water project in the country. DWR operates and maintains the SWP, which conveys an annual average of 2.5 MAF of water through 20 pumping plants, 4 pumping-generating plants, 5 hydroelectric powerhouses, 34 storage facilities, and about 701 miles of open canals and pipelines.

DWR operates the SWP to export Delta flows and store and transfer water from the Feather River basin to the San Joaquin Valley, South San Francisco Bay, areas north of Suisun Bay, coastal counties, and ultimately to Southern California. The State Legislature authorized the SWP in 1951 for water supply, flood control, hydropower generation, recreation, and fish and wildlife purposes. Approximately 25 million of California's estimated 37 million residents benefit from SWP water, which also irrigates about 750,000 acres of farmland, mainly in the south San Joaquin Valley. Of the contracted water supply, M&I users have received about half of the total water delivered over the last 20 years; the remainder is supplied for agricultural use. A total of 29 contracting agencies receive water from the SWP.

In the southern Delta, the SWP diverts water from Clifton Court Forebay for delivery south of the Delta. The Harvey O. Banks Pumping Plant lifts water from Clifton Court Forebay into Bethany Reservoir. The water delivered to Bethany Reservoir flows into the California Aqueduct, the main conveyance facility of the SWP. Along the western San Joaquin Valley, the California Aqueduct transports water through the Gianelli Pumping/Generating Plant for

storage in San Luis Reservoir until it is needed for later use. The 444-mile-long California Aqueduct conveys water to the agricultural lands of the San Joaquin Valley and the urban regions of Southern California. The west branch of the aqueduct ends in Castaic Lake, and the east branch terminates at Lake Perris in Southern California.

1.4 NEPA Requirements

NEPA is a planning process to inform stakeholders, public agencies, and decision makers of the significance of potential environmental effects that may result from taking an action or implementing a Federal action. These processes disclose the significance of the effects of a proposed action on the natural and human environment. The environmental effects of a range of reasonable alternatives, including a no-action alternative, are also analyzed as required under NEPA.

1.4.1 NEPA Process

Reclamation is the Federal lead agency for NEPA compliance (42 U.S. Code 4321 et seq.). Based on a review of technical data and the scope of the SLWRI, Reclamation determined that the proposed action would result in significant impacts and that an EIS is the appropriate NEPA document to be prepared. Consequently, this PDEIS has been made available for public review, and a Draft EIS, Final EIS, and ROD will be published subsequently.

The EIS, when finalized, will satisfy NEPA requirements for formulating and evaluating alternatives, disclosing environmental impacts, and indentifying potential mitigation measures. Section 1.5.2, “Intended Use of Final EIS,” describes the roles and responsibilities of Federal, State, and local agencies and includes a list of agencies that may use the EIS, when finalized, for NEPA compliance, or to inform decisions regarding resources within their jurisdictions.

1.5 Intended Use of EIS

This section described how this PDEIS will be used now and when it is finalized.

1.5.1 Intended Use of Preliminary Draft EIS

Release of this Preliminary Draft EIS, the Draft Feasibility Report, and their appendices presents SLWRI findings to date, and provides another opportunity for public and stakeholder input. When additional information and studies are incorporated into the SLWRI, Reclamation will distribute a formal Draft EIS for public review and comment.

1.5.2 Intended Use of Final EIS

An EIS identifies and evaluates alternatives that meet the project purpose and can also avoid project-related impacts, analyzes the environmental effects of an action, and indicates additional measures to reduce or avoid potential environmental effects resulting from the action alternatives (i.e., mitigation measures). An EIS must also disclose significant environmental effects that cannot be avoided, growth-inducing effects, significant cumulative impacts, and effects found not to be significant. The purpose of an EIS is not to recommend approval or rejection of a project, but to provide information to aid the public and decision makers/permitting agencies in the decision-making process.

This EIS, when finalized, is intended to be used by the Federal lead agency when considering approval of the proposed action or an alternative to the proposed action. All cooperating agencies, responsible agencies, and other Federal, State, and local agencies with permitting or approval authority over any aspect of the proposed action are expected to use the information contained in the Final SLWRI EIS to meet most, if not all, of their information needs to make decisions and/or issue permits with respect to the proposed action. Table 1-1 presents Federal, State, and local agencies that may use the EIS for their decision-making needs.

This PDEIS also serves as a companion document to the Draft Feasibility Report, published concurrently. The Draft Feasibility Report builds on the information contained in the *Shasta Lake Water Resources Investigation Plan Formulation Report* (Reclamation 2007) and incorporates information contained in the SLWRI PDEIS by reference. The Feasibility Report, when finalized, will be used to determine the type and extent of Federal interest in enlarging Shasta Dam and Reservoir.

Table 1-1. Agency Roles and Responsibilities

Agency	Role/Responsibility
Federal	
U.S. Army Corps of Engineers (cooperating agency)	Permitting under Section 404 of the Clean Water Act; Permitting under Sections 9, 10, and 13 of the Rivers and Harbors Act
U.S. Department of the Interior, Bureau of Indian Affairs (cooperating agency)	Participating in SLWRI feasibility study
U.S. Department of the Interior, Bureau of Land Management	Reviewing SLWRI studies for consistency of project facilities with management of the Sacramento River Bend Management Area
U.S. Department of the Interior, Bureau of Reclamation	Serving as NEPA lead agency
U.S. Fish and Wildlife Service	Completing Federal Endangered Species Act consultation and incidental take authorization; verifying compliance with the Fish and Wildlife Coordination Act
National Marine Fisheries Service	Completing Federal Endangered Species Act consultation and incidental take authorization; verifying compliance with the Magnuson-Stevens Act

Table 1-1. Agency Roles and Responsibilities (contd.)

Agency	Role/Responsibility
State	
U.S. Forest Service (cooperating agency)	Verifying consistency of project facilities with management of the Shasta-Trinity National Forest and Whiskeytown-Shasta-Trinity National Recreation Area; regulating occupancy and use of National Forest lands under the Federal Land Policy Management Act
U.S. Environmental Protection Agency	Reviewing effects on air quality for compliance with the Clean Air Act and State Implementation Plan; verifying compliance with the Safe Drinking Water Act; reviewing and filing EIS
California Air Resources Board	Verifying compliance with criteria pollutant standards
California Department of Boating and Waterways	Verifying compliance with the California Harbors and Navigation Code
California Department of Conservation	Designating Important Farmland for the State
California Department of Fish and Game (trustee agency)	Completing California Endangered Species Act consultation and incidental take authorization; permitting under Section 1602 of the Fish and Game Code (streambed alteration agreement); completing consultation as a trustee agency
California Department of Forestry and Fire Protection	Providing fire protection services to unincorporated areas
California Department of Parks and Recreation	Verifying consistency with management of State Park lands
California Department of Transportation	Issuing encroachment permit and/or approving transportation management plan
California Department of Water Resources	Operating the State Water Project; participating in the SLWRI feasibility study
California Department of Toxic Substances Control	Verifying compliance with regulations for generation, transportation, treatment, storage, and disposal of hazardous waste
California Energy Commission	Verifying compliance with State energy policies
California Highway Patrol	Verifying that the project would not interfere with any emergency response plan or emergency response times
California Resources Agency	Verifying that California's natural and cultural resources are protected
Central Valley Flood Protection Board (formerly The Reclamation Board)	Issuing levee and floodway encroachment permits
California Office of Historic Preservation	Verifying compliance with Section 106 of the National Historic Preservation Act
State Lands Commission	Verifying consistency with the management of lands managed by the commission; possibly issuing a State Lands lease
Native American Heritage Commission	Identifying sacred sites and most likely descendants for Native American burials; providing Native American contact information
State Water Resources Control Board, Regional Water Quality Control Boards	National Pollutant Discharge Elimination System permitting under Section 402 of the Clean Water Act; issuing certification under Section 401 of the Clean Water Act; issuing water right permits

Table 1-1. Agency Roles and Responsibilities (contd.)

Agency	Role/Responsibility
Shasta County	Verifying compliance with the State's Surface Mining and Reclamation Act; issuing other possible construction authorizations/ encroachment permits
Tehama County	Verifying compliance with the State's Surface Mining and Reclamation Act; issuing other possible construction authorizations/ encroachment permits
Local	
Shasta County Air Quality Management District	Reviewing effects on air quality and authority to construct/permit to operate
Resource Conservation Districts	Verifying consistency with protected agricultural lands in the primary and extended study areas

Key:
EIS = environmental impact statement
NEPA = National Environmental Policy Act
SLWRI = Shasta Lake Water Resources Investigation
State = State of California

1.6 Areas of Controversy/Issues to Be Resolved

Several areas of controversy and issues to be resolved have been identified in the SLWRI to date.

1.6.1 Areas of Controversy

Federal, State, and local stakeholders identified several areas of controversy during the SLWRI scoping process and SLWRI agency meetings and workshops. Major concerns are listed below:

- **Impacts on Cultural Resources** — Sites of cultural and religious significance exist in and around Shasta Lake, including sites related to historical activities of Native Americans. The Winnemem Wintu have raised concerns about inundation effects on sites they value for historical and cultural significance that would result from enlarging Shasta Lake through a dam raise.

- **Impacts on Recreation** — Shasta Lake is the principal recreation destination in Shasta County, which realizes annually well over $160 million related to outdoor recreation. Shasta Lake has attracted development of 11 private marinas with 1,075 houseboats and 18 public campgrounds. Stakeholders are concerned about possible adverse effects on recreation at Shasta Lake, such as impacts on concessionaires and their facilities and potential impacts on the regional economy.

- **Impacts on McCloud River's Free-Flowing Condition or Wild Trout Fishery** — No formally designated components of the National or State wild and scenic rivers programs are present in the primary

study area. However, although the McCloud River is not formally designated, Section 5093.542 of the California Public Resources Code specifies that the McCloud River should be maintained in its free-flowing condition, and its wild trout fishery protected from 0.25 miles below McCloud Dam downstream to the McCloud River Bridge. Section 5093.542 was established through enactment of the Wild and Scenic Rivers Act, as amended (Sections 5093.50 – 5093.70). Up to about 3,500 feet of the lower McCloud River above the McCloud River Bridge and within the special designation would be occasionally inundated if Shasta Dam were modified. DWR and other State agencies, landowners, and various environmental groups have expressed concerns about potential impacts on McCloud River resources resulting from enlarging Shasta Dam and Lake.

Another area of controversy concerns whether State agencies can participate in projects that could have an adverse effect on the McCloud River's free-flowing conditions or its wild-trout fishery. Section 5093.542(c) of the California Public Resources Code states the following:

> *Except for participation by DWR in studies involving the technical and economic feasibility of enlargement of Shasta Dam, no department or agency of the state shall assist or cooperate with, whether by loan, grant, license, or otherwise, any agency of the federal, state, or local government in the planning or construction of any dam, reservoir, diversion, or other water impoundment facility that could have an adverse effect on the free-flowing condition of the McCloud River, or on its wild trout fishery.*

Furthermore, Section 5093.542(d) states the following:

> *All state agencies exercising powers under any other provision of law with respect to the protection and restoration of fishery resources shall continue to exercise those powers in a manner to protect and enhance the fishery [of the protected segments of the McCloud River].*

Participation by various State agencies in planning and potential construction activities associated with modifying Shasta Dam and Reservoir, including related permitting and approval processes, varies by an agency's mandate and PRC Section 5093.542. DFG has taken the position that it must participate in preparing the EIS to comply with Section 5093.542(d). Other State agencies, including DWR and the State Water Resources Control Board, have participated to a limited extent or expressed their intent to participate in the SLWRI. The CALFED Program Plan (CALFED 2000b) concluded that although

Section 5093.542 sought to protect the free-flowing condition of the McCloud River, it also provided for investigations of enlarging Shasta Dam.

- **Impacts on Reservoir-Area Property Owners** — Raising Shasta Dam would affect privately owned real estate. The raise would (1) inundate additional lands around Shasta Lake; (2) affect existing structures, requiring acquisition of private property or relocation of displaced parties; and (3) require replacement of bridges and segments of existing paved and unpaved roads. These potential effects concern property owners around Shasta Lake.

- **Impacts on Environment, Especially Biological Resources** — Raising Shasta Dam or modifying project operations would affect a broad range of environmental resources, some adversely and some beneficially. Concern has been expressed about potential impacts on all of the following:

  - Wildlife habitat, special-status plant and animal species, and State-designated fully protected species at the reservoir rim

  - Fishery habitat on several creeks and streams that flow into Shasta Lake

  - Fishery and riparian habitat resources along the upper Sacramento River below Shasta Dam

  - Delta smelt and other sensitive aquatic species in the Delta

  - Delta water quality and South Delta water levels

  - Central Valley hydrology below CVP and SWP facilities, and resulting effects on water supplies for water contractors and other water users.

- **Reservoir Reoperation** — Residents and businesses around Shasta Lake have expressed interest in revising the operation of Shasta Dam to reduce the potential for extreme seasonal drawdown for flood control, such as occurred in early 2004. The flood control diagram has not been changed since July 1977 (USACE 1997), and new and evolving technology could reduce Shasta Lake water surface fluctuations associated with drawdown operations for flood control.

1.6.2 Issues to Be Resolved

Issues to be resolved for the SLWRI are described below.

Native American Concerns and Cultural Resources

This PDEIS and accompanying Draft Feasibility Report are consistent with the National Historic Preservation Act Section 106, and describe supporting analyses, studies, coordination, impacts, and mitigation, as necessary. Reclamation has invited Federally recognized tribes and non-Federally recognized tribal groups to be consulting parties to the SLWRI. Although no Federally recognized tribes reside in the immediate Shasta Lake area, members of the Winnemem band of the Wintu Indians have raised concerns about potential impacts of enlarging Shasta Dam on sites they value for historical and cultural significance. Colusa Indian Community Council of the Cachil Dehe Band of Wintun Indians is a cooperating agency for the SLWRI, pursuant to NEPA. The Winnemem Wintu will continue to have the opportunity to participate, and are anticipated to continue to provide input, through the Section 106 process as an invited consulting party, as well as through the NEPA process.

Impacts on Biological Resources

The physical environment and associated landscapes within and adjacent to the primary study area provide for a wide array of habitat used by a diverse assemblage of wildlife with varying habitat needs and home ranges. To date, species-specific survey efforts as part of the SLWRI have only included focused investigations for a number of special-status species in the inundation and relocation areas described previously. The scale of these surveys has been limited, and because of a variety of external factors, have not addressed habitat for species with a large home range or at a watershed scale. Therefore, for species that have large home ranges (e.g., Pacific fisher), or that use a wide range of habitats for some aspect of their life history, analyses presented in this document assume presence over a conservatively large geographic area to cover the full range of impacts anticipated for these species.

Off-Site Mitigation for Impacts on Biological Resources

Details about off-site opportunities to mitigate impacts on biological resources in the primary study area are not yet available. Potential mitigation lands containing wetland and special-status species habitat comparable to those that would be affected by the proposed action have been identified near the study area. Additional discussion of how these lands may be applied as mitigation and at what ratios will be provided in future documents. A discussion of mitigation for loss of habitat through preservation and enhancement in mitigation areas will be included in future documents.

Water Rights

Improving the reliability of water supplies is a primary objective of the SLWRI. The potential water supply reliability benefits of the project alternatives are described in Chapter 2. Water rights for the expanded Shasta Reservoir, which

are appropriated by the State Water Resources Control Board, must be in place before the project can operate. Evaluation of water rights will remain a focus of the SLWRI.

Coordinated CVP and SWP Operational Conditions

Planning assumptions and information on water operations used to develop comprehensive alternatives for the SLWRI were developed in 2006, and reflect the coordinated CVP and SWP operations described in the 2004 *Long-Term CVP Operations Criteria and Plan* (2004 OCAP) (Reclamation). In addition, the model package used to evaluate potential effects of the alternatives included in this PDEIS was based on operations described in the 2004 *Long-Term CVP and SWP OCAP Biological Assessment* (2004 OCAP BA) (Reclamation).

Reclamation consulted with the National Oceanic and Atmospheric Administration NMFS and U.S. Fish and Wildlife Service (USFWS) on the 2004 OCAP, and the two agencies issued the 2004 *Biological Opinion on the Long-Term CVP and SWP OCAP* (2004 NMFS BO) and 2005 *Reinitiation of Formal and Early Section 7 ESA Consultation on the Coordinated Operations of the CVP and SWP and the OCAP to Address Potential Critical Habitat Issues* (2005 USFWS BO), respectively. In 2007, the District Court for the Eastern District of California (District Court), in *Natural Resources Defense Council v. Kempthorne*, found the 2005 USFWS BO to be unlawful and inadequate. In May 2008, in *Pacific Coast Federation of Fishermen's Associations v. Gutierrez*, the District Court found the 2004 NMFS BO to be unlawful and inadequate. The District Court remanded both BOs to the fishery agencies.

In August 2008, Reclamation reinitiated consultation with the fishery agencies based on the 2008 *Biological Assessment on the Continued Long-Term Operations of the CVP and SWP* (Reclamation 2008b). USFWS issued the *Formal ESA Consultation on the Proposed Coordinated Operations of the CVP and SWP* in December 2008 (2008 USFWS BO), finding that the long-term operations of the CVP and SWP, as described in the 2004 OCAP BA, would jeopardize the continued existence of the delta smelt. In June 2009, NMFS issued the *BO and Conference Opinion on the Long-Term Operations of the CVP and SWP* (2009 NMFS BO), finding that the same operations would jeopardize populations of listed salmonids, steelhead, green sturgeon, and orcas. Because both agencies made jeopardy determinations, both agencies included a Reasonable and Prudent Alternative (RPA) in their respective BOs.

Several lawsuits were filed challenging the validity of the 2008 USFWS BO and 2009 NMFS BO and Reclamation's acceptance of the RPA included with each BO (*Consolidated Salmonid Cases, Delta Smelt Consolidated Cases*). On November 13, 2009, and March 5, 2010, the District Court concluded that Reclamation had violated NEPA by failing to perform any NEPA analysis before provisionally adopting the 2008 USFWS RPA and 2009 NMFS RPA. On December 14, 2010, the District Court found the 2008 USFWS BO to be unlawful and remanded the BO to USFWS. The District Court issued a similar

ruling for the 2009 NMFS BO on September 20, 2011. On May 4, 2011, in the *Delta Smelt Consolidated Cases*, the District Court ordered USFWS to prepare a draft BO by October 1, 2011, which was subsequently extended to an unspecified date to be agreed upon by involved parties. Reclamation and USFWS must prepare a final BO and final NEPA document by November 1, 2013, and December 1, 2013, respectively.

Reclamation and DWR use CalSim-II to study operations, benefits, and effects of new facilities and operational parameters for the CVP and SWP. A set of operational assumptions was developed in 2006 based on water operations described in the 2004 OCAP BA and the Coordinated Operations Agreement between Reclamation and DWR for the CVP and SWP, as ratified by Congress. These assumptions were used to guide development, modeling, and evaluation of potential effects of the No-Action Alternative and action alternatives included in this PDEIS. Rationale for the decision to use these existing evaluations as the basis of analysis in the PDEIS and accompanying Draft Feasibility Report is provided in Chapter 3, "Considerations for Describing the Affected Environment and Environmental Consequences." Modeling studies and associated analyses will be updated and included in the Draft EIS and other future SLWRI documents.

1.7 Documents Used to Prepare Preliminary Draft EIS

1.7.1 CVPIA EIS

The CVPIA is a Federal statute enacted in 1992 with the following purposes:

> *To protect, restore, and enhance fish, wildlife, and associated habitats in the Central Valley and Trinity River basins of California; to address impacts of the CVP on fish, wildlife and associated habitats; to improve the operational flexibility of the CVP; to increase water-related benefits provided by the CVP to the state of California through expanded use of voluntary water transfers and improved water conservation; to contribute to the state of California's interim and long-term efforts to protect the Bay-Delta; and to achieve a reasonable balance among competing demands for use of CVP water, including the requirements of fish and wildlife, agricultural, municipal and industrial and power contractors.*

A programmatic EIS was prepared by Reclamation and USFWS in October 1999 to address the potential impacts of implementing the CVPIA. Although not tiering from that document, this SLWRI PDEIS uses information contained in the CVPIA EIS, updated to reflect current and project-specific conditions.

1.7.2 CALFED EIS/EIR

CALFED is a collaboration of 25 Federal and State agencies with regulatory and management responsibilities in the Bay-Delta to develop and implement a long-term comprehensive plan to restore ecological health and improve water management for beneficial uses of the Bay-Delta system. The objective of the collaborative planning process is to identify comprehensive solutions to the problems of ecosystem quality, water delivery reliability, water quality, and Delta levee integrity.

In July 2000, the CALFED agencies released the *Final Programmatic EIS/Environmental Impact Report* (EIR) (CALFED 2000b), which analyzed a range of alternatives to solve Bay-Delta system problems. In August 2000, the CALFED agencies issued a programmatic ROD that identified 12 action plans. Specifically, plans were identified for the Governance, Ecosystem Restoration, Watersheds, Water Supply Reliability, Storage, Conveyance, Environmental Water Account, Water Use Efficiency, Water Quality, Water Transfer, Levees, and Science programs (CALFED 2000a). The CALFED agencies then began implementing Stage 1 of the ROD, including the first 7 years of a 30-year program to establish a foundation for long-term actions. The SLWRI and associated EIS would be consistent with the CALFED *Programmatic EIS/EIR*, but the SLWRI EIS does not tier from that EIS/EIR.

1.8 Organization of Preliminary Draft EIS

Chapter 1, "Introduction," summarizes the purpose, need, objectives, authorization, and location of the proposed action; provides an overview of the environmental review process and background for the project; summarizes intended use of the FEIS and areas of controversy and issues to be resolved; and discusses documents used to prepare this PDEIS.

Chapter 2, "Alternatives," summarizes the methods used for selecting project alternatives, describes the project alternatives, discusses alternatives that have been eliminated from further discussion, and presents the likely preferred alternative and rationale for selection.

Chapter 3, "Considerations for Describing Affected Environment and Environmental Consequences," describes the approach to describing the affected environment and environmental consequences, defines impact levels, and describes the methodology for cumulative effects, including cumulative projects. This chapter also presents the regulatory framework for the resources chapters that follow.

Chapters 4 – 25 describe the existing environmental and resource-specific regulatory frameworks for each resource area analyzed in this PDEIS, in the following order:

- Geology, geomorphology, minerals, and soils
- Air quality and climate
- Hydrology, hydraulics, and water management
- Water quality
- Noise and vibration
- Hazards and hazardous materials and waste
- Agriculture and important farmland
- Fisheries and aquatic ecosystems
- Botanical resources and wetlands
- Wildlife resources
- Cultural resources
- Indian Trust Assets
- Socioeconomics, population, and housing
- Land use and planning
- Recreation and public access
- Aesthetics and visual resources
- Transportation and traffic
- Utilities and service systems
- Public services
- Power and energy
- Environmental justice
- Wild and scenic river considerations for McCloud River

Each resource chapter listed above also describes project-level impacts of the No-Action Alternative and action alternatives on the resource or issue area, mitigation measures for those impacts, and cumulative effects of all of the alternatives.

Chapter 26, "Other Required Disclosures," describes any significant adverse effects of the proposed project that cannot be avoided, irreversible and irretrievable commitments of resources, growth-inducing effects, and compliance with applicable laws.

Chapter 27, "Public Involvement, Consultation, and Coordination," describes the public scoping process, agencies and organizations consulted, and areas of controversy, and identifies issues to be resolved.

Chapter 28, "References," lists the sources of information used to prepare this PDEIS.

Chapter 29, "DEIS Distribution List," lists the elected officials; government departments; Federal, State, and local agencies; and special-interest groups that received notice of the availability of this PDEIS.

Chapter 30, "List of EIS Preparers," lists individuals who participated in preparation of this PDEIS, and provides qualifications for those individuals, in order of organization and agency.

Chapter 31, "Index," lists important terms and topics and gives page numbers of relevant discussions.

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Chapter 2
Alternatives

NEPA and CEQA require consideration of a range of alternatives to a proposed action that would feasibly attain the majority of a project's basic objectives and accomplish the project purpose and need, while avoiding or minimizing environmental impacts. The purpose of including alternatives in an EIS is to offer a clear basis for choice by decision makers and the public about whether to proceed with a proposed action or project.

NEPA requires that alternatives be evaluated at a comparable level of detail (40 Code of Federal Regulations 1502.14(b)). Similarly, the Council on Environmental Quality regulations for implementing NEPA (40 Code of Federal Regulations 1502.14) require all reasonable alternatives to be objectively evaluated in an EIS so that each alternative is evaluated at an equal level of detail. Alternatives that cannot reasonably meet the project purpose and need do not require detailed analysis.

CEQA requires that the lead agency consider alternatives that would avoid or reduce one or more of the significant impacts identified for a project in an EIR. The State CEQA Guidelines state that an EIR needs to describe and evaluate only those alternatives necessary to permit a reasonable choice and to foster informed decision making and informed public participation (Section 15126.6(f)). Consideration of alternatives focuses on those that can either eliminate significant adverse environmental impacts, or reduce them to less-than-significant levels; alternatives considered in this context may include those that are more costly, and those that could impede, to some degree, the attainment of all the project objectives (Section 15126.6(b)). CEQA does not require the alternatives to be evaluated at the same level of detail as a proposed project.

This chapter documents compliance with NEPA requirements for alternatives analysis and the alternatives development process, and describes the six alternatives evaluated in detail in this PDEIS. This chapter is also generally consistent with CEQA requirements.

2.1 Alternatives Development Process

This section describes the alternatives development process for the SLWRI. A more detailed description of this process is included in the Plan Formulation Appendix.

2.1.1 Plan Formulation Process

The plan formulation process for Federal water resources studies and projects begins with identifying existing and projected future resources conditions likely to occur in a study area. This is followed by defining water resources problems, needs, and opportunities to be addressed, and developing planning objectives, constraints, and criteria.

For the SLWRI, the above process was separated into five phases, of which the first three have been completed. These planning phases are shown in Figure 2-1 and described below:

- **Mission Statement Phase –** This study phase consisted of projecting without-project future conditions, defining resulting resource problems and needs, defining a specific set of planning objectives, and identifying constraints and criteria for addressing the planning objectives.

- **Initial Alternatives Phase –** This phase included developing a number of potential management measures, or project actions or features designed to address planning objectives. These measures were then used to formulate a set of plans that were conceptual in scope (concept plans). These initial plans were evaluated and compared to the planning objectives to identify the most suitable plans for further development.

- **Comprehensive Plans Phase –** The measures and concept plans carried forward were further refined and developed with more specificity to formulate comprehensive alternative plans to address the planning objectives. These plans were then evaluated and compared.

- **Plan Refinement Phase –** This phase focuses on further refinement of the comprehensive plans to identify a plan suitable to be recommended for implementation. This phase includes preparing and circulating a Draft Feasibility Report and Draft EIS.

- **Recommended Plan Phase –** The next phase of the SLWRI planning process will focus on identifying a recommended plan, preparing a Biological Assessment, and confirming Federal and non-Federal responsibilities. This phase will conclude with the preparation and processing of a Final Feasibility Report to support a Federal decision, and a Final EIS.

Public and stakeholder outreach was performed concurrently with the above phases, as shown in Figure 2-1. Major reports include the *Strategic Agency Public Involvement Plan*, published in 2003 (Reclamation), and the *Environmental Scoping Report*, published in 2006 (Reclamation).

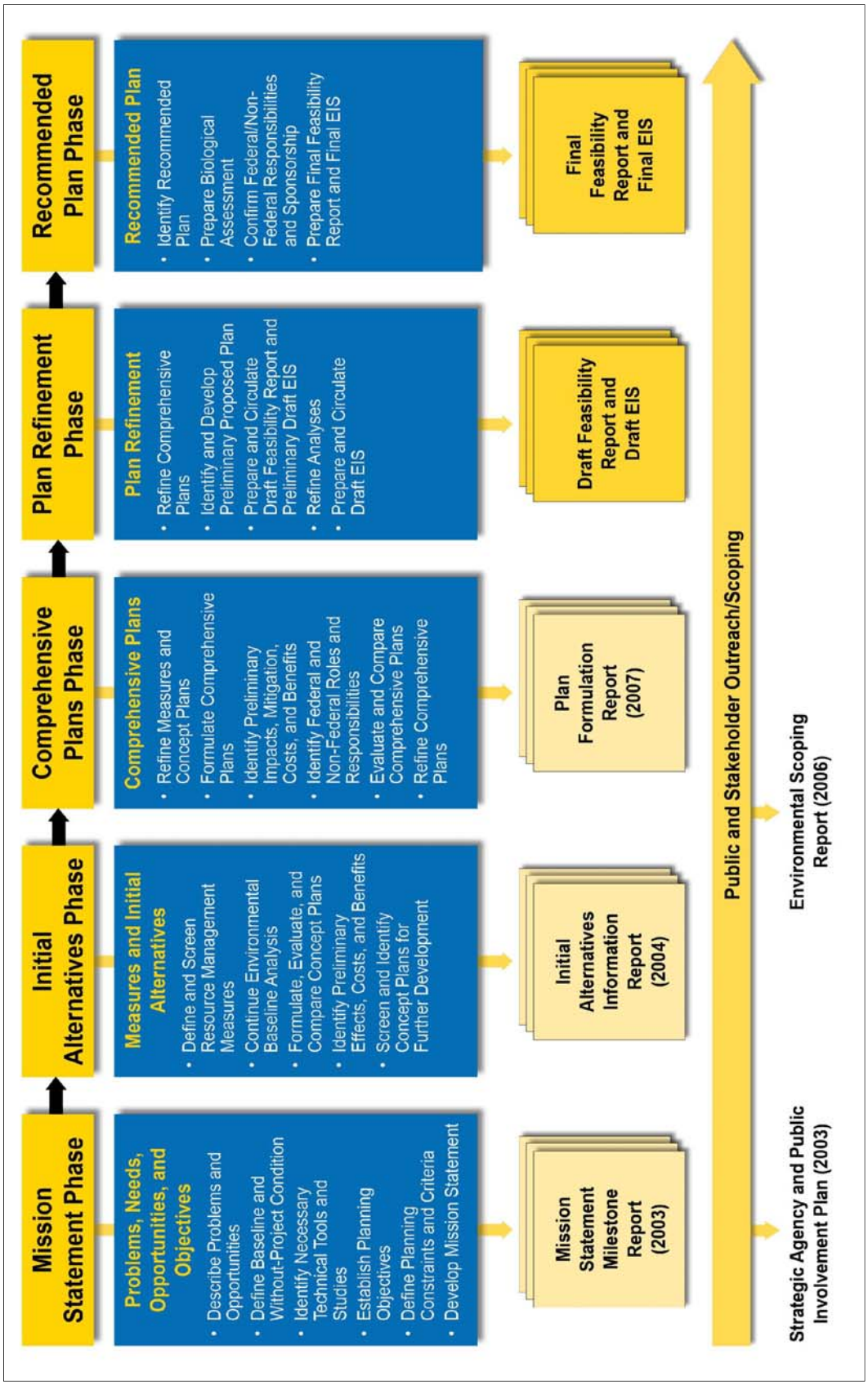


Figure 2-1. Plan Formulation Phases

2.1.2 Project Objectives

On the basis of the problems, needs, and opportunities identified in the plan formulation process, study authorities, and other pertinent direction, including information contained in the CALFED Bay-Delta Program Record of Decision (ROD) (CALFED 2000), primary and secondary objectives were developed. Primary objectives are those which specific alternatives are formulated to address. The primary objectives are considered to have coequal priority, with each pursued to the maximum practicable extent without adversely affecting the other. Secondary objectives are actions, operations, or features that should be considered in the plan formulation process, but only to the extent possible through pursuit of the primary objectives.

- **Primary Objectives**:
  - Increase the survival of anadromous fish populations in the Sacramento River, primarily upstream from the Red Bluff Diversion Dam (RBDD)
  - Increase water supply and water supply reliability for agricultural, municipal and industrial (M&I), and environmental purposes to help meet current and future water demands, with a focus on enlarging Shasta Dam and Reservoir
- **Secondary Objectives**:
  - Conserve, restore, and enhance ecosystem resources in the Shasta Lake area and along the upper Sacramento River
  - Reduce flood damage along the Sacramento River
  - Develop additional hydropower generation capabilities at Shasta Dam
  - Maintain and increase recreation opportunities at Shasta Lake
  - Maintain or improve water quality conditions in the Sacramento River downstream from Shasta Dam and in the Delta

Criteria, constraints, and additional planning considerations used to guide alternatives formulation are described in the Plan Formulation Appendix.

Following development of objectives, constraints, and criteria for the SLWRI, the next major step in formulating concept plans was to identify and evaluate potential management measures.

2.1.3 Management Measures

A management measure is any structural or nonstructural project action or feature that could address the objectives and satisfy the other applicable planning considerations. Numerous potential management measures were identified based on previous studies, programs, and projects to address the objectives. These measures were developed through study team meetings, field inspections, outreach, and environmental scoping for the SLWRI. Management measures are listed in Table 2-1 and described in detail in the Plan Formulation Appendix.

In the context of SLWRI management measures and project actions, the term "enhancement" specifically refers to restoration actions that improve environmental conditions above the baseline (without-project condition). Correspondingly, the term "mitigation" refers to restoration actions that improve environmental conditions toward the baseline to compensate for project impacts. The relationship between restoration, enhancement, and mitigation is illustrated in Figure 2-2.

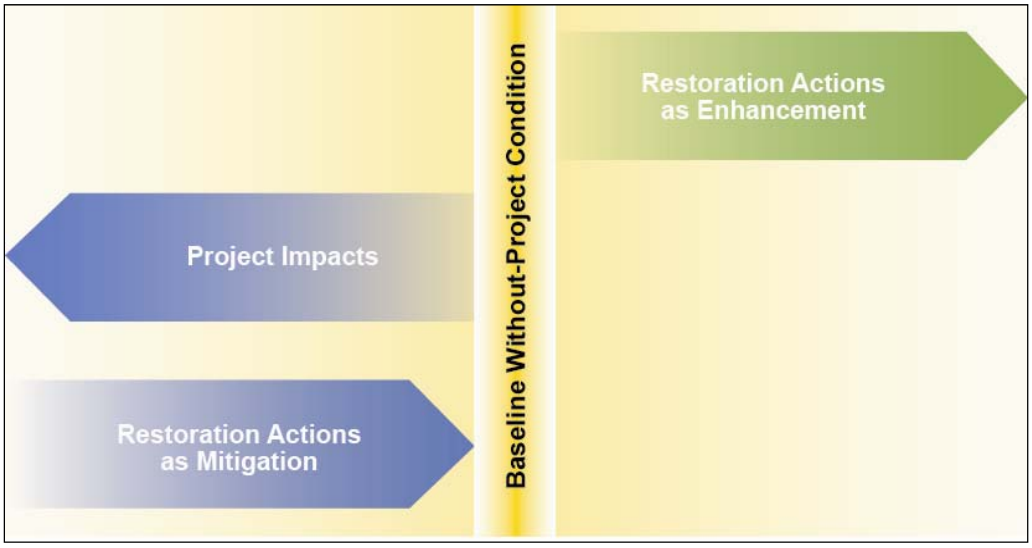


Figure 2-2. Conceptual Schematic of Restoration Actions as Enhancement Versus Restoration Actions as Mitigation

Table 2-1. Management Measures to Address Objectives

Objectives		Management Measure	Retained	Deleted
Primary Objectives				
Increase Anadromous Fish Survival	Improve Fish Habitat	Restore abandoned gravel mines along the Sacramento River		X
		Construct instream aquatic habitat downstream from Keswick Dam	X	
		Replenish spawning gravel in the Sacramento River	X	
		Construct instream fish habitat on tributaries to the Sacramento River		X
		Remove instream sediment along Middle Creek		X
		Rehabilitate inactive instream gravel mines along Stillwater and Cottonwood creeks		X
	Improve Water Flows and Quality	Make additional modifications to Shasta Dam for temperature control	X	
		Enlarge Shasta Lake cold-water pool	X	
		Modify storage and releases operations at Shasta Dam	X	
		Modify ACID diversions to reduce flow fluctuations		X
		Increase instream flows on Clear, Cow, and Bear creeks		X
		Construct a storage facility on Cottonwood Creek to augment spring instream flows		X
		Transfer existing Shasta Reservoir storage from water supply to cold-water releases		X
		Remove Shasta Dam and Reservoir		X
	Improve Fish Migration	Improve fish trap below Keswick Dam		X
		Screen diversions on Old Cow and South Cow creeks		X
		Remove or screen diversions on Battle Creek		X
		Construct a migration corridor from the Sacramento River to the Pit River		X
		Cease operating or remove the Red Bluff Diversion Dam		X
		Reoperate the CVP to improve overall fish management		X
		Construct a fish ladder on Shasta Dam		X
		Reintroduce anadromous fish to areas upstream from Shasta Dam		X
Increase Water Supply Reliability	Increase Surface Water Storage	Increase conservation storage space in Shasta Reservoir by raising Shasta Dam	X	
		Construct new conservation storage reservoir(s) upstream from Shasta Reservoir		X
		Construct new conservation storage on tributaries to the Sacramento River downstream from Shasta Dam		X
		Construct new conservation offstream surface storage near the Sacramento River downstream from Shasta Dam		X
		Construct new conservation surface water storage south of the Delta		X
		Increase total or seasonal conservation storage at other CVP facilities		X
		Dredge bottom of Shasta Reservoir		X

Table 2-1. Management Measures to Address Objectives (contd.)

Objectives		Management Measure	Retained	Deleted
Increase Water Supply Reliability (continued)	Reoperate Reservoir	Increase effective conservation storage space in Shasta Reservoir by increasing efficiency of reservoir operation for water supply reliability	X	
		Increase the conservation pool in Shasta Reservoir by encroaching on dam freeboard		X
		Increase conservation storage space in Shasta Reservoir by reallocating space from flood control		X
	Improve Conjunctive Water Management	Develop conservation offstream surface storage near the Sacramento River downstream from Shasta Dam		X
		Develop conservation groundwater storage near the Sacramento River downstream from Shasta Dam		X
		Develop additional conservation groundwater storage south of the Delta		X
	Coordinate Operation and Precipitation Enhancement	Improve Delta export and conveyance capability through coordinated CVP and SWP operations		X
		Implement additional precipitation enhancement		X
	Reduce Demand	Implement water use efficiency methods	X	
		Retire agricultural lands		X
	Improve Water Transfers and Purchases	Transfer water between users		X
	Expand Delta Export and Conveyance Facilities	Expand Banks Pumping Plant		X
		Construct Delta-Mendota Canal/California Aqueduct intertie		X
	Improve Surface Water Treatment	Implement treatment/supply of agricultural drainage water		X
		Construct desalination facility		X

Table 2-1. Management Measures to Address Objectives (contd.)

Objectives		Management Measure	Retained	Deleted
Secondary Objectives				
Conserve, Restore, and Enhance Ecosystem Resources	Improve Cold-Water and Warm-Water Fishery Habitat	Construct shoreline fish habitat around Shasta Lake	X	
		Construct instream fish habitat on tributaries to Shasta Lake	X	
		Increase instream flows on the lower McCloud River		X
		Reduce acid mine drainage entering Shasta Lake		X
		Reduce motorcraft access to upper reservoir arms		X
		Increase instream flows on the Pit River		X
	Restore and Conserve Riparian and Wetland Habitat	Restore riparian and floodplain habitat along the Sacramento River	X	
		Restore wetlands along the Fall River and Hat Creek		X
		Conserve upper Pit River riparian areas		X
		Restore riparian and floodplain habitat on lower Clear Creek		X
		Promote Great Valley cottonwood regeneration along the Sacramento River		X
		Conserve riparian corridor along Cow Creek		X
		Remove and control nonnative vegetation in the Cow Creek and Cottonwood Creek watersheds		X
	Improve Other Fish and Wildlife Habitat	Create a parkway along the Sacramento River		X
		Enhance forest management practices to conserve bald eagle nesting habitat		X
		Remove and control nonnative plants around Shasta Lake		X
		Control erosion and restore affected habitat in the Shasta Lake area		X
		Develop geographic information system for Shasta to Red Bluff reach		X
		Implement erosion control in tributary watersheds		X
Reduce Flood Damage		Update Shasta Dam and Reservoir flood management operations	X	
		Increase flood management storage space in Shasta		X
		Implement nonstructural flood damage reduction measures		X
		Implement traditional flood damage reduction measures		X
		Route PMF from top of conservation pool		X

Table 2-1. Management Measures to Address Objectives (contd.)

Objectives	Management Measure	Retained	Deleted
Develop Additional Hydropower Generation	Modify existing/construct new generation facilities at Shasta Dam to take advantage of increased hydraulic head	X	
	Construct new hydropower generation facilities		X
Maintain and Increase Recreation Opportunities	Maintain and enhance recreation capacity, facilities, and opportunities	X	
	Develop new NRA recreation plan		X
	Reoperate reservoir for recreation	X	
Maintain or Improve Water Quality	Improve operational flexibility for Delta water quality by increasing storage in Shasta Reservoir	X	

Key:
ACID = Anderson-Cottonwood Irrigation District
Banks Pumping Plant = Harvey O. Banks Pumping Plant
CVP = Central Valley Project
Delta = Sacramento-San Joaquin Delta
NRA = National Recreation Area
PMF = probable maximum flood
SWP = State Water Project

The SLWRI study team and stakeholders reviewed the management measures for their ability to address the primary and secondary objectives. Retained management measures were combined to formulate concept plans. As detailed in the Plan Formulation Appendix, measures are retained for possible inclusion in an alternative plan or deleted from further consideration for various reasons. One important factor for retention in alternative plans is the potential for a measure to directly address an objective without adversely impacting other objectives.

Of the management measures listed in Table 2-1, eight measures addressing primary objectives were selected for further consideration and potential inclusion in alternative plans. Eight measures addressing secondary objectives were also selected for potential inclusion in alternative plans. Measures that have been carried forward are believed to best address the objectives of the SLWRI, with consideration of planning constraints and criteria. It should be noted that measures that have been deleted from consideration in this phase may be reconsidered in the future as mitigation measures.

2.1.4 Initial Alternatives Phase

The retained measures were used to formulate a preliminary set of plans that were conceptual in scope. Each concept plan was reviewed for impacts, costs, and benefits and compared to objectives to determine whether the plan should be eliminated or carried forward into the comprehensive plans phase. The purpose of this phase of the formulation process was to (1) explore an array of different strategies to address the primary objectives, constraints, and criteria, and (2) identify concept plans that would warrant further development in the comprehensive plans phase.

First, two sets of plans were developed that focused on either anadromous fish survival (AFS) or water supply reliability (WSR) as the single primary objective. Three AFS plans and four WSR plans were developed. Although the AFS and WSR plans focused on single objectives, each generally contributed to both primary objectives. In the three AFS plans, for example, emphasis was placed on combinations of measures that could best address the fish survival goals while considering incidental benefits to water supply reliability, if possible. Second, five plans were developed that included measures to address both primary and, to a lesser degree, secondary objectives, termed combined objective (CO) plans. All 12 concept plans are listed in Table 2-2, and are explained in detail in the Plan Formulation Appendix.

Table 2-2. Summary of Concept Plan Features

Plan	Features													
		Primary Objective Focus							Secondary Objectives Addressed[4]					
	Dam Raise	Water Supply Reliability[2]			Anadromous Fish Survival				Environmental Restoration			Flood Control and Hydropower		Recreation
	Raise Shasta Dam[1] (feet)	Increase Conservation Storage	Perform Conjunctive Water Management[3]	Reoperate Shasta Dam	Modify TCD	Replenish Spawning Gravel	Enlarge Shasta Lake Cold-Water Pool	Increase Minimum Flows[3]	Restore Shoreline Aquatic Habitat	Restore Tributary Aquatic Habitat	Restore Riparian Habitat	Modify Flood Control Operations and Implement Shasta Public Safety[3] Features	Modify Hydropower Facilities	Maintain and Increase Recreation Opportunities
AFS-1	6.5	*		Changes to water supply operations and modification of the TCD would likely be included, to some extent, in any alternative that includes raising Shasta Dam.			X					Changes to flood control operations at Shasta Dam, Public Safety,[3] and hydropower facilities would likely be part of any alternative that includes physically modifying Shasta Dam; the degree and details of these changes will be included in feasibility level alternative plans.		Included in feasibility level alternative plans.
AFS-2	6.5	*					*	X						
AFS-3	6.5	*				X	*	X						
WSR-1	6.5	X					*							
WSR-2	18.5	X					*							
WSR-3	202.5	X					*							
WSR-4	18.5	X	X				*							
CO-1	6.5	X				X	X							
CO-2	18.5	X				X	X							
CO-3	18.5	X				X	X	X						
CO-4	6.5	X	X			X	X		X	X	X			
CO-5	18.5	X	X			X	X		X	X	X			

Notes:

[1] Raising Shasta Dam provides both water supply and temperature benefits, regardless of how the additional storage is exercised. While the AFS measures focus on use of the additional space for anadromous fish survival, they also provide water supply benefits. Similarly, the WSR measures focus on water supply reliability but the reservoir enlargements also provide benefits to anadromous fish.

[2] All concept plans will include attention to water demand reduction.

[3] These measures were used for evaluation because they were retained at the time of plan formulation. However, they have since been removed from consideration.

[4] Water quality was added as a management measure after development of concept plans, and is not considered in this table.

Key:

* Coincidental benefit, although not a primary focus of the concept plan.

AFS = anadromous fish survival

CO = combined objectives

TCD = temperature control device

WSR = water supply reliability

X = Primary focus of concept plan

The 12 concept plans were compared considering two basic planning criteria: effectiveness and efficiency. Effectiveness is the extent to which an alternative alleviates problems and achieves objectives; efficiency is the measure of how efficiently an alternative alleviates identified problems and meets specified objectives to protect the Nation's environment. These, along with completeness and acceptability, are the four general criteria identified in the *Federal Water Resources Council Principles and Guidelines for Water and Related Land Resources Implementation Studies* (WRC 1983). Based on this comparison, and the relative ability of plans to address both primary objectives, five of the concept plans were initially recommended for further development as comprehensive plans (CP): WSR-1, WSR-2, WSR-4, CO-2, and CO-5. CO-2 was subsequently eliminated from further consideration because continued evaluation concluded that restoration of existing gravel mines would have a low likelihood of successfully benefiting salmon resources. Subsequent analysis of WSR-4 and the conjunctive use component of CO-5 indicated tradeoffs between conjunctive use water supply benefits and critical gains in fisheries benefits. The resulting reduction in benefits to fisheries operations in dry and critical years was deemed unacceptable in terms of meeting primary project objectives. Thus, WSR-4 and the conjunctive use component of CO-5 were eliminated from further consideration.

The eight concept plans eliminated from further consideration are described in Section 2.2, "Alternatives Considered and Eliminated from Further Consideration." Although these concept plans were not further considered as stand-alone plans, major features of some of these plans were refined for further development into alternatives. Concept plans eliminated from further consideration, and rationale for their elimination, are discussed in detail in the Plan Formulation Appendix.

2.1.5 Development and Refinement of Comprehensive Plans

Through continued refinement of management measures and concept plans carried forward, the following plan types were identified for further development into comprehensive plans:

- Plan(s) to raise Shasta Dam between 6.5 feet and 18.5 feet, focusing on both water supply reliability and anadromous fish survival but with benefits to various secondary objectives (subsequently developed into CP1, CP2, and CP3)

- Plan(s) to raise Shasta Dam by about 18.5 feet, focusing on anadromous fish survival, but also including water supply reliability and other various secondary objectives (subsequently developed into CP4)

- Plan(s) to raise Shasta Dam by about 18.5 feet, focusing on all objectives (subsequently developed into CP5)

Considering results of initial plan formulation efforts, the approach was to first formulate plans focusing on different dam raise heights within the range of 6.5 to 18.5 feet to address the first plan type listed above. A dam raise of 12.5 feet in CP2 was chosen because it represented a midpoint between the smallest and largest likely and practical dam raises. Next, the approach was to identify the most efficient and effective of the identified dam raise heights, and formulate comprehensive plans to focus on anadromous fish survival and other objectives at this height.

Using the general rationale described above, and incorporating input from the public scoping process and continued coordination with resource agencies and other interested parties, five comprehensive plans were developed in addition to the No-Action Alternative:

- **Comprehensive Plan 1 (CP1)** — 6.5-foot dam raise, enlarging the reservoir by 256,000 acre-feet, focusing on both anadromous fish survival and water supply reliability.

- **Comprehensive Plan 2 (CP2)** — 12.5-foot dam raise, enlarging the reservoir by 443,000 acre-feet, focusing on both anadromous fish survival and water supply reliability.

- **Comprehensive Plan 3 (CP3)** — 18.5-foot dam raise, enlarging the reservoir by 634,000 acre-feet, focusing on both anadromous fish survival and water supply reliability.

- **Comprehensive Plan 4 (CP4)** — 18.5-foot dam raise, enlarging the reservoir by 634,000 acre-feet, focusing on anadromous fish survival while increasing water supply reliability.

- **Comprehensive Plan 5 (CP5)** — 18.5-foot dam raise, enlarging the reservoir by 634,000 acre-feet, a combination plan focusing on all objectives.

The five comprehensive plans were designated as the action alternatives for the purpose of this PDEIS, and are described in Section 2.4.

Because of the large number of possibilities for increasing anadromous fish survival, additional analyses were conducted to determine the combination of actions that would provide the greatest overall benefits within CP4. These analyses are described below.

Refinement of Plan for Anadromous Fish Survival Focus with Water Supply Reliability

Primarily using the SALMOD model, and based on output from the water operations (CalSim-II), reservoir temperature, and river temperature models, a suite of flow- and temperature-focused actions (scenarios) were investigated to

assess which combination of actions would likely result in the maximum increase in fish populations.

To formulate CP4, three dam height raises were considered (6.5 feet, 12.5 feet, and 18.5 feet), resulting in 256,000 acre-feet, 443,000 acre-feet, and 634,000 acre-feet of increased storage, respectively. For each of these proposed dam raises, several combinations for allocating the increased storage were analyzed. For instance, assuming a dam raise of 12.5 feet, three options were considered: (1) no increase in the minimum pool, (2) an increase in the minimum pool similar to a 6.5-foot dam raise, and (3) all of the increased space dedicated to increased fisheries. The combinations considered represent scenarios developed to focus on increasing the cold-water pool, and are listed in Table 2-3.

Table 2-3. Scenarios Considered for Cold-Water Storage – Anadromous Fish Survival Focus with Water Supply Reliability

Scenario	Dam Raise (feet)	Enlarged Reservoir	Description
A (CP1)	6.5	256,000 acre-feet	No increase in minimum pool.
B	6.5	256,000 acre-feet	Dedicate 256,000 acre-feet of water from increased storage to increase the size of the cold-water pool for fishery benefit.
C (CP2)	12.5	443,000 acre-feet	No increase in minimum pool.
D	12.5	443,000 acre-feet	Dedicate 187,000 acre-feet of the additional water from increased storage to increase the size of the cold-water pool for fishery benefit.
E	12.5	443,000 acre-feet	Dedicate 443,000 acre-feet of water from increased storage to increase the size of the cold-water pool for fishery benefit.
F (CP3/CP5)	18.5	634,000 acre-feet	No increase in minimum pool.
G	18.5	634,000 acre-feet	Dedicate 191,000 acre-feet of the additional water from increased storage to increase the size of the cold-water pool for fishery benefit.
H (CP4)	18.5	634,000 acre-feet	Dedicate 378,000 acre-feet of the additional water from increased storage to increase the size of the cold-water pool for fishery benefit.
I	18.5	634,000 acre-feet	Dedicate 634,000 acre-feet of water from increased storage to increase the size of the cold-water pool for fishery benefit.

Key:
CP = comprehensive plan

Additional scenarios focusing on increasing Sacramento River flows with an 18.5-foot raise were also analyzed. The flow combinations were based primarily on flows identified as part of the Anadromous Fish Restoration Plan (USFWS 2001). These scenarios are listed in Table 2-4.

Table 2-4. Scenarios Considered to Augment Flows – Anadromous Fish Survival Focus Plan

Flow Augmentation Scenario	Dam Raise (feet)	Enlarged Reservoir	Description
1	18.5	634,000 acre-feet	October – March AFRP flows or 500 cfs increase, whichever is less.
2	18.5	634,000 acre-feet	October – March AFRP flows or 750 cfs increase, whichever is less.
3	18.5	634,000 acre-feet	October – March AFRP flows or 1,000 cfs increase, whichever is less.
4	18.5	634,000 acre-feet	Increase August flows to 10,000 cfs and September flows to 6,000 cfs for temperature control.

Key:
AFRP = Anadromous Fish Restoration Plan (USFWS 2001)
cfs = cubic foot per second

Quantitative analysis indicated that increasing the minimum pool in Shasta Reservoir would have the greatest net fishery benefit. By increasing the minimum pool, the allowable carryover pool storage would increase in the reservoir. This carryover would act to conserve cold water that could be managed to better benefit anadromous fish. Scenarios 1, 2, 3, and 4 (flow augmentation scenarios) showed limited benefits to anadromous fish compared with other scenarios, and were eliminated from further analysis. Scenarios B, E, and I would not contribute to increased water supply reliability. Although CP4 focuses on anadromous fish survival, because these three scenarios would not contribute to a primary objective, they were deleted from further consideration. Of the remaining scenarios, Scenarios D and H were deemed to be the most cost-effective. Based on further analysis, Scenario H was chosen to represent reservoir operations in CP4 because this scenario would provide the greatest benefit to anadromous fish and still meet the primary objective of water supply reliability. Scenario comparison and selection are discussed further in the Plan Formulation Appendix.

2.2 Alternatives Considered and Eliminated from Further Analysis

Alternatives considered but eliminated from further analysis are described below. Plans are described that were developed during the initial plans phase, and the comprehensive plans phase, consistent with the alternatives development process discussed above. Management measures deleted from further consideration were summarized previously and are also described in the Plan Formulation Appendix.

2.2.1 Initial Alternatives Phase

The following concept plans were eliminated from further consideration as stand-alone plans.

- **AFS-1**– Increase Cold Water Assets with Shasta Operating Pool Raise (6.5 feet). AFS-1 focused on maintaining cooler water temperatures in the upper Sacramento River by increasing the minimum end-of-October carryover storage target. This would allow additional cold water to be stored for use in the following year. No changes would be made to the existing seasonal temperature targets for anadromous fish on the upper Sacramento River, but the ability to meet these targets would be improved. It was found that this plan had a significant potential to benefit anadromous fish in the upper Sacramento River, but there would be no additional increase in water supply reliability. Major plan components included (1) raising Shasta Dam by 6.5 feet for the primary purpose of enlarging the cold-water pool and regulating water temperature in the upper Sacramento River and (2) increasing the size of the minimum operating pool to 880,000 acre-feet. This plan was not retained for further development as a stand-alone plan because, although it had considerable benefits for anadromous fish survival, it did not meet the primary planning objective of increasing water supply reliability.

- **AFS-2** – Increase Minimum Anadromous Fish Flow with Shasta Enlargement (6.5 feet). AFS-2 focused on the primary planning objective of anadromous fish survival by using the additional reservoir storage to increase minimum seasonal flows in the upper Sacramento River from the current 3,250 cubic feet per second (cfs) to about 4,200 cfs. The primary component of AFS-2 included raising Shasta Dam by 6.5 feet for the primary purpose of enlarging the volume of water available to meet minimum flows for winter-run Chinook salmon on the upper Sacramento River. No changes would be made to the carryover target volume or minimum operating pool. Subsequent evaluation indicated that although at various stages of development the concept of increasing minimum flows would be beneficial for fish, at other life stages increasing minimum flows would be detrimental. Accordingly, this plan was deleted from further development.

- **AFS-3** – Increase Minimum Anadromous Fish Flow with Shasta Enlargement (6.5 feet) and Restore Aquatic Habitat. AFS-3 was similar to AFS-2, except that it also includes acquiring, restoring, and reclaiming one or more inactive gravel mine along the upper Sacramento River to restore about 150 acres of aquatic and floodplain habitat. Major plan components included (1) raising Shasta Dam by 6.5 feet for the primary purpose of enlarging the volume of water available to meet minimum flows for winter-run Chinook salmon on the upper Sacramento River and (2) acquiring, restoring, and reclaiming one or more inactive gravel mining operations along the upper Sacramento River to restore about 150 acres of aquatic and floodplain habitat. Increasing minimum flows was not found to significantly benefit to anadromous fish, and concerns were expressed

regarding significant uncertainties about offstream areas being able to successfully support viable fish spawning and rearing. Further, during public scoping activities in late 2005, little to no interest was demonstrated for restoring inactive gravel mines along the Sacramento River above the RBDD. Accordingly, this plan element was deleted from further consideration at this time.

- **WSR-3** – Increase Water Supply Reliability with Shasta Enlargement (High Level). WSR-3 focused on water supply reliability by increasing the volume of water stored in Shasta Lake by the maximum amount technically feasible. Major components of this plan included (1) raising Shasta Dam by about 202.5 feet for the primary purpose of creating 9.3 million acre feet (MAF) of additional storage available for water supply and (2) major modifications to, or replacing, dam appurtenances, including hydropower facilities and the temperature control device (TCD). Raising the dam to this level would require extensive and very costly reservoir area relocations such as moving the Pit River Bridge, Interstate-5 (I-5), and the Union Pacific Railroad, and would require modifying Keswick Dam and its powerplant. This plan would provide a major increase in water supply reliability, anadromous fish, hydropower, flood damage reduction, and recreation resources. However, the plan is not financially feasible at this time because the construction cost is estimated at over $6 billion (at October 2008 price levels). Accordingly, this plan was deleted from further development.

- **WSR-4** – Increase Water Supply Reliability with Shasta Enlargement (18.5 feet) and Conjunctive Water Management. WSR-4 focused on the primary objective of water supply reliability by raising Shasta Dam 18.5 feet in combination with conjunctive water management. Major components of this plan included (1) raising Shasta Dam by 18.5 feet for the primary purpose of creating 636,000 acre-feet of additional storage available for water supply and (2) implementing a conjunctive water management program, consisting largely of contracts between Reclamation and certain Sacramento River basin water users. The conjunctive water management component included downstream facilities, such as additional river diversions and transmission and groundwater pumping facilities, to facilitate exchanges. Reclamation would provide additional surface supplies in wet and normal water years to participating CVP users, in exchange for reducing deliveries in dry and critically dry years, when users would rely more on groundwater supplies. Preliminary estimates of the conjunctive water management component associated this alternative indicated that water supply yield could be increased between 10 to 20 percent. However, few to no fishery benefits would result and no strong indication of non-Federal participation in a conjunctive water management component was identified. Accordingly, this plan element was deleted from further consideration.

- **CO-1 and CO-2** – Increase Anadromous Fish Habitat and Water Supply Reliability with Shasta Enlargement (6.5 feet and 18.5 feet). CO-1 and CO-2 addressed both primary objectives by restoring anadromous fish habitat and raising Shasta Dam. Both CO-1 and CO-2 would dedicate some of the added reservoir space from the dam raise to increasing the minimum carryover storage in Shasta Reservoir to make more cold-water releases for regulating water temperature in the upper Sacramento River. Major components of this plan included (1) raising Shasta Dam by 6.5 feet and 18.5 feet, respectively, for the purposes of expanding the cold-water pool and creating 260,000 acre-feet and 630,000 acre-feet, for CO-1 and CO-2, respectively, of additional storage available for water supply, (2) acquiring, restoring, and reclaiming one or more inactive gravel mining operations along the upper Sacramento River to create about 150 acres of aquatic and floodplain habitat, and (3) revising flood control operations to benefit water supply reliability by managing floods more efficiently. For reasons similar to those described for AFS-3, both CO-1 and CO-2 were eliminated as stand-alone plans and the gravel mine restoration components of both plans were deleted from further consideration.

- **CO-3** – Increase Anadromous Fish Flow/Habitat and Water Supply Reliability with Shasta Enlargement (18.5 feet). CO-3 is similar to CO-2, except a portion of the additional storage would be dedicated to managing flows for winter-run Chinook salmon on the upper Sacramento River. Under this preliminary plan, approximately 320,000 acre-feet would be dedicated to increasing minimum flows from approximately 3,250 cfs to about 4,200 cfs between October 1 and April 30. However, subsequent evaluation indicated that although at various stages of development the concept of increasing minimum flows would be beneficial for fish, at other life stages increasing minimum flows would be detrimental. Accordingly, this plan was deleted from further development.

- **CO-4** – Multipurpose with Shasta Enlargement (6.5 feet). This plan addressed both primary and secondary objectives through a combination of measures, including raising Shasta Dam, restoring habitat, and adding recreation facilities in the Shasta Lake area. Enlargement of the reservoir and limited reservoir reoperation would also help improve operations for flood management and recreation. Major components of this plan included increasing water supply reliability with a 6.5-foot dam raise, increasing anadromous fish survival by increasing cold-water pool depth and volume in Shasta Reservoir, and restoring inactive gravel mines and floodplain habitat along the Sacramento River. In addition, the plan included further investigation of and potential modifications to the existing TCD at Shasta Dam for enhanced temperature management, and increasing the operational efficiencies of Shasta Dam and Reservoir for water supply

reliability and flood control. Finally, the plan included implementing conjunctive water management, as in WSR-4, shoreline and tributary fish habitat improvements in the Shasta Lake area, and restoring one or more riparian habitat areas between Redding and Red Bluff on the Sacramento River. CO-4 was eliminated from further consideration primarily because of low effectiveness and efficiency and redundancies with WSR-1 and CO-5, both of which were recommended for further development.

2.2.2 Comprehensive Plans Phase

The scenarios presented in Tables 2-5 and 2-6 were eliminated from further consideration during the comprehensive plans phase. These scenarios are described further in the Plan Formulation Appendix.

Table 2-5. Eliminated Scenarios Considered to Augment Flows – Anadromous Fish Survival Focus Plan

Scenario	Description	Reason for Elimination
1	Dam raise of 18.5 feet. Additional 634,000 acre-feet of storage. October – March AFRP flows or 500 cfs increase, whichever is less.	Analysis indicated limited benefits to fish compared with overall cost of the project.
2	Dam raise of 18.5-feet. Additional 634,000 acre-feet of storage. October – March AFRP flows or 750 cfs increase, whichever is less.	Analysis indicated limited benefits to fish compared with overall cost of the project.
3	Dam raise of 18.5-feet. Additional 634,000 acre-feet of storage. October – March AFRP flows or 1,000 cfs increase, whichever is less.	Analysis indicated limited benefits to fish compared with overall cost of the project.
4	Dam raise of 18.5-feet. Additional 634,000 acre-feet of storage. Increase August flows to 10,000 cfs and September flows to 6,000 cfs for temperature control.	Analysis indicated limited benefits to fish compared with overall cost of the project.

Source: USFWS 2001
Key:
AFRP = Anadromous Fish Restoration Plan
cfs = cubic feet per second

Table 2-6. Eliminated Scenarios Considered for Cold-Water Storage – Anadromous Fish Survival Focus Plan

Scenario	Description	Reason for Elimination
B	Dam raise of 6.5 feet. Additional 256,000 acre-feet of storage. Dedicating 256,000 acre-feet of water from increased storage to increase the size of the cold-water pool for fishery benefit.	Although this scenario had considerable benefits for anadromous fish survival, it did not considerably contribute to other objectives.
D	Dam raise of 12.5 feet. Additional 443,000 acre-feet of storage. Dedicating 187,000 acre-feet of the additional water from increased storage to increase the size of the cold-water pool for fishery benefit.	Although this scenario had considerable benefits for anadromous fish survival, it was not as cost-effective as an 18.5-foot raise.
E	Dam raise of 12.5 feet. Additional 443,000 acre-feet of storage. Dedicating 443,000 acre-feet of water from increased storage to increase the size of the cold-water pool for fishery benefit.	Although this scenario had considerable benefits for anadromous fish survival, it did not considerably contribute to other objectives.
G	Dam raise of 18.5 feet. Additional 634,000 acre-feet of storage. Dedicating 191,000 acre-feet of the additional water from increased storage to increase the size of the cold-water pool for fishery benefit.	Although this scenario had considerable benefits for anadromous fish survival, it was redundant with Scenario H and provided less benefit.
I	Dam raise of 18.5 feet. Additional 634,000 acre-feet of storage. Dedicating 634,000 acre-feet of water from increased storage to increase the size of the cold-water pool for fishery benefit.	Although this scenario had considerable benefits for anadromous fish survival, it did not considerably contribute to other objectives.

2.3 No-Action Alternative

NEPA and CEQA require the analysis of a baseline alternative, representing a scenario in which the project is not implemented. For all Federal feasibility studies of potential water resources projects, the NEPA No-Action Alternative is intended to account for existing facilities, conditions, land uses, and reasonably foreseeable actions expected to occur in the study area. Reasonably foreseeable actions include actions with current authorization, secured funding for design and construction, and environmental permitting and compliance activities that are substantially complete.

Under CEQA, the No-Project Alternative is similar to NEPA's No-Action Alternative, but it involves the review of two scenarios: the existing condition baseline, which represents only current conditions at the time the Notice of Preparation is published, and "reasonably foreseeable" future conditions without the project (which is equivalent to the NEPA No-Action Alternative). Table 2-1 of the Modeling Appendix describes the existing condition, and shows which actions were assumed to be part of the future condition (or No-Action /No-Project Alternative).

For the PDEIS, the No-Action Alternative is considered to be the basis for comparison with potential action alternatives, consistent with the *Federal Water Resources Council Principles and Guidelines for Water and Related Land*

Resources Implementation Studies (WRC 1983) and NEPA guidelines. Thus, if no proposed action is determined to be feasible, the No-Action Alternative is the default option.

Plan formulation efforts and analysis of the No-Action Alternative and action alternatives discussed in this chapter are based on CVP and SWP operational conditions described in the 2004 Operations Criteria and Plan Biological Assessment (Reclamation 2004). Modeling studies will be updated to reflect changes in water operations resulting from ongoing Operations Criteria and Plan reconsultation and other relevant water resources projects and programs, including, potentially, Bay-Delta Conservation Plan/Delta Habitat Conservation and Conveyance Plan efforts. The results of these updated studies will be incorporated into the Draft EIS and other future SLWRI documents.

Under the No-Action Alternative, the Federal Government would continue to implement reasonably foreseeable actions, as defined above, but would not take additional actions toward implementing a plan to raise Shasta Dam to help increase anadromous fish survival in the upper Sacramento River, nor help address the growing water supply and reliability issues in California. The following discussions highlight the consequences of implementing the No-Action Alternative, as they relate to the objectives of the SLWRI.

2.3.1 Anadromous Fish Survival

Much has been done to address anadromous fish survival problems in the upper Sacramento River. Solutions have ranged from changes in the timing and magnitude of releases from Shasta Dam to constructing and operating the TCD at the dam. Actions also include site-specific projects, such as introducing spawning gravel to the Sacramento River, and work to improve or restore spawning habitat in tributary streams. However, some actions have had an adverse effect on Sacramento River habitat, including implementing requirements of the Trinity River ROD, as amended (Reclamation 2000), which reduced flows from the Trinity River basin into Keswick Reservoir and then into the Sacramento River. Water diverted from the Trinity River is generally cooler than flows released from Shasta Dam. Accordingly, since implementation of the Trinity ROD, some of the benefits derived from flow changes and the Shasta TCD have been offset by the reduction in cooler water from the Trinity River. Increased demand for water for agricultural, M&I, and environmental uses is also expected to reduce the reliability of cold water for anadromous fish. Prolonged drought that depletes the cold-water pool in Shasta Reservoir could put populations of anadromous fish at risk of severe population decline or extirpation in the long-term (NMFS 2009). The risk associated with a prolonged drought is especially high in the Sacramento River because Shasta Reservoir is operated to maintain only 1 year of carryover storage. Under the No-Action Alternative, after 2 years of drought, Shasta Reservoir storage would be insufficient to provide cold water throughout the winter-run Chinook salmon spawning season. A drought lasting several years would likely result in the extirpation of winter-run Chinook salmon (NMFS 2009).

Under the No-Action Alternative, it is assumed that actions to protect fisheries and benefit aquatic environments would continue, including maintaining the TCD and satisfying existing regulatory requirements.

2.3.2 Water Supply Reliability

Demands for water in the Central Valley and throughout California exceed available supplies, and the need for additional supplies is expected to grow. There is growing competition for limited system resources between various users and uses, including agricultural, M&I, and environmental. M&I water demands and environmental water requirements have each increased, resulting in greater competition for limited water supplies. As mentioned, the population of California is expected to increase by more than 60 percent above 2005 levels by 2050. Significant increases in population also are expected to occur in the Central Valley, nearly 130 percent above 2005 levels by 2050. As these population increases occur, and are coupled with the need to maintain a healthy and vibrant industrial and agricultural economy, the demand for water would continue to significantly exceed available supplies. Competition for available water supplies would intensify as water demands increase to support this population growth.

Water conservation and reuse efforts are expected to significantly increase, and forced conservation resulting from increasing water shortages would continue. Without developing cost-effective new sources, however, the growing urban population would increasingly rely on shifting water supplies from such areas as agricultural production to satisfy M&I demands. It is likely that with continued and deepening shortages in available water supplies, adverse economic impacts would increase over time in the Central Valley and elsewhere in California. One example could include higher water costs, resulting in a further shift in agricultural production to areas outside California and/or outside the United States. Under the No-Action Alternative, Shasta Dam would not be modified and the CVP would continue operating similarly to existing conditions.

The No-Action Alternative would continue to meet water supply demands at levels similar to existing conditions, but would not be able to meet the expected increased demand in California.

2.3.3 Ecosystem Resources, Flood Management, Hydropower Generation, Recreation, and Water Quality

As opportunities arise, some locally sponsored efforts would likely continue to improve environmental conditions on tributaries to Shasta Lake and along the upper Sacramento River. However, overall, future environmental-related conditions in these areas would likely be similar to existing conditions. The quantity, quality, diversity, and connectivity of riparian, wetland, and riverine habitats along the Sacramento River have been limited by confinement of the river system by levees, reclamation of adjacent lands for farming, bank protection, channel stabilization, and land development.

Shasta Dam and Reservoir have greatly reduced flood damage along the Sacramento River. Shasta Dam and Reservoir were constructed at a total cost of about $36 million. During flood events in 1983, 1986, and 1997, Shasta Dam, in combination with the Sacramento River Flood Control Project, prevented an estimated $14 billion in property losses due to flooding. Accordingly, from a flood damage perspective only, Shasta Dam has far more than paid for itself. However, residual risks to human life, health, and safety along the Sacramento River remain. Development in flood-prone areas has exposed the public to the risk of flooding. Storms producing peak flows, and volumes greater than the existing flood management system was designed for, can occur, and result in extensive flooding along the upper Sacramento River. Under the No-Action Alternative, the threat of flooding would continue, and may increase as population growth continues.

California's demand for electricity is expected to significantly increase in the future. Under the No-Action Alternative, no actions would be taken to help meet this growing demand.

As California's population continues to grow, demands would grow significantly for water-oriented recreation at and near the lakes, reservoirs, streams, and rivers of the Central Valley. This increase in demand would be especially pronounced at Shasta Lake.

To address the impact of water quality deterioration on the Sacramento River basin and Delta ecosystems and endangered and threatened fish populations, several environmental flow goals and objectives in the Central Valley (including the Delta) have been established through legal mandates aimed at maintaining and recovering endangered and threatened fish and wildlife, and protecting designated critical habitat. Despite these efforts, under the No-Action Alternative, these resources would continue to decline and ecosystems would continue to be impacted. In addition, Delta water quality may continue to decline.

2.4 Action Alternatives

The five comprehensive plans designated as the action alternatives for the purpose of this PDEIS are discussed below. Management measures, construction activities, and environmental commitments common to these alternatives are described first.

2.4.1 Management Measures Common to All Action Alternatives

Eight of the management measures retained during the alternatives development process are included, to some degree, in all of the action alternatives. These measures were included because they (1) would either be incorporated or required with any dam raise, (2) were logical and convenient additions that would significantly improve any alternative, or (3) should be considered with

any new water increment developed in California. The eight measures include enlarging the Shasta Lake cold-water pool, modifying the TCD, increasing conservation storage, reducing demand, modifying flood operations, modifying hydropower facilities, maintaining or increasing recreation opportunities, and maintaining or improving water quality.

Enlarge Shasta Lake Cold-Water Pool

Cold water released from Shasta Dam significantly influences water temperature conditions in the Sacramento River between Keswick Dam and the RBDD. At a minimum, all comprehensive plans include enlarging the cold-water pool by raising Shasta Dam to enlarge Shasta Reservoir. Some alternatives also increase the seasonal carryover storage in Shasta Lake.

Modify Temperature Control Device

For all action alternatives, the TCD would be modified to account for an increased dam height and to reduce leakage of warm water into the structure. Minimum modifications to the TCD include raising the existing structure and modifying the shutter control. This measure would increase the ability of operators at Shasta Dam to meet downstream temperature requirements, and provide more operational flexibility to achieve desirable water temperatures during critical periods for anadromous fish.

Increase Conservation Storage

All action alternatives include increasing the amount of space available for water conservation storage in Shasta Reservoir by raising Shasta Dam. Conservation storage is the portion of the reservoir capacity available to store water for subsequent release to increase water supply reliability for agricultural, M&I, and environmental purposes. All action alternatives include a range of dam enlargements and increases in conservation space.

Reduce Demand

All action alternatives include a water conservation program for new water supplies that are created by the project. This program would augment current water use efficiency practices. The proposed program would consist of a 10-year initial program to which Reclamation would allocate approximately $2.3 million to $3.8 million to fund water conservation efforts. Funding would be proportional to additional water supplies delivered and would focus on assisting project beneficiaries (agencies receiving increased water supplies because of the project), with developing new or expanded urban water conservation, agricultural water conservation, and water recycling programs. Program actions would be a combination of technical assistance, grants, and loans to support a variety of water conservation projects such as recycled wastewater projects, irrigation system retrofits, and urban utilities retrofit and replacement programs. The program could be established as an extension of existing Reclamation programs, or as a new program through teaming with SLWRI cost-sharing partners. Combinations and types of water use efficiency actions funded would be tailored to meet the needs of identified cost-sharing partners, including

consideration of cost-effectiveness at a regional scale for agencies receiving funding.

Modify Flood Operations

Physical enlargement of Shasta Reservoir would require alterations to existing flood operation guidelines or rule curves, to reflect physical modifications, such as an increase in dam/spillway elevation. The rule curves would be revised with the goal of reducing flood damage and enhancing other objectives to the extent possible. Potential modification of flood operations would be considered for all action alternatives.

Modify Hydropower Facilities

Under each action alternative, physical enlargement of Shasta Dam would likely require various minimum modifications, commensurate with the magnitude of the enlargement, to the existing hydropower facilities at the dam to enable their continued efficient use. These modifications, in conjunction with increased lake surface elevations, may provide incidental benefits to hydropower generation. Although modifications could also be included to further increase the power production capabilities of the reservoir (e.g., additional penstocks and generators), they are believed to be a detail beyond the scope of this investigation and are not considered further at this level of planning.

Maintain and Increase Recreation Opportunities

In addition to the measures described above, all action alternatives address, to some extent, the secondary objective of maintaining or increasing recreation opportunities at Shasta Lake. Outdoor recreation, and especially recreation at Shasta Lake, represents a major source of enjoyment to millions of people annually and is a major source of income to the northern Sacramento Valley. Shasta Dam and Reservoir are within the Shasta Unit of the Whiskeytown-Shasta-Trinity National Recreation Area (NRA). Recreation within these lands is managed by USFS. As part of this administration, USFS either directly operates and maintains, or manages through leases, numerous public campgrounds, marinas, boat launching facilities, and related water-oriented recreation facilities. Enlarging Shasta Dam and Reservoir would affect some of these facilities. Consistent with the position of USFS, and planning conditions described in this chapter, all of the action alternatives include features to, at a minimum, maintain the overall recreation capacity of the existing facilities. All action alternatives also provide for modernization of recreation facilities.

Maintain or Improve Water Quality

All action alternatives could contribute to improved Delta water quality conditions and Delta emergency response. Additional storage in Shasta Reservoir would provide improved operational flexibility. Shasta Dam has the ability to provide increased releases and high-flow releases to reestablish Delta water quality. Improved Delta water quality conditions could provide benefits for both water supply reliability and ecosystem restoration by potentially

increasing Delta outflow during drought years and reducing salinity during critical periods.

2.4.2 Construction Activities Common to All Action Alternatives

Common construction activities would include land-based construction activities associated with the following:

- Clearing vegetations from portions of the inundated reservoir area.
- Constructing the dam, appurtenant structures, reservoir area dikes, and railroad embankments.
- Relocating roadways, bridges, recreation facilities, utilities, and miscellaneous minor infrastructure.

Construction activities common to all action alternatives are described below.

Clearing Portions of Inundated Reservoir Area

A portion of the acreage inundated at the new full pool would need to be cleared. This would include removing trees and other vegetation from around the reservoir. Willows, cottonwoods, and buttonbush would not be removed in and along riparian areas. Manzanita removed in cleared areas would be stockpiled and used for fish habitat structures placed in designated locations. Structures, utilities, and other infrastructure would also need to be removed and/or relocated, as described below in more detail.

Fifteen vegetation management areas have been delineated to facilitate efficient removal of vegetation around the reservoir perimeter, including 11 areas of complete vegetation removal and 4 areas of overstory removal (see Figure 2-3). The acreages of each vegetation management area affected by identified reservoir clearing treatments are included below in the detailed description of each action alternative.

Vegetation management activities would need to be complete before inundation of new areas created by a dam raise. A single staging area (landing) would serve each vegetation management area. Access for vegetation removal activities would most likely be limited to late summer and fall, when water levels were low and recreation use had decreased. Removal by helicopter is generally limited to spring and fall because of the limited availability of helicopters during the summer fire season. Vegetation removal would also be limited during bird nesting season, typically spring through summer. Reservoir area breeding surveys would be performed to determine the appropriate time frame for vegetation removal activities. Because of distance and/or safety constraints, helicopters would not be used in the following vegetation management areas: Bridge Bay, Lakeshore East, Pit Arm, and McCloud Arm. Slash burning could take place during the winter following vegetation treatment and would comply with all regulations set forth by the Shasta County Air Quality Management District. Methods for clearing the reservoir area are summarized below.

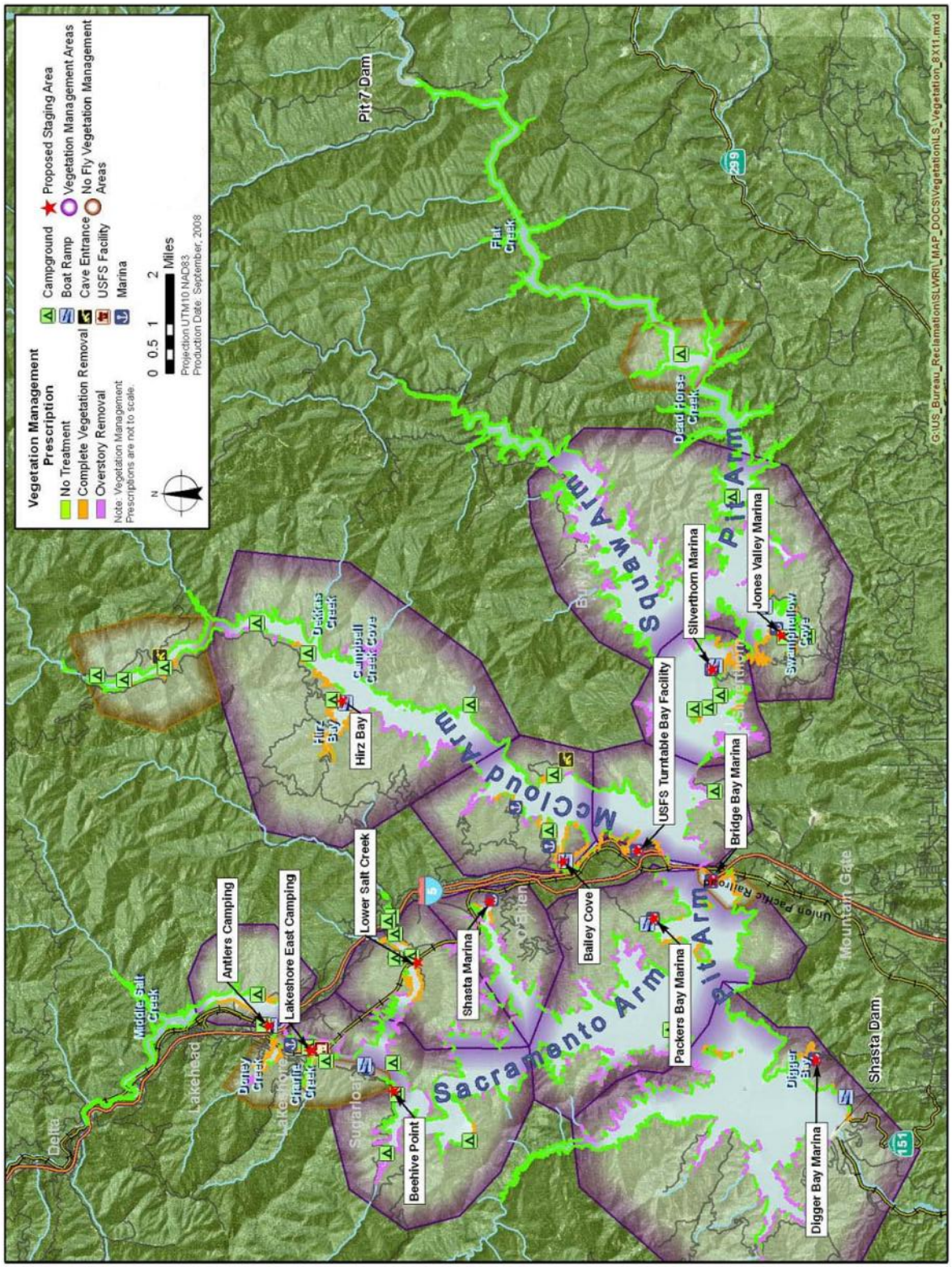


Figure 2-3. Vegetation Management Areas

Complete Vegetation Removal Complete vegetation removal would clear all existing vegetation from the designated treatment area and would generally be applied to locations along and adjacent to developed recreation areas, including boat ramps, day use areas, campgrounds, marinas, and resorts. Exceptions would be made in areas with high shoreline erosion potential, or in habitat for special-status species.

Timber would be harvested and removed to landings by ground-skidding equipment if road access were present and slopes were less than 35 percent; otherwise, trees would be yarded by helicopter and residual vegetation and activity-created slash would be piled and burned by hand. Where possible, trees would be felled into the reservoir during removal to minimize damage to reservoir walls. Tree stumps would be cut to within 24 inches of the ground surface and brush stumps would be cut flush to the ground. Stumps would be left in place to reduce shoreline erosion. Complete vegetation removal is intended to maximize shoreline access and minimize the risk to visitors from snags and water hazards.

Overstory Removal Overstory removal involves removing all trees from the treatment area that are greater than 10 inches in diameter at breast height, or 15 feet in height, generally in houseboat mooring areas or narrow arms of the reservoir where snags pose the greatest risk to boaters. Trees would be harvested and removed to landings by ground-skidding equipment if road access were present and slopes were less than 35 percent; otherwise, trees would be yarded by helicopter and activity-created slash would be piled and burned by hand. The remaining understory vegetation would be left in place. As for complete vegetation removal, where possible, trees would be felled into the reservoir during removal to minimize damage to reservoir walls. Tree stumps would be cut to within 24 inches of the ground surface. Stumps would be left in place to reduce shoreline erosion. Overstory removal is intended to minimize the risk to visitors from snags and water hazards.

No Treatment Designated areas of the inundation zone would be left untreated with no vegetation removed. This prescription would generally be applied to stream inlets, the upper end of major drainages, the shoreline of wider arms of the reservoir, and special habitat areas. This treatment is intended to maximize the habitat benefits of inundated and residual vegetation.

Construction of Dam and Appurtenant Structures

This section summarizes major features associated with enlarging Shasta Dam and Reservoir and modifying its appurtenances for all action alternatives. Total surface area that would be required for work limits and permanent features, and an estimate of materials needed to modify Shasta Dam and its appurtenances, are included in the detailed description of each action alternative. For more detailed explanations of design considerations, please refer to the Engineering Summary Appendix.

Dam Crest Structure Removal Before any enlargement of Shasta Dam, existing structures on the dam crest would need to be removed. These structures include the gantry crane, existing spillway drum gates and frames, the spillway bridge, concrete in the spillway crest and abutments, upstream parapet walls, sidewalks, curbing, crane rails, and control equipment.

Modification of the main dam would require the demolition, removal, and transportation to waste of top-of-dam materials. This would include the demolition and removal of the upstream reinforced-concrete parapet wall and curb. Sawcuts would be used to aid in removing the upstream reinforced-concrete parapet wall and curb. In addition, sawcuts would be required along the upstream face and crest of the dam before the excavation of a 2-foot by 2-foot end area at the upstream face of the dam to embed a 12-inch polyvinyl chloride waterstop. The existing dam crest would be prepared by using a high-pressure water jet on the concrete surface. Existing roadway drains would be backfilled with cement grout.

Four-inch-diameter drain holes on 10-foot centers would be drilled from two different locations: from the existing dam crest to drain the surface contact, with each hole 2.5 feet long (248 holes), and from the existing dam crest for surface drainage at the downstream overhang, with one hole per block and each hole 6.5 feet long (50 holes). A 3-foot-diameter vertical shaft would be excavated through the concrete from the existing dam crest to the hoist gallery to install electrical conduit.

The existing spillway drum gates and piers would require removal according to a phased construction plan that would minimize impacts to reservoir operations during construction. Two drum gates and one pier would be removed to construct three new piers and install three new sloping fixed-wheel gates. This would be followed by removal of the remaining drum gate and pier to construct two new piers and install three new sloping fixed-wheel gates. This work would require two construction seasons to complete.

Removing the existing spillway bridge should be phased and/or scheduled to allow vehicular access across the dam for the longest time possible. The cantilever parapet wall sections at the dam crest would be removed by wire saw.

Control equipment for the TCD would be removed, stored, and reinstalled when the TCD structure is modified. The elevator on the dam would be removed, stored, and reinstalled for any of the dam raises. Storage would most likely be on site, within the parking lot of the left wing dam.

Main Gravity Dam Shasta Dam would be raised by placing mass concrete corresponding in width to the existing dam monolith blocks on the existing dam crest (concrete gravity section and spillway crest section). Structural concrete would be placed for the top of the dam, including for the roadway, the upstream and downstream parapets, and the walkway 1092.5 feet above mean sea level

(elevation 1,092.5). Reinforcing bars would be used around the utility gallery, and nominal temperature steel would be used for the exposed structural concrete surfaces. Two 6-inch-diameter steel top-of-dam drains would be furnished and installed in each block to drain to the upstream face. Surface area and features of the new dam crest would be similar to the existing dam crest, including gantry crane rails and surface drains. A new upstream parapet wall would provide flood protection. The dam raise would include a new utility gallery and 5-inch-diameter formed drains on 10-foot centers.

Wing Dams Zoned embankment wing dams were originally constructed on both abutments of the main dam to protect the contact between the concrete and the excavated foundation surface. The left wing dam would be raised 20.5 feet to elevation 1,098.0 to maintain the same height above the top of joint-use storage, as for existing conditions. This would involve extending the existing reinforced-concrete core wall to the raised dam crest, and placing a thick layer of large rockfill downstream from the core wall. The upstream face would consist of a reinforced concrete or mechanically stabilized earth wall, and a concrete parapet wall to elevation 1,101.5. The road from the concrete dam crest would be ramped up through the left wing dam to the new embankment crest. Roadways and security features on the existing dam crest would be relocated to the new dam crest. The existing rotunda on the left abutment of the dam would be removed and reconstructed.

A building housing a visitor center and Reclamation offices, a parking lot, picnic areas, and vista points have been incorporated into the abutment design. The existing roadways, lawns, sidewalks, trees, and other features on the left wing dam crest would be restored to preraise configurations. Existing facilities would be removed from the site before construction, and replaced after the raise is completed.

The right wing dam would be raised to meet the dam crest. Concrete was selected for the right wing dam in lieu of embankment to facilitate construction. The new right wing dam crest would provide surface area and features similar to the existing dam crest, including gantry crane rails and surface drains. A new upstream parapet wall would provide flood protection. The right wing dam would include a new utility gallery and a foundation drainage curtain. Right abutment access roads would be modified to match the new dam crest.

Spillway Structural concrete would be used to raise the existing spillway crest and to shape the raised spillway crest. The existing spillway bridge, two existing spillway piers, cantilever wall sections, and three existing drum gates and operating equipment would be removed. Five new spillway piers would be constructed at locations within the spillway, designed to avoid existing overflow block contraction joints, and a new concrete spillway crest would be constructed between them. The locations of the new piers would result in different widths of spillway gates. The three existing 110-foot by 28-foot drum gates would be replaced with six sloping, fixed-wheel gates (four 48-foot by 38-foot and two

54-foot by 38-foot gates). The total spillway crest length would decrease from 330 feet to 300 feet, as a result. A new bridge would be required over the spillway to allow for vehicular traffic and for a gantry crane to travel from one end of the dam to the other.

Temperature Control Device Modifications to the TCD would be needed for dam full pool elevation raises. Modifications would primarily include extending the main steel structure to the new full pool elevation; raising the TCD operating equipment, including gate hoists, electrical equipment, miscellaneous metalwork, and hoist platform above the new top of joint-use elevation; and lengthening/replacing shutter operating cables.

Shasta Powerplant Penstock Intake and Penstock Modifications The centerline of the existing penstock intakes would remain at the current level, but the gate hoists would require relocation with a higher dam crest. Additional penstock foundations providing seismic restraint would be constructed on the exposed portion of the penstocks downstream from the dam, regardless of the size of the dam raise, to address identified existing seismic deficiencies.

Pit 7 Dam Powerhouse The only expected modifications to the Pit 7 Powerhouse associated with the proposed action include installation of a tailwater depression system. During high flows, a tailwater depression system would introduce compressed air into the turbine runner pit to depress the tailwater to a level that does not interfere with turbine operation, thereby allowing continued turbine operation.

The tailwater depression system would include air compressors, air discharge piping with control valves, water-level sensors, power supply, and electrical controls. Air compressors would be of the high-volume, low-pressure type, referred to as "blowers." Blowers would be driven by electric motors supplied with available power from the Pit 7 Powerhouse.

Reservoir Area Dikes and Railroad Embankments

The proposed dikes would be constructed using common earthmoving equipment and methods. Additional excavation to provide working surfaces and keys for the embankment fill would be required along the slope of the upstream foundation for some of the proposed dikes. Ground treatment and/or over-excavation may be necessary in some areas to remove and/or treat pervious material. It is expected that approximately 1 foot of organic-rich soil and vegetation would be excavated from the foundation of the proposed dikes, and a shear key on the upstream sides of the dikes. Riprap would be placed on the upstream face of each dike to the crest of the dike to protect against wave run-up and erosion. The volume of riprap required for each dike is summarized below in the detailed description of each action alternative. Reservoir dikes are further described in the Engineering Summary Appendix.

Relocations

As a result of the proposed Shasta Dam raise, the following major features would be inundated by the increase in full pool elevation. Existing infrastructure affected by enlarging Shasta Dam and Reservoir would need to be removed and/or relocated.

Roadways Criteria were established for four typical road replacement scenarios. Road design criteria and construction characteristics are discussed in detail in the Engineering Summary Appendix.

Roadway construction activities would involve, but not be limited to, demolition of existing roadways as required; clearing, grubbing, and site preparation of work areas, as required; grading road alignments to meet finished grades; placing road subgrade; installing storm drain culverts; constructing retaining wall systems; installing road appurtenances such as guardrails; performing construction-related traffic control; and establishing and maintaining a Stormwater Pollution Prevention Plan (SWPPP). Noisy equipment, such as pile drivers, are anticipated for road construction work. Typical noise would result from trucks and diesel-powered equipment.

Replacement roadways would be constructed by excavating the existing up-grade slope to provide fill material for the embankment fill portion of road construction; bench-excavating into the up-grade slope above the existing roadway to establish the new road finished grade; building the new road on an engineered fill embankment from imported borrow material; or building the new road directly above the existing road on an engineered fill embankment from imported borrow material. A road alignment may use either a single method of construction for the entire alignment, or it may use all four methods at different locations along an alignment. To limit impacts to existing roadways, road closures would be avoided whenever possible.

Estimated work limits for road segment relocation are described in the Engineering Summary Appendix. Estimated work limits depend on the surrounding terrain, and vary from a minimum of 5 feet to 30 feet wide, measured from the extent of earthwork. Where the road would be constructed as an embankment fill against an existing steep hillside, a 5-foot-wide minimum work area would be used. Where the terrain beyond the limit of earthwork was flat enough to be used as work areas for construction equipment, the work limits would range from 15 feet to 30 feet wide. Features associated with proposed roadway relocations for all action alternatives are summarized below in the detailed description of each action alternative.

Vehicle Bridges As a result of raising Shasta Dam for any of the action alternatives, the following local road vehicle bridges would be replaced:

- Charlie Creek Bridge
- Doney Creek Bridge

- McCloud River Bridge
- Didallas Creek Bridge

Criteria and assumptions considered in determining structure type and length for the replacement structures are included in the Engineering Summary Appendix. Based on the design criteria and assumptions, and considering preliminary horizontal alignments and profile grades developed for the relocated roadways, Table 2-7 summarizes proposed bridge characteristics for the four road bridges requiring replacement under all action alternatives.

Table 2-7. Features of Proposed Bridge Relocations Common to All Action Alternatives

Bridge Feature	Charlie Creek Bridge	Doney Creek Bridge	McCloud River Bridge	Didallas Creek Bridge
Bridge Length (lf)	782	760	490	115
Number of Abutments	2	2	2	2
Number of Piers	4	4	4	0
Pier Diameter (lf)	14	14	6	N/A
Volume of Backfill (cy)	480	400	530	180
Volume of Concrete (cy)	3,530	3,320	2,320	760
Quantity of Steel (tons)	575	516	380	104
Number of Class 140 Piles	24	24	24	24
Number of 24-inch Cast-In-Steel-Shell Piles	72	72	32	N/A
Volume of Excavated Material (cy)	1,200	550	820	440
Quantity of Demolished Material (cy)	3,500	3,300	2,300	800

Key:
cy = cubic yards
lf = linear feet
N/A = not applicable
sf = square feet
SLWRI = Shasta Lake Water Resources Investigation

Construction would take place during the low-water season, and is expected to last between 6 and 8 months. The waterway would remain clear for navigation during construction. Bridge construction would begin with piers and abutments. To allow underwater construction of pier foundations, steel pile shells would be driven into the lake bed to create a temporary cofferdam. It may be necessary to dewater the shells during drilling if water seeps in. A hole would then be drilled to the specified foundation depth. Reinforcing steel would be installed within the shells before concrete was poured. After completion of the piers and abutments, construction of the superstructure and bridge deck would begin via the balanced cantilever method. This process entails forming and constructing the horizontal structure outward from the piers in each direction, in equal (balanced) proportions, until the superstructure/deck segments meet at midspan.

Traffic would continue on the existing bridges during construction. It is likely that barges would be used extensively for bridge foundation construction, bridge assembly, transport of materials, workers, and equipment, and demolition of the existing bridges. Concrete would be poured from barges. A

staging area would be required on the lakeshore, from which barges could be loaded and unloaded.

Although Fender's Ferry Bridge would not need to be replaced as a result of the Shasta Dam raises, modifications to the bridge would be necessary. The Fender's Ferry Bridge is a three-span structure with a steel plate girder superstructure supported on riveted steel tower bents and reinforced concrete piers with spread footings. As a result of differences in east and west riverbank topography, the western pier steel tower is supported at a much lower elevation than the eastern pier tower. Thus, at the proposed full pool elevations, the eastern pier steel tower would be inundated.

The existing reinforced concrete pier and footing would be enlarged and extended, and the existing steel tower modified to prevent inundation as a result of the higher full pool levels associated with the dam raise scenarios under consideration. Proposed modifications include the following:

- Enlarging the existing reinforced concrete footing.
- Enlarging and extending the existing reinforced concrete columns and pier wall to elevation 1096.16.
- Removing approximately 24 feet of the lower portion of the eastern pier steel tower (based on location of existing cross bracing).
- Reusing the existing steel bearing assemblies.

Quantities for the major items of work are estimated in the Engineering Summary Appendix.

Construction activities would likely be completed from the existing embankment without constructing cofferdams around the pier because average water surface elevations are below the existing eastern pier bottom-of-footing elevation for all months, with the exception of April and May. Construction of temporary bents to support the superstructure would be necessary to facilitate construction of the pier modifications. During construction activities, temporary traffic controls may be needed to facilitate delivery of materials and construction of temporary support bents.

Railroad Bridges

Pit River Bridge Pier Modification The new full pool elevations would inundate the existing bridge bearings and low-chord steel truss members. To prevent the existing steel bearings and lower portions of the steel truss members from being submerged, a watertight concrete tub structure would be required. The reinforced concrete structure would be attached to the top of two existing concrete piers. The structure footprint would be rectangular and approximately 151 feet long by 52.5 feet wide.

Because the existing bridge superstructure and top-of-pier are exposed to the elements, a structure cover would not be required; however, two submersible sump pumps would be installed to keep the water level in the new concrete protective structure from rising near the bearings. Each pump would discharge into 2-inch-diameter copper tubing, and the two lines would tee into a 2.5-inch-diameter line that would follow the slope upward to the discharge point. Check valves and ball valves would prevent pumped water from draining out of the line back into the sump. Protective grates would prevent large objects from entering the sump area.

Union Pacific Railroad Bridges The existing Sacramento River Second Crossing and Doney Creek railroad bridge superstructures consist of deck truss bridges with a single track. The piers and abutments were designed to accommodate a future parallel single-track superstructure. Portions of both bridges would be submerged for any reservoir raise and would need to be replaced with new, higher superstructures. Structural analyses of the existing bridge piers under design earthquake loads indicated that new bridge piers would be required. Minimal changes would be required for the railroad vertical alignment. The feasibility designs would permit uninterrupted rail service during construction.

The proposed new bridge superstructure would be a composite superstructure consisting of steel plate girders and a reinforced concrete deck. In general, the bridge superstructures would be designed to be continuous over the piers. However, with a requirement for 16 feet of vertical clearance between the two westernmost piers (underneath Span 2) for the Sacramento River Second Crossing railroad bridge (with a minimum width of 30 feet), to allow for the passage of houseboats, Span 2 is a simply supported span. No minimum clearance for houseboat traffic would be required for the Doney Creek railroad bridge; large-diameter concrete columns with drilled shafts would support the superstructure and be founded on bedrock. The Sacramento River Second Crossing railroad bridge would require nine spans, with a total length of 982 feet between concrete abutments. The Doney Creek railroad bridge would require five spans, with a total length of 537.5 feet between concrete abutments. The proposed relocation of the railroad bridges would require the railroad tracks to be realigned between the two bridges. This realignment would parallel the existing tracks with a 25-foot offset to the east.

Recreation Facilities Any raise of Shasta Dam would have some effect on the many recreation features found along the reservoir shoreline. These features include marinas/boat ramps, resorts, campgrounds/day use areas, cabins, trails, and USFS facilities. Areas for potential recreation mitigation (referred to as windows) and corresponding relocation plans for each window have been developed. Figure 2-4 details the location of these windows and existing recreation sites with proposed modification, expansion, or relocation. After authorization of the project, further detailed designs would need to be developed.

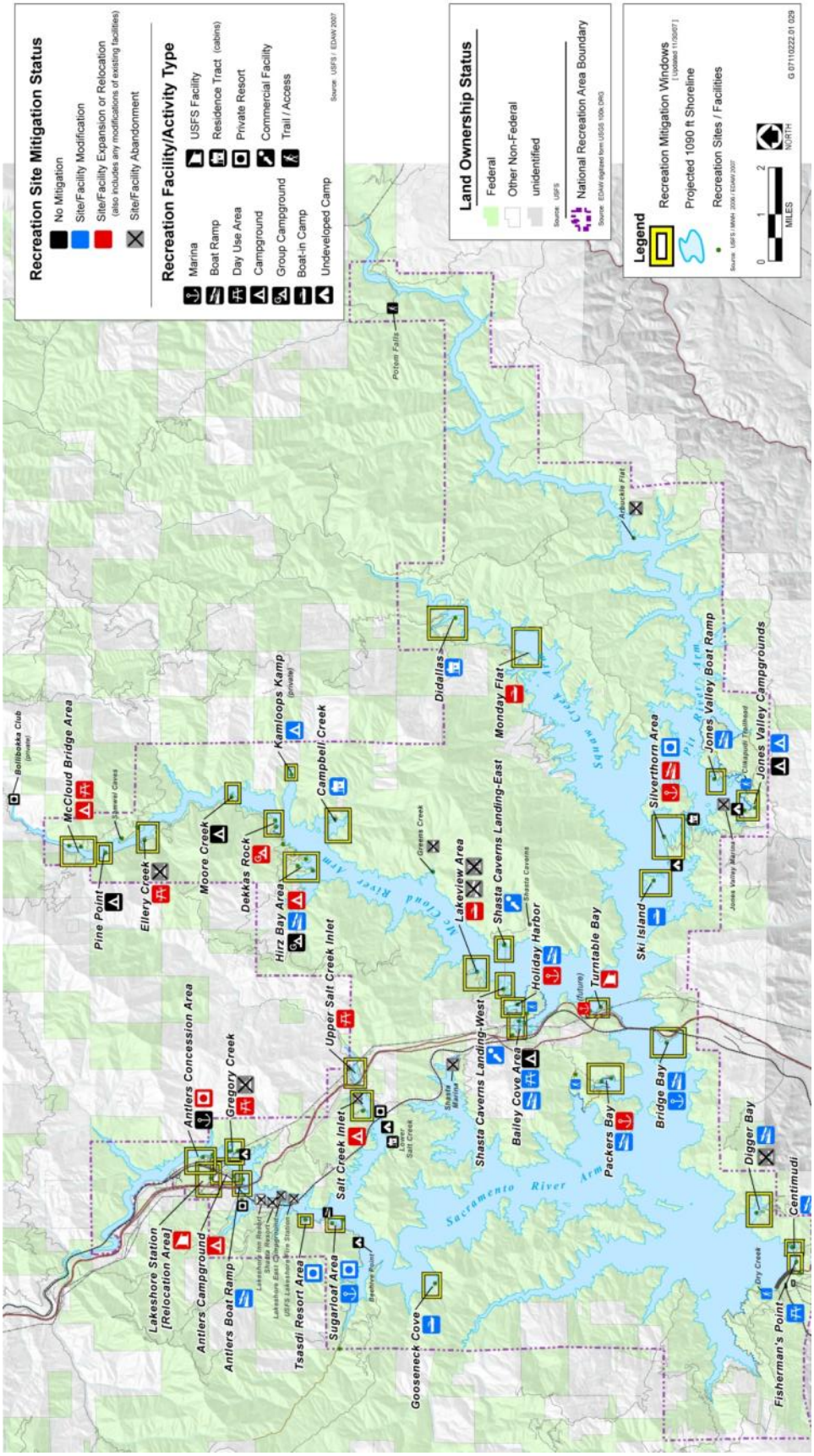


Figure 2-4. Recreation Mitigation Study Windows

The primary goal of the relocation plans is to verify that with any dam raise, the existing recreation capacity could be maintained. Reclamation and USFS would continue to work together to revise a recreation plan that is suitable for the NRA.

Inundated recreation facilities and associated utilities would be relocated before demolition, with the exception of facilities identified for abandonment. Action alternatives would, at minimum, maintain the existing recreation capacity at Shasta Lake. Recreation facilities proposed for relocation are included below in the detailed description of each action alternative. Construction-specific information regarding relocating and demolishing recreation facilities is under development and will be completed after project authorization.

Marina/Boat Ramp Modifications Several marinas around Shasta Lake would be affected by raising Shasta Dam. Typically, marinas consist of a parking area, a boat ramp, various structures (retail, restrooms, maintenance facilities, storage, administration, etc.), and utilities (power, water, and septic). Most of the effects of the dam raise would be due to the inundation of boat ramps, parking lots, structures, and utilities. Boat ramps would be modified in place, on fill, where possible. Parking areas would be replaced on fill, or relocated above the new reservoir elevation. Existing structures that would be inundated would be demolished, and either replaced above the reservoir elevation (upslope or on placed fill), or moved to a floating structure on the water to provide better access for recreational users. Any access roads would be relocated above the new full pool for continued access around the marinas. Existing septic systems that would be inundated would be demolished and removed from the area or relocated. New facilities could also be connected to new localized wastewater treatment facilities. Power lines would be installed to accommodate new structures.

Marinas and boat ramps that could not be modified in place would be relocated to adjacent areas that can provide the necessary grade and access for ramps. To maintain current recreation capacity, 10.7 acres of expanded, or new, boat ramp and/or marina land use would be needed. The following potential areas could be used to meet this need:

- Antlers Boat Ramp and Adjacent Marina Area
- Packers Bay Marina
- Silverthorn Marina Area
- Holiday Harbor

Resort Modifications Raising Shasta Dam would affect approximately six resorts around the reservoir to some degree. Inundated structures and structures within 3 feet of the new full pool would be demolished. Septic systems would also be demolished, and remaining structures would either connect to new

localized wastewater treatment facilities or relocated to other septic systems. Fourteen acres of land would be needed to maintain the current resort capacity.

Campground/Day Use Area Modifications Many undeveloped areas have been identified as potential campgrounds to replace capacity lost because of inundation. While some inundated campgrounds would be relocated on fill at their existing location, others would be moved around the reservoir to new locations identified as potential campground sites. Thirty acres of expanded, or new, campgrounds would be needed to maintain the current recreation capacity. The following areas could be used to meet this need:

- Antlers Campground
- Oak Grove Campground
- Hirz Bay Campground
- McCloud Bridge Area

Six acres of expanded, or new, boat-in campgrounds would be needed to maintain the current recreation capacity. The following areas could be used to meet this need:

- Lakeview Marina Area
- Monday Flat Boat-In Camp

Six acres of expanded, or new, day-use campgrounds would be needed to maintain the current recreation capacity. The following areas could be used to meet this need:

- Ellery Creek Campground
- Gregory Creek Campground
- McCloud Bridge Area
- Upper Salt Creek

USFS Facilities Modifications Recreation within the NRA is managed by USFS, which has several facilities located throughout the reservoir area. USFS facilities consist of various storage and maintenance buildings and equipment, fire protection equipment, customer service facilities, office space, and employee living facilities. Two USFS facilities would be inundated, and require relocation or replacement. The station located in the Lakeshore area would be inundated by a Shasta Dam raise, and would be relocated to an area above the new full pool. The new facility would contain all of the features that exist at the current facility. The inundated facility would be demolished, and hauled to waste. Turntable Bay, another USFS facility, would be inundated by a Shasta Dam raise. Additional space at Turntable Bay would allow the facility to be relocated on fill in its current location.

Utilities and Miscellaneous Minor Infrastructure Gas/petroleum facilities, potable water facilities, power and telecommunications infrastructure, and wastewater facilities would be relocated. New facilities would be designed and constructed in accordance with applicable Federal, State, and local codes and requirements. Relocated facilities would be of the same types, sizes, and materials as existing facilities. Demolished facilities would not be reused to construct relocated facilities. Demolished and relocated utilities are summarized as part of the detailed description of each action alternative. An expanded discussion of the approach and methodology for demolition, design, and relocation criteria for each category of utilities is included in the Engineering Summary Appendix.

Construction Staging

Reclamation would establish staging areas for equipment storage and maintenance, construction materials, fuels, lubricants, solvents, and other possible contaminants in coordination with the resource agencies. Staging areas would likely be located within disturbed areas or at existing facilities that are expected to be inundated, such as campgrounds, recreation parking facilities, the top of Shasta Dam, and the parking area along the left wing dam, where feasible.

Staging areas would have a stabilized entrance and exit and would be located at least 100 feet from bodies of water, if possible. If an off-road site is chosen, qualified biological and cultural resources personnel would survey the selected site to verify that no sensitive resources would be disturbed by staging activities. If sensitive resources were found, an appropriate spatial and temporal buffer zone would be staked and flagged to avoid impacts. Where possible, no equipment refueling or fuel storage would take place within 100 feet of a body of water.

Construction Schedule, Equipment, and Workforce

Total construction duration is estimated at 3 to 4 years. An overlap is expected in the timing of construction of some of the construction components. Construction would be phased, when feasible, to avoid negative environmental impacts.

Construction would typically occur during daylight hours, Monday through Friday. However, construction contractors may extend these hours and schedule construction work on weekends, if necessary, to complete aspects of the work within a given time frame. Construction would require typical heavy construction equipment including excavators, backhoes, bulldozers, scrapers, graders, water trucks, front-end loaders, dump trucks, drill rigs, pump trucks, truck-mounted cranes, pickup trucks, barges, helicopters, and miscellaneous equipment.

About 58 highway truck trips would be needed per day to bring construction material to the site. In addition, about 23 highway truckloads per day could be

needed to carry construction debris and waste material to a suitable landfill. The construction labor force is estimated to average about 350 people over the total construction period.

Borrow Sources

Multiple borrow sources are available to meet project needs for concrete, sand and gravel, core and homogenous fill, shell fill, riprap, and filter and drain materials for reservoir area embankments. Potential borrow sources were examined at a preliminary level and would need further sampling and testing to determine suitability and refine quantity estimates. Potential borrow sources include areas of the dike construction sites, areas located below the reservoir's inundation zone, and commercial sources. Commercial sources are located within approximately 2 to 30 miles of the Bridge Bay site, and within approximately 15 to 43 miles of the Lakeshore sites. Potential borrow sources are identified in Figure 2-5. Available fill material from potential borrow sources are described in the Engineering Summary Appendix.

2.4.3 Environmental Commitments Common to All Action Alternatives

As part of project planning and environmental assessment, Reclamation and/or its contractors would incorporate certain environmental commitments and best management practices (BMP) into the SLWRI action alternatives to avoid or minimize potential impacts. Reclamation will also coordinate planning, engineering, design and construction, operation, and maintenance phases of the project with applicable resource agencies.

The following environmental commitments would be incorporated into any action alternative for any project-related construction activities.

Develop and Implement Construction Management Plan

Reclamation would develop and implement a construction management plan to avoid or minimize potential impacts to public health and safety during project construction, to the extent feasible. The construction management plan would inform contractors and subcontractors of work hours, modes and locations of transportation and parking for construction workers; location of overhead and underground utilities; worker health and safety requirements; truck routes; stockpiling and staging procedures; public access routes; terms and conditions of all project permits and approvals; and emergency response services contact information.

The plan would also include construction notification procedures for the police, public works, and fire department in the cities and counties where construction occurs. Notices would also be distributed to neighboring property owners.

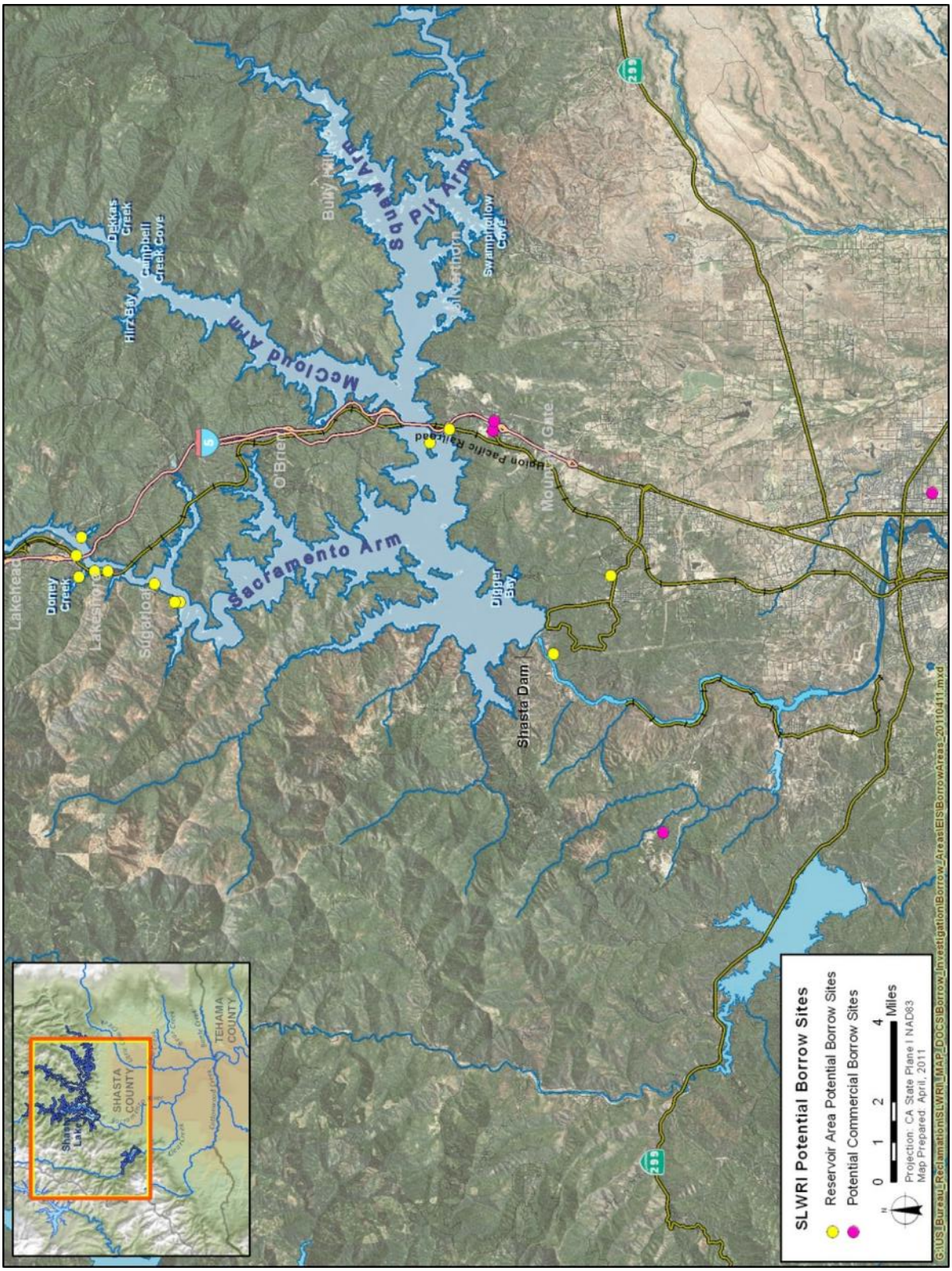


Figure 2-5. Potential Borrow Sources

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The plan would also include construction notification procedures for the police, public works, and fire department in the cities and counties where construction occurs. Notices would also be distributed to neighboring property owners.

Comply with Permit Terms and Conditions

Reclamation would require its contractors and suppliers, its general contractor, and all of the general contractor's subcontractors and suppliers to comply with all of the terms and conditions of all project permits, approvals, and conditions attached thereto. Compliance with applicable laws, policies, and plans for this project is discussed in Section 26.6 of this PDEIS.

Develop and Implement Erosion and Sediment Control Plan

Reclamation would prepare and implement an erosion and sediment control plan to control short-term and long-term erosion and sedimentation effects, and to stabilize soils and vegetation in areas affected by construction activities. The plan would include all of the necessary local jurisdiction requirements regarding erosion control, and would implement BMPs for erosion and sediment control, as required. Types of BMPs may include, but would not be limited to, earth dikes and drainage swales, stream bank stabilization, and use of silt fencing, sediment basins, fiber rolls, and sandbag barriers.

Develop and Implement Stormwater Pollution Prevention Plan

This project is subject to construction-related stormwater permit requirements of the Federal Clean Water Act (CWA) National Pollutant Discharge

Elimination System program. Reclamation would obtain any required permits through the Central Valley Regional Water Quality Control Board before any ground-disturbing construction activity. According to the requirements of Section 402 of the CWA, Reclamation and/or its contractors would prepare and implement a SWPPP before construction that identifies BMPs to prevent or minimize the discharge of sediments and other contaminants with the potential to affect beneficial uses or lead to violations of water quality objectives of surface waters. The SWPPP would include development of site-specific structural and operational BMPs to prevent and control impacts on runoff quality, and measures to be implemented before each storm event. The SWPPP would contain a site map that shows the construction site perimeter, existing and proposed buildings, lots, roadways, stormwater collection and discharge points, general topography both before and after construction, and drainage patterns across the project. Additionally, the SWPPP must contain a visual monitoring program, a chemical monitoring program for "non-visible" pollutants to be implemented if a BMP fails, and a sediment monitoring plan if the site discharges directly to a water body listed on the CWA 303(d) list for sediment. BMPs for the project could include, but would not be limited to, silt fencing, straw bale barriers, fiber rolls, storm drain inlet protection, hydraulic mulch, and stabilized construction entrances.

Develop and Implement Feasible Spill Prevention and Hazardous Materials Management As part of the SWPPP, Reclamation and/or its contractors would develop and implement a spill prevention and control plan to minimize effects from spills of hazardous, toxic, or petroleum substances for project-related construction activities occurring in or near waterways. The accidental release of chemicals, fuels, lubricants, and nonstorm drainage water into water bodies would be prevented to the extent feasible. Spill prevention kits would always be in close proximity when hazardous materials would be used (e.g., crew trucks and other logical locations). Feasible measures would be implemented so that hazardous materials would be properly handled and the quality of aquatic resources would be protected by all reasonable means during work in or near any waterway. No fueling would be done within the ordinary high-water mark, immediate floodplain, or full pool inundation area, unless equipment stationed in these locations could not be readily relocated. Any equipment that could be readily moved out of the water body would not be fueled in the water body or immediate floodplain. As for stationary equipment, for all fueling done at the construction site, containments would be installed so that any spill would not enter the water, contaminate sediments that may come in contact with the water, or damage wetland or riparian vegetation. Any equipment that could be readily moved out of the water body would not be serviced within the ordinary high-water mark or immediate floodplain.

Additional BMPs designed to avoid spills from construction equipment and subsequent contamination of waterways would also be implemented. These may include, but would not be limited to, the following:

- Storage of hazardous materials in double-containment and, if possible, under a roof or other enclosure.

- Disposal of all hazardous and nonhazardous products in a proper manner.

- Monitoring of on-site vehicles for fluid leaks and regular maintenance to reduce the chance of leakage.

- Containment (using a prefabricated temporary containment mat, a temporary earthen berm, or other measure can provide containment) of bulk storage tanks.

Fisheries Conservation

The measures discussed below would be implemented to minimize potential adverse effects to fish species.

Implement In-Water Construction Work Windows Reclamation would identify and implement feasible in-water construction work windows in consultation with NMFS, USFWS, and California Department of Fish and Game (DFG). In-water work windows would be timed to occur when sensitive fish species were not present or would be least susceptible to disturbance (e.g., July through September).

Monitor Construction Activities A qualified biologist would monitor potential impacts to important fishery resources throughout all phases of project construction. Monitoring may not be necessary during the entire duration of the project if, based on the monitor's professional judgment (and with concurrence from Reclamation), a designated on-site contractor would suffice to monitor such activities and would agree to notify a biologist if aquatic organisms are in danger of harm. However, the qualified biologist must be available by phone and Internet and be able to respond promptly to any problems that arise.

Perform Fish Rescue/Salvage If spawning activities for sensitive fish species were encountered during construction activities, the biologist would be authorized to stop construction activities until appropriate corrective measures were completed or it was determined that the fish would not be harmed.

A qualified biologist would identify any fish species that may be impacted by the project. The biologist would facilitate rescue and salvage of fish and other aquatic organisms that become entrapped within construction structures and cofferdam enclosures in the construction area. Any rescue, salvage, and handling of listed species would be conducted under appropriate authorization (i.e., incidental take statement/permit for the project, Federal Endangered Species Act section 4(d) scientific collection take permit, or a Memorandum of Understanding). If fish are identified as threatened with entrapment in construction structures, construction would be stopped and efforts made to

allow fish to leave the project area before resuming work. If fish are unable to leave the project area of their own volition, then fish would be collected and released outside the work area. Fish entrapped in cofferdam enclosures would be rescued and salvaged before the cofferdam area was completely dewatered. Appropriately sized fish screens would be installed on the suction side of any pumps used to dewater in-water enclosures.

Reporting A qualified biologist would prepare a letter report detailing the methodologies used and the findings of fish monitoring and rescue efforts. Monitoring logs would be maintained and provided, with monitoring reports. The reports would contain, but not be limited to, the following: summary of activities; methodology for fish capture and release; table with dates, numbers, and species captured and released; photographs of the enclosure structure and project site conditions affecting fish; and recommendations for limiting impacts during subsequent construction phases, if appropriate.

Water Quality Protection

The measures discussed below would be implemented to minimize potential adverse effects to water quality.

Implement In-Water Construction Work Windows All construction activities along the Sacramento River would be conducted during months when instream flows are managed outside the flood season (e.g., June 15 to September 15).

Comply with All Permits and Regulations Project activities would be conducted to comply with all additional requirements specified in permits relating to water quality protection. Relevant permits anticipated to be obtained for the proposed action include a California Fish and Game Code 1602 Lake and Streambed Alteration Agreement, Regional Water Quality Control Board Section 401 certification or waiver, and CWA Section 404 compliance through the U.S. Army Corps of Engineers (USACE).

Implement Water Quality Best Management Practices BMPs that would be implemented to avoid and/or minimize potential impacts associated with dam construction and the 10-year-long spawning gravel augmentation program are described below.

Handle Spawning Gravel to Minimize Potential Water Quality Impacts Gravel would be sorted and transported in a manner that minimizes potential water quality impacts (e.g., management of fine sediments, etc.). Gravel would be washed at least once and have a cleanliness value of 85 or higher based on CalTrans Test No. 227. Gravel would also be completely free of oils, clay, debris, and organic material.

Minimize Potential Impacts Associated with Equipment Contaminants For in-river work, all equipment would be steam-cleaned every day to remove hazardous materials before the equipment entered the water.

Minimize Potential Impacts Associated with Access and Staging Existing access roads would be used to the extent possible. Equipment staging areas would be located outside of the Sacramento River ordinary high water mark or the Shasta Dam full pool inundation area, and away from sensitive resources.

Remove Temporary Fills as Appropriate Temporary fill for access, side channel diversions, and/or side channel cofferdams, would be completely removed after completion of construction.

Remove Equipment from River Overnight and During High Flows Construction contractors would remove all equipment from the river on a daily basis at the end of the workday. Construction contractors would also monitor Reclamation's Central Valley Operations Office Web site daily for forecasted flows posted there to determine and anticipate any potential changes in releases. If flows are anticipated to inundate a work area that would normally be dry, the contractor would immediately remove all equipment from the work area.

Revegetation Plan

Reclamation, in conjunction with cooperating agencies and private landowners, would prepare a comprehensive revegetation plan to be implemented in conjunction with other management plans (e.g., erosion and sediment control plan). This plan would apply to any area included as part of an action alternative, such as inundation, relocation, or mitigation activities. Overall objectives of the plan would be to reestablish native vegetation to control erosion; provide effective ground cover; minimize opportunities for nonnative plant species to establish or expand; and provide habitat diversity over time. Reclamation would work closely with cooperating agencies, private landowners, and revegetation specialists to develop the site-specific planting patterns and species assemblages necessary for a revegetation effort of this magnitude.

Invasive Species Management

Reclamation would develop and implement a control plan to prevent the introduction of zebra/quagga mussels and other invasive species to project areas. The control plan would cover all workers, vehicles, watercraft, and equipment (both land and aquatic) that would come into contact with Shasta Lake, the shoreline of Shasta Lake, the Sacramento River, and any riverbanks, floodplains, or riparian areas. Plan activities may include, but would not be limited to, the following:

- Preinspection and cleaning of all construction vehicles, watercraft, and equipment before being shipped to project areas, and postinspections.

- Reinspection of all construction vehicles, watercraft, and equipment on arrival at project areas

- Inspection and cleaning of all personnel before work in project areas

All inspections would be conducted by trained personnel and would include both visual and hands-on inspection methods of all vehicle and equipment surfaces, up to and including internal surfaces that have contacted raw water.

Approved cleaning methods would include a combination of the following:

- Precleaning: draining, brushing, vacuuming, high-pressure water treatment, thermal treatment

- Cleaning: freezing, desiccation, thermal treatment, high-pressure water treatment, chemical treatment

On-site cleanings would require capture, treatment, and/or disposal of any and all water needed to conduct cleaning activities.

Construction Material Disposal

Reclamation's contractors would take measures to recycle or reuse demolished materials, such as steel or copper wire, where practical.

Asphalt Removal

Per California Fish and Game Code 5650 Section (a), all asphaltic roadways and parking lots inundated by the proposed action would be demolished and removed according to Shasta County standards. Asphalt would be disposed of at an approved and permitted waste facility. Dirt roads inundated by the proposed action would remain in place.

2.4.5 Comprehensive Plan 1 (CP1) – 6.5-Foot Dam Raise, Anadromous Fish Survival and Water Supply Reliability

CP1 consists of enlarging Shasta Dam by raising the crest 6.5 feet and enlarging the reservoir by 256,000 acre-feet.

Major Components of CP1

CP1 includes the following major components:

- Raising Shasta Dam and appurtenant facilities by 6.5 feet.

- Implementing the set of eight common management measures described above.

By raising Shasta Dam 6.5 feet from a crest at elevation 1,077.5 to elevation 1,084.0, CP1 would increase the height of the reservoir full pool by 8.5 feet. The additional 2-foot increase in the height of the full pool above the dam raise height would result from spillway modifications, including replacing the three

drum gates with six sloping, fixed-wheel gates. This increase in full pool height would add approximately 256,000 acre-feet of additional storage to the overall reservoir capacity. Accordingly, the overall full pool storage would increase from 4.55 MAF to 4.81 MAF. Table 2-8 summarizes major physical features associated with CP1.

Under CP1, operations for water supply, hydropower, and environmental requirements would be similar to existing operations, with the additional storage retained for water supply reliability and as an expanded cold-water pool for fisheries benefits. As mentioned, this alternative (and all comprehensive plans) includes extending the existing TCD for efficient use of the expanded cold-water pool.

CP1 would also include the potential to revise the operational rules for flood control for Shasta Dam and Reservoir, which could reduce the potential for flood damage, and benefit recreation. Reservoir reoperation would likely include increasing the bottom of the flood control pool elevation based on increased dam height and reservoir capacity. Because of reservoir geometry, this would decrease the depth of the flood control pool, allowing higher winter and spring water levels. Increased reservoir capacity could have further flood damage reduction benefits in years when water levels are below the new flood control pool elevation.

There is also limited potential for changes in flood control rules to allow more operational flexibility in reservoir drawdown requirements in response to storms, resulting in a net increase in the rate of spring reservoir filling during some years. Higher spring water levels and associated increases in reservoir surface area would benefit recreation.

Table 2-8. Physical Features of Action Alternatives

Main Features	Action Alternatives				
	CP1	**CP2**	**CP3**	**CP4**	**CP5**
Dam and Appurtenant Structures					
Shasta Dam					
Crest Raise (feet)	6.5	12.5	18.5	18.5	18.5
Full Pool Height Increase (feet)	8.5	14.5	20.5	20.5	20.5
Elevation of Full Pool (feet)	1,075.5	1,081.5	1,087.5	1,087.5	1,087.5
Capacity Increase (acre-feet)	256,000	443,000	634,000	634,000	634,000
Wing Dams	Raise to meet dam crest. Build new visitor center along left wing dam. Relocate gantry crane on right wing dam.	Raise to meet dam crest. Build new visitor center along left wing dam. Relocate gantry crane on right wing dam.	Raise to meet dam crest. Build new visitor center along left wing dam. Relocate gantry crane on right wing dam.	Raise to meet dam crest. Build new visitor center along left wing dam. Relocate gantry crane on right wing dam.	Raise to meet dam crest. Build new visitor center along left wing dam. Relocate gantry crane on right wing dam.
Spillway	Raise crest and extend piers. Replace 3 drum gates with 6 sloping wheel gates.	Raise crest and extend piers. Replace 3 drum gates with 6 sloping wheel gates.	Raise crest and extend piers. Replace 3 drum gates with 6 sloping wheel gates.	Raise crest and extend piers. Replace 3 drum gates with 6 sloping wheel gates.	Raise crest and extend piers. Replace 3 drum gates with 6 sloping wheel gates.
Temperature Control Device	Raise/modify controls.	Raise/modify controls.	Raise/modify controls.	Raise/modify controls.	Raise/modify controls.
Shasta Powerplant	Raise hoists.	Raise hoists.	Raise hoists.	Raise hoists.	Raise hoists.
Pit 7 Dam	Install a tailwater depression system.	Install a tailwater depression system.	Install a tailwater depression system.	Install a tailwater depression system.	Install a tailwater depression system.
Reservoir Area Dikes and Railroad Embankments	Construct 5 new dikes.	Construct 6 new dikes.	Construct 7 new dikes.	Construct 7 new dikes.	Construct 7 new dikes.
Relocations					
Roadways	Match replacement widths to existing paved roads to be replaced.	Match replacement widths to existing paved roads to be replaced.	Match replacement widths to existing paved roads to be replaced.	Match replacement widths to existing paved roads to be replaced.	Match replacement widths to existing paved roads to be replaced.
Length of Relocated Roadway (linear feet)	17,409	29,054	33,788	33,788	33,788
Number of Road Segments Affected	10	21	30	30	30

Table 2-8. Physical Features of Comprehensive Plans (contd.)

Main Features	Project Alternatives				
	CP1	CP2	CP3	CP4	CP5
Vehicle Bridges	Relocate 4 bridges, modify 1 bridge.	Relocate 4 bridges, modify 1 bridge.	Relocate 4 bridges, modify 1 bridge.	Relocate 4 bridges, modify 1 bridge.	Relocate 4 bridges, modify 1 bridge.
Railroad Bridges	Modify 3 bridges.	Modify 3 bridges.	Modify 3 bridges.	Modify 3 bridges.	Modify 3 bridges.
Recreation Facilities	Modify or replace 9 marinas, 6 boat ramps, 6 resorts, 202 campgrounds/day-use areas/RV sites, 2 USFS facilities, 8.1 miles of trail, and 2 trailheads.	Modify or replace 9 marinas, 6 boat ramps, 6 resorts, 261 campgrounds/day-use areas/RV sites, 2 USFS facilities, 9.9 miles of trail, and 2 trailheads.	Modify or replace 9 marinas, 6 boat ramps, 6 resorts, 328 campgrounds/day-use areas/RV sites, 2 USFS facilities, 11.6 miles of trail, and 2 trailheads.	Modify or replace 9 marinas, 6 boat ramps, 6 resorts, 328 campgrounds/day-use areas/RV sites, 2 USFS facilities, 11.6 miles of trail, and 2 trailheads.	Modify or replace 9 marinas, 6 boat ramps, 6 resorts, 328 campgrounds/day-use areas/RV sites, 2 USFS facilities, 11.6 miles of trail, and 2 trailheads. Add 6 trailheads and18 miles of new hiking trails.
Utilities	Relocate inundated utilities. Construct wastewater treatment facilities.	Relocate inundated utilities. Construct wastewater treatment facilities.	Relocate inundated utilities. Construct wastewater treatment facilities.	Relocate inundated utilities. Construct wastewater treatment facilities.	Relocate inundated utilities. Construct wastewater treatment facilities.
Ecosystem Enhancements	None	None	None	Reserve 378 TAF of the additional storage for cold-water supply for anadromous fish. Implement adaptive management plan to benefit anadromous fish. Augment spawning gravel in the upper Sacramento River at the rate of up to 10,000 tons per year. Restore 0.8 miles of riparian, floodplain, and side channel habitat along the upper Sacramento River.	Construct shoreline fish habitat around Shasta Lake. Augment spawning gravel in the upper Sacramento River at the rate of up to 10,000 tons per year. Restore 0.8 miles of riparian, floodplain, and side channel habitat along the upper Sacramento River. Enhance aquatic habitat in tributaries to Shasta Lake to improve fish passage.

Key:
CP = comprehensive plan
GWh = gigawatt-hour
RV = recreational vehicle
TAF = thousand acre-feet
USFS = U.S. Department of Agriculture, Forest Service

Potential Benefits of CP1

Major potential benefits of CP1, related to contributions to the SLWRI objectives and broad public services, are described below.

Increase Anadromous Fish Survival Water temperature is one of the most important factors in achieving recovery goals for anadromous fish in the Sacramento River. CP1 would increase the ability of Shasta Dam to make cold-water releases and regulate water temperatures for fish in the upper Sacramento River, primarily in dry and critically dry water years. This would be accomplished by raising Shasta Dam 6.5 feet, thus increasing the depth of the cold-water pool in Shasta Reservoir and resulting in an increase in seasonal cold-water volume below the thermocline (layer of greatest water temperature and density change). Cold water released from Shasta Dam significantly influences water temperature conditions in the Sacramento River between Keswick Dam and the RBDD. Hence, the most significant water temperature benefits to anadromous fish would occur upstream from the RBDD. It is estimated that under CP1, improved water temperature conditions could result in an average annual increase in the salmon population of about 366,000 out-migrating juvenile Chinook salmon.

Increase Water Supply Reliability CP1 would increase water supply reliability by increasing firm water supplies for irrigation and M&I deliveries primarily during drought periods. This action would contribute to replacement of supplies redirected to other purposes in the Central Valley Project Improvement Act (CVPIA), which would help reduce estimated future water shortages by increasing firm yield for agricultural and M&I deliveries by at least 76,400 acre-feet per year and average annual yield by about 46,400 acre-feet per year. For this PDEIS, firm yield is considered equivalent to the estimated increase in the reliability of supplies during dry and critically dry periods. The majority of increased firm yield (66,800 acre-feet) would be for south-of-Delta agricultural and M&I deliveries. In addition, water use efficiency could help reduce current and future water shortages by allowing a more effective use of existing supplies. As population and resulting water demands continue to grow and available supplies continue to remain relatively static, more effectively using these supplies could reduce potential critical impacts to agricultural and urban areas resulting from water shortages. Under CP1, approximately $2.3 million would be allocated over an initial 10-year period to fund agricultural and M&I water conservation programs, focused on agencies benefiting from increased reliability of project water supplies.

Develop Additional Hydropower Generation Higher water surface elevations in the reservoir would result in an increase in power generation of about 42 gigawatt-hours (GWh) per year. This generation value is the expected increased generation from Shasta Dam and other CVP/SWP facilities.

Maintain and Increase Recreation Opportunities CP1 includes features to at least maintain the existing recreation capacity at Shasta Lake. Although CP1 does not include specific features to further benefit recreation resources, a small benefit would likely occur to the water-oriented recreation experience at Shasta Lake due to the increase in lake surface area and modernization of recreation facilities. The maximum surface area of the lake would increase by about 1,110 acres (4 percent), from 29,600 acres to about 30,700 acres. There is also limited potential for reservoir reoperation to provide additional benefits to recreation by raising the bottom of the flood control pool elevation and allowing more reliable filling of the reservoir during the spring.

Benefits Related to Other SLWRI Objectives CP1 could also provide benefits related to flood damage reduction, ecosystem restoration, and water quality. Enlarging Shasta Dam would provide for incidental increased reservoir capacity to capture flood flows, which could reduce flood damage along the upper Sacramento River. Improved fisheries conditions as a result of CP1, as described above, and increased flexibility to meet flow and temperature requirements, could also enhance overall ecosystem resources in the Sacramento River. Furthermore, CP1 could potentially benefit ecosystem restoration through improved Delta water quality conditions by increasing Delta outflow during drought years and reducing salinity during critical periods. CP1 may also contribute to improving Delta water quality through increased Delta emergency response capabilities. When Delta emergencies occur, additional water in Shasta Reservoir could improve operational flexibility for increasing releases to supplement existing water sources to reestablish Delta water quality. In addition to Delta emergency response, increased storage in Shasta Reservoir could increase emergency response capability for CVP/SWP water supply deliveries.

Construction for CP1

Construction activities for CP1 are described in Section 2.4.2, “Construction Activities Common to All Action Alternatives.” Information specific to CP1 construction activities is summarized in Tables 2-9 through 2-15.

Table 2-9. Reservoir Clearing Treatment Applied – CP1

Landing	Complete Removal (acres)	Complete Removal Quantity (board feet)	Overstory Removal (acres)	Overstory Removal Quantity (board feet)
Antlers	8	48,600	5	33,400
Bailey Cove	17	148,400	7	40,600
Beehive Point	3	5,400	24	102,300
Bridge Bay	9	51,800	0	0
Digger Bay	8	27,700	31	92,600
Hirz Bay	22	211,200	22	169,500
Jones Valley	17	81,700	51	328,000
Lakeshore East	17	58,800	2	12,500
Lower Salt Creek	14	96,300	15	62,700
McCloud Arm	4	14,900	0	0
Packers Bay	7	29,200	22	78,800
Pit Arm	2	22,400	0	0
Shasta Marina	1	17,900	13	89,400
Silverthorn	17	117,900	18	115,100
Turntable	5	33,100	8	88,700
Total	**150**	**965,300**	**220**	**1,213,600**

Key:
CP = comprehensive plan

Table 2-10. Physical Features for Proposed Modifications of Shasta Dam and Appurtenances – CP1

Physical Features	Quantities
Quantity of Concrete (cubic yards)	56,972
Quantity of Cement (tons)	128,589
Quantity of Metalwork (pounds)	19,712,823
Volume of Imported Fill Material (cubic yards)	61,220
Volume of Excavation to Waste Material (cubic yards)	1,610
Quantity of Demolished Material (cubic yards)	31,647
Area of Permanent Structures (square feet)	412,570
Area of Work Limits (square feet)	460,920

Key:
CP = comprehensive plan

Table 2-11. Physical Features for Proposed Dikes – CP1

Dike Features	Quantities
Lakeshore Dikes	
Doney Creek Dike	
Volume of Fill Material (core, drain, filter) (cubic yards)	-
Volume of Riprap (cubic yards)	-
Volume of Excavated Material (cubic yards)	-
Site Clearing and Grubbing Below Dike (acres)	-
Antlers Dike	
Volume of Fill Material (core, drain, filter) (cubic yards)	-
Volume of Riprap (cubic yards)	-
Volume of Excavated Material (cubic yards)	-
Site Clearing and Grubbing Below Dike (acres)	-
North Railroad Dike	
Volume of Fill Material (core, filter) (cubic yards)	17,142
Volume of Riprap (cubic yards)	410
Volume of Excavated Material (cubic yards)	1,503
Site Clearing and Grubbing Below Dike (acres)	1.15
Middle Railroad Dike	
Volume of Fill Material (core, filter) (cubic yards)	13,350
Volume of Riprap (cubic yards)	320
Volume of Excavated Material (cubic yards)	3,985
Site Clearing and Grubbing Below Dike (acres)	2.88
South Railroad Dike	
Volume of Fill Material (core, filter) (cubic yards)	101,942
Volume of Riprap (cubic yards)	2,460
Volume of Excavated Material (cubic yards)	8,503
Site Clearing and Grubbing Below Dike (acres)	6.22
Bridge Bay Dikes	
West Dike	
Volume of Fill Material (core, drain, filter) (cubic yards)	3,015
Volume of Riprap (cubic yards)	230
Volume of Excavated Material (cubic yards)	2,122
Site Clearing and Grubbing Below Dike (acres)	0.79
East Dike	
Volume of Fill Material (core, drain, filter) (cubic yards)	956
Volume of Riprap (cubic yards)	40
Volume of Excavated Material (cubic yards)	927
Site Clearing and Grubbing Below Dike (acres)	0.41

Key:
- = not applicable
CP = comprehensive plan

Table 2-12. Physical Features for Proposed Road Relocations by Major Road Focus Area – CP1

Road Relocation Features	Relocation Amounts
Lakeshore Drive	
Length (linear feet)	8,075
Clearing and Grubbing (acres)	4
Excavation to Embankment (cubic yards)	46,100
Embankment Fill (cubic yards)	95,875
Number of Road Segments Affected	4
Closure Expected	No
Turntable Bay Area	
Length (linear feet)	6,190
Clearing and Grubbing (acres)	2
Excavation to Embankment (cubic yards)	19,000
Embankment Fill (cubic yards)	71,500
Number of Road Segments Affected	3
Closure Expected	Yes
Gillman Road	
Length (linear feet)	-
Clearing and Grubbing (acres)	-
Excavation to Embankment (cubic yards)	-
Embankment Fill (cubic yards)	-
Number of Road Segments Affected	-
Closure Expected	-
Jones Valley and Silverthorn Area	
Length (linear feet)	1,950
Clearing and Grubbing (acres)	1
Excavation to Embankment (cubic yards)	0
Embankment Fill (cubic yards)	41,250
Number of Road Segments Affected	1
Closure Expected	Yes
Salt Creek Road	
Length (linear feet)	-
Clearing and Grubbing (acres)	-
Excavation to Embankment (cubic yards)	-
Embankment Fill (cubic yards)	-
Number of Road Segments Affected	-
Closure Expected	-
Remaining Road Relocations	
Length (linear feet)	229
Clearing and Grubbing (acres)	0.4
Excavation to Embankment (cubic yards)	15
Embankment Fill (cubic yards)	34,231
Number of Road Segments Affected	2
Closure Expected	No

Key:
- = not applicable
CP = comprehensive plan

Table 2-13. Recreation Facilities to Be Modified or Relocated – CP1

Recreation Facilities	No. of Impacted Facilities	Relocation Needed[1]
Marinas/Boat Ramps	9/6	8.5 acres
Resorts/Campground and Day-Use Areas	6/202	48.7 acres
Trailheads	2	2
Trails	-	8.1 miles

Note:
[1]Does not include on-site modification of facilities.
Key:
- = not applicable
CP = comprehensive plan

Table 2-14. Recreation and Nonrecreation Demolition and Construction Material Quantities – CP1

Material	Quantity
Recreation Facilities	
Imported Fill (cubic yards)	236,182
Excavation to Waste (cubic yards)	592,276
Demolition (cubic yards)	99,240
Nonrecreation Structures	
Demolition (cubic yards)	8,710

Key:
CP = comprehensive plan

Table 2-15. Physical Features for Proposed Utilities Relocations – CP1

Utility Type	Relocation Amounts
Potable Water Facilities	
Length of Waterlines Relocated (linear feet)	7,210
Wells/Tanks Relocated (number)	12
Pump Stations Relocated (number)	2
Length of Waterline Demolished (linear feet)	8,910
Wells/Tanks Demolished (number)	16
Pump Stations Demolished (number)	2
Gas/Petroleum Facilities	
Tanks Relocated (number)	7
Tanks Demolished (number)	7
Wastewater Facilities	
Septic Systems Relocated[1] (number)	14
Vault/Pit Toilets Relocated (number)	2
Pump Stations Relocated (number)	1
Length of Wastewater Pipe Relocated (linear feet)	430
Septic Systems Demolished[2] (number)	211
Vault/Pit Toilets Demolished (number)	2
Pump Stations Demolished (number)	2
Length of Wastewater Pipe Demolished (linear feet)	2,340
Package Wastewater Treatment Plants[3] (number)	Up to 6
Power Distribution Facilities	
Power Lines Relocated (linear feet)	30,260
Power Towers Relocated (number)	6
Power Lines Demolished (linear feet)	26,397
Power Towers Demolished (number)	6
Telecommunications	
Copper Wire Relocated (linear feet)	27,925
Fiber-Optic Cable Relocated (linear feet)	4,300
Copper Wire Demolished (linear feet)	23,575
Fiber-Optic Cable Demolished (linear feet)	3,640

Note:
[1] Does not include septic systems replaced with new sewer connections.
[2] Includes demolition of septic systems to be relocated, replaced with new sewer connections, and removed without relocation or replacement.
[3] Includes additional lift stations, force main, laterals, and holding tank pumps/valves not shown.
Key:
CP = comprehensive plan

Operations and Maintenance for CP1

Shasta Dam is operated in conjunction with other CVP facilities to manage floodwater, storage of surplus winter runoff for irrigation in the Sacramento and San Joaquin valleys, M&I use, maintenance of navigation flows, protection and conservation of fish in the Sacramento River and Delta, and generation of hydroelectric energy. Storage in Shasta Reservoir fluctuates greatly throughout the year; storage is typically highest at the end of winter, in April and May, as the need for flood control reservation space in the reservoir decreases. Storage is typically at its lowest in September and October, after the irrigation season and before winter refill begins. Shasta Reservoir capacity is currently 4,552 TAF, with a maximum objective release capacity of 79,000 cfs. The end-of-September storage target for Shasta Reservoir is 1,900 TAF, except in the driest 10 percent of water years, to conserve sufficient cold water for meeting temperature criteria for the winter-run Chinook incubation period (summer to early fall). Storage levels are lowest by October to provide sufficient flood risk reduction and capture capacity during the following wet months. The storage target gradually increases from October to full pool in May; storage is then withdrawn for high water demand (agricultural, M&I, fishery, and water quality uses, etc.) during summer.

A series of rules and regulations in the form of flow requirements, water quality requirements, water supply commitments, and flood control requirements governs operations at Shasta Reservoir. Federal and State laws, regulations, standards, and plans regulating Shasta Dam operations are described in detail in Chapter 6, "Hydrology, Hydraulics, and Water Management," and include the following:

- NMFS 2004 Operations Criteria and Plan Biological Opinion (NMFS 2004)
- CVPIA (Reclamation 1999)
- CVP long-term water service contracts (see *Hydrology, Hydraulics, and Water Management Technical Report*, Table 1-25)
- Trinity River ROD (Reclamation 2000)
- Flow objective for navigation at Wilkins Slough (Reclamation 2004)
- Flood management requirements in accordance with the Water Control Manual (USACE 1997)
- SWRCB Orders 90-05 and 91-01
- 1960 DFG Reclamation Memorandum of Agreement (DFG 1960)

- Water Quality Control Plan for the San Francisco Bay/San Joaquin Delta Estuary (SWRCB 1995)

- SWRCB Water Right Revised Decision 1641 (SWRCB 2000)

- Coordinated Operations Agreement (Reclamation and DWR 1986)

Under CP1, Shasta Dam operational guidelines would continue unchanged, with the additional storage retained for water supply reliability and as an expanded cold-water pool for fisheries benefits. For CP1, existing water quality and temperature requirements would typically be met in most years; therefore, additional water in storage would be released for water supply purposes. Accordingly, minimal increases in flow would be expected in months when Delta exports were constrained, or when flow was not required for water supply purposes.

At a base level, CP1 would store some additional flows behind Shasta Dam during periods when downstream needs would have already been met, but flows would have been released because of storage limitations. The resulting increase in storage would be released downstream when there were opportunities for beneficial use of the water, either to meet water supply reliability demands or to improve Reclamation's abilities to meet its environmental objectives. The additional water in storage would also expand the cold-water pool, thus benefiting fisheries. Conversely, if water in storage were insufficient to meet all of the project purposes, the first increment to be reduced would be deliveries to water service contractors. Releases from Shasta Dam under CP1 would typically increase in the summer months, corresponding with the periods of greatest agricultural demands. Similarly, releases would be reduced in the winter months, when the increased storage space could be used to capture additional runoff rather than releasing water to the downstream river, as would occur under Shasta Reservoir's current operations.

Maintenance of facilities related to the proposed dam and reservoir enlargement would be similar to maintenance activities currently conducted at Shasta Dam and Reservoir.

2.4.6 Comprehensive Plan 2 (CP2) – 12.5-Foot Dam Raise, Anadromous Fish Survival and Water Supply Reliability

CP2 consists primarily of enlarging Shasta Dam by raising the crest 12.5 feet and enlarging the reservoir by 443,000 acre-feet.

Major Components of CP2

CP2 includes the following major components:

- Raising Shasta Dam and appurtenant facilities by 12.5 feet.

- Implementing the set of eight common management measures previously described.

A dam raise of 12.5 feet was chosen because it represents a midpoint between the likely smallest dam raise considered and the largest practical dam raise that would not require relocating the Pit River Bridge. By raising Shasta Dam from a crest at elevation 1,077.5 to elevation 1,090.0, CP2 would increase the height of the reservoir's full pool by 14.5 feet. The additional 2-foot increase in the height of the full pool above the dam raise height would result from spillway modifications similar to CP1. This increase in full pool height would add approximately 443,000 acre-feet of storage to the reservoir's capacity. Accordingly, storage in the overall full pool would increase from 4.55 MAF to 5.0 MAF. Table 2-8 summarizes physical features that would be associated with the CP2 dam raise.

Under CP2, operations for water supply, hydropower, and environmental requirements would be similar to existing operations, with the additional storage retained for water supply reliability and as an expanded cold-water pool for fisheries benefits. The existing TCD would be extended for efficient use of the expanded cold-water pool.

As described for CP1, this alternative would also include the potential to revise flood control operational rules, which could reduce the potential for flood damage and benefit recreation.

Potential Benefits of CP2

Major potential benefits of CP2, related to contributions to the SLWRI objectives, are described below.

Increase Anadromous Fish Survival Water temperature is one of the most important factors in achieving recovery goals for anadromous fish in the Sacramento River. CP2 would increase the ability of Shasta Dam to make cold-water releases and regulate water temperatures for fish in the upper Sacramento River, primarily in dry and critically dry water years. This would be accomplished by raising Shasta Dam 12.5 feet, thus increasing the depth of the cold-water pool in Shasta Reservoir and resulting in an increase in seasonal cold-water volume below the thermocline (layer of greatest water temperature and density change). Cold water released from Shasta Dam significantly influences water temperature conditions in the Sacramento River between Keswick Dam and the RBDD. Hence, the most significant water temperature benefits to anadromous fish would occur upstream from the RBDD. It is estimated that improved water temperature conditions under CP2 could result in an average annual increase in the salmon population of about 234,000 out-migrating juvenile Chinook salmon.

Increase Water Supply Reliability CP2 would increase water supply reliability by increasing firm water supplies for irrigation and M&I deliveries

primarily during drought periods. This action would contribute to replacement of supplies redirected to other purposes in the CVPIA, which would help reduce estimated future water shortages by increasing the reliability of firm water supplies for agricultural and M&I deliveries by at least 105,100 acre-feet per year and average annual yield by about 62,800 acre-feet per year. For this PDEIS, firm yield is considered equivalent to the estimated increase in the reliability of supplies during dry and critically dry periods. The majority of increased firm yield (85,300 acre-feet) would be for south-of-Delta agricultural and M&I deliveries. In addition, water use efficiency could help reduce current and future water shortages by allowing a more effective use of existing supplies. As population and resulting water demands continue to grow and available supplies continue to remain relatively static, more effectively using these supplies could reduce potential critical impacts to agricultural and urban areas resulting from water shortages. Under CP2, approximately $3.1 million would be allocated over an initial 10-year period to fund agricultural and M&I water conservation programs, focused on agencies benefiting from increased reliability of project water supplies.

Develop Additional Hydropower Generation Higher water surface elevations in the reservoir would result in a net increase in power generation of about 68 GWh per year. This generation value is the expected increased generation from Shasta Dam and other CVP/SWP facilities.

Maintain and Improve Recreation Opportunities CP2 includes features to, at minimum, maintain the existing recreation capacity at Shasta Lake. Although CP2 does not have specific features to further benefit recreation resources, a small benefit would likely occur to the water-oriented recreation experience at Shasta Lake due to the increase in lake surface area and modernization of recreation facilities. The maximum surface area of the lake would increase by about 1,750 acres (6 percent), from 29,600 acres to about 31,300 acres. There is also limited potential for reservoir reoperation to provide additional benefits to recreation by raising the bottom of the flood control pool elevation and allowing more reliable filling of the reservoir during the spring.

Benefits Related to Other SLWRI Objectives CP2 could also provide benefits related to flood damage reduction, ecosystem restoration, and water quality, as described for CP1, but to a greater extent because of increased capacity and associated overall system flexibility.

Construction for CP2

Construction activities for CP2 are described in Section 2.4.2, “Construction Activities Common to All Action Alternatives.” Information specific to CP2 construction activities is summarized in Tables 2-16 through 2-22.

Table 2-16. Reservoir Clearing Treatment Applied – CP2

Landing	Complete Removal (acres)	Complete Removal Quantity (board feet)	Overstory Removal (acres)	Overstory Removal Quantity (board feet)
Antlers	12	76,600	8	52,700
Bailey Cove	26	234,000	11	64,000
Beehive Point	4	8,500	38	161,300
Bridge Bay	14	81,600	0	0
Digger Bay	13	43,700	49	146,000
Hirz Bay	35	333,000	34	267,300
Jones Valley	26	128,800	81	517,100
Lakeshore East	27	92,800	4	19,700
Lower Salt Creek	22	151,800	24	98,900
McCloud Arm	7	23,500	0	0
Packers Bay	11	46,000	35	124,200
Pit Arm	3	35,300	0	0
Shasta Marina	2	28,200	21	141,000
Silverthorn	26	185,900	29	181,400
Turntable	8	52,200	13	139,900
Total	**236**	**1,521,900**	**347**	**1,913,500**

Key:
CP = comprehensive plan

Table 2-17. Physical Features for Proposed Modifications of Shasta Dam and Appurtenances – CP2

Physical Features	Quantities
Quantity of Concrete (cubic yards)	77,314
Quantity of Cement (tons)	170,500
Quantity of Metalwork (pounds)	20,435,889
Volume of Imported Fill Material (cubic yards)	94,420
Volume of Excavation to Waste Material (cubic yards)	1,610
Quantity of Demolished Material (cubic yards)	29,202
Area of Permanent Structures (square feet)	412,570
Area of Work Limits (square feet)	460,920

Key:
CP = comprehensive plan

Table 2-18. Physical Features for Proposed Dikes – CP2

Dike Features	Quantities
Lakeshore Dikes	
Doney Creek Dike	
Volume of Fill Material (core, drain, filter) (cubic yards)	12,246
Volume of Riprap (cubic yards)	980
Volume of Excavated Material (cubic yards)	3,108
Site Clearing and Grubbing Below Dike (acres)	1.5
Antlers Dike	
Volume of Fill Material (core, drain, filter) (cubic yards)	-
Volume of Riprap (cubic yards)	-
Volume of Excavated Material (cubic yards)	-
Site Clearing and Grubbing Below Dike (acres)	-
North Railroad Dike	
Volume of Fill Material (core, filter) (cubic yards)	17,142
Volume of Riprap (cubic yards)	410
Volume of Excavated Material (cubic yards)	1,503
Site Clearing and Grubbing Below Dike (acres)	1.15
Middle Railroad Dike	
Volume of Fill Material (core, filter) (cubic yards)	13,350
Volume of Riprap (cubic yards)	320
Volume of Excavated Material (cubic yards)	3,985
Site Clearing and Grubbing Below Dike (acres)	2.88
South Railroad Dike	
Volume of Fill Material (core, filter) (cubic yards)	101,942
Volume of Riprap (cubic yards)	2,460
Volume of Excavated Material (cubic yards)	8,503
Site Clearing and Grubbing Below Dike (acres)	6.22
Bridge Bay Dikes	
West Dike	
Volume of Fill Material (core, drain, filter) (cubic yards)	7,661
Volume of Riprap (cubic yards)	780
Volume of Excavated Material (cubic yards)	4,967
Site Clearing and Grubbing Below Dike (acres)	1.38
East Dike	
Volume of Fill Material (core, drain, filter) (cubic yards)	3,007
Volume of Riprap (cubic yards)	160
Volume of Excavated Material (cubic yards)	2,002
Site Clearing and Grubbing Below Dike (acres)	0.63

Key:
- = not applicable
CP = comprehensive plan

Table 2-19. Physical Features for Proposed Road Relocations by Major Road Focus Area – CP2

Road Relocation Features	Relocation Amounts
Lakeshore Drive	
Length (linear feet)	13,063
Clearing and Grubbing (acres)	7
Excavation to Embankment (cubic yards)	55,100
Embankment Fill (cubic yards)	145,875
Number of Road Segments Affected	6
Closure Expected	No
Turntable Bay Area	
Length (linear feet)	6,190
Clearing and Grubbing (acres)	2
Excavation to Embankment (cubic yards)	19,100
Embankment Fill (cubic yards)	71,500
Number of Road Segments Affected	3
Closure Expected	Yes
Gillman Road	
Length (linear feet)	1,246
Clearing and Grubbing (acres)	1
Excavation to Embankment (cubic yards)	0
Embankment Fill (cubic yards)	28,500
Number of Road Segments Affected	3
Closure Expected	Yes
Jones Valley and Silverthorn Area	
Length (linear feet)	1,950
Clearing and Grubbing (acres)	1
Excavation to Embankment (cubic yards)	0
Embankment Fill (cubic yards)	41,250
Number of Road Segments Affected	1
Closure Expected	Yes
Salt Creek Road	
Length (linear feet)	4,325
Clearing and Grubbing (acres)	1
Excavation to Embankment (cubic yards)	4,050
Embankment Fill (cubic yards)	34,563
Number of Road Segments Affected	4
Closure Expected	Yes
Remaining Road Relocations	
Length (linear feet)	2,280
Clearing and Grubbing (acres)	1
Excavation to Embankment (cubic yards)	120
Embankment Fill (cubic yards)	76,126
Number of Road Segments Affected	4
Closure Expected	No

Key:
CP = comprehensive plan

Table 2-20. Recreation Facilities to Be Modified or Relocated – CP2

Recreation Facilities	No. of Impacted Facilities	Relocation Needed[1]
Marinas/Boat Ramps	9/6	8.5 acres
Resorts/Campground and Day Use Areas	6/261	50.9 acres
Trailheads	2	2
Trails	-	9.9 miles

Note:
[1] Does not include on-site modification of facilities

Table 2-21. Recreation Facilities Demolition and Construction Material Quantities – CP2

Material	Quantity
Recreation Facilities	
Imported Fill (cubic yards)	384,191
Excavation to Waste (cubic yards)	430,584
Demolition (cubic yards)	102,076
Nonrecreation Structures	
Demolition (cubic yards)	21,450

Key:
CP = comprehensive plan

Table 2-22. Physical Features for Proposed Utilities Relocations – CP2

Utility Type	Relocation Amounts
Potable Water Facilities	
Length of Waterlines Relocated (linear feet)	8,450
Wells/Tanks Relocated (number)	13
Pump Stations Relocated (number)	2
Length of Waterline Demolished (linear feet)	11,220
Wells/Tanks Demolished (number)	28
Pump Stations Demolished (number)	2
Gas/Petroleum Facilities	
Tanks Relocated (number)	10
Tanks Demolished (number)	10
Wastewater Facilities	
Septic Systems Relocated[1] (number)	19
Vault/Pit Toilets Relocated (number)	2
Pump Stations Relocated (number)	1
Length of Wastewater Pipe Relocated (linear feet)	430
Septic Systems Demolished[2] (number)	239
Vault/Pit Toilets Demolished (number)	2
Pump Stations Demolished (number)	2
Length of Wastewater Pipe Demolished (linear feet)	2,340
Package Wastewater Treatment Plants[3] (number)	Up to 6
Power Distribution Facilities	
Power Lines Relocated (linear feet)	36,305
Power Towers Relocated (number)	6
Power Lines Demolished (linear feet)	33,705
Power Towers Demolished (number)	6
Telecommunications	
Copper Wire Relocated (linear feet)	30,205
Fiber-Optic Cable Relocated (linear feet)	5,840
Copper Wire Demolished (linear feet)	27,810
Fiber-Optic Cable Demolished (linear feet)	5,180

Note:
[1] Does not include septic systems replaced with new sewer connections.
[2] Includes demolition of septic systems to be relocated, replaced with new sewer connections, and removed without relocation or replacement.
[3] Includes additional lift stations, force main, laterals, and holding tank pumps/valves not shown.
Key:
CP = comprehensive plan

Operations and Maintenance for CP2

Operations under CP2 are governed by the same regulatory constraints as described for CP1. Similar to CP1, under CP2, Shasta Dam operational guidelines would continue unchanged, with the additional storage retained for water supply reliability and to create an expanded cold-water pool for fisheries. For CP2, existing water quality and temperature requirements would typically be met in most years; therefore, additional water in storage would be released for water supply purposes. Accordingly, minimal increases in flow would be expected in months when Delta exports were constrained, or when flow was not usable for water supply purposes.

At a base level, CP2 would store some additional flows behind Shasta Dam during periods when downstream needs would have already been met, but flows would have been released because of storage limitations. The resulting increase in storage would be released downstream when there were opportunities for beneficial use of the water, either to meet water supply reliability demands or to improve Reclamation's abilities to meet its environmental objectives. The additional water in storage would also expand the cold-water pool, thus benefiting fisheries. Conversely, if water in storage were insufficient to meet all of the project purposes, the first increment to be reduced would be deliveries to water service contractors. Releases from Shasta Dam under CP2 would typically increase in the summer months, corresponding with the periods of greatest agricultural demands. Similarly, releases would be reduced in the winter months, when the increased storage space could be used to capture additional runoff rather than releasing water to the downstream river, as would occur with Shasta Reservoir's current operations.

Maintenance of facilities related to the proposed dam and reservoir enlargement would be similar to maintenance activities currently conducted at Shasta Dam and Reservoir.

2.4.7 Comprehensive Plan (CP3) – 18.5-Foot Dam Raise, Anadromous Fish Survival and Water Supply Reliability

CP3 consists primarily of enlarging Shasta Dam by raising the dam crest 18.5 feet and enlarging the reservoir by 634,000 acre-feet.

Major Components of CP3

CP3 includes the following major components:

- Raising Shasta Dam and appurtenant facilities by 18.5 feet.
- Implementing the set of eight common management measures previously described.

By raising Shasta Dam 18.5 feet, from a crest at elevation 1,077.5 to elevation 1,096.0, CP3 would increase the height of the reservoir full pool by 20.5 feet. The additional 2-foot increase in the height of the full pool above the dam raise

height would result from spillway modifications similar to CP1. This increase in full pool height would add approximately 634,000 acre-feet of storage to the reservoir's capacity. Accordingly, storage in the overall full pool would increase from 4.55 MAF to 5.19 MAF. Although higher dam raises are technically and physically feasible, 18.5 feet is the largest dam raise that would not require extensive and costly reservoir area relocations, such as relocating the Pit River Bridge, I-5, and the Union Pacific Railroad tracks. Table 2-8 summarizes major components that would be associated with the CP3 dam raise.

Under CP3, operations for water supply, hydropower, and environmental requirements would be similar to existing operations, with the additional storage retained for water supply reliability and as an expanded cold-water pool for fisheries benefits. The existing TCD would be extended for efficient use of the expanded cold-water pool.

As described for the above alternatives, this alternative would also include the potential to revise flood control operational rules, which could reduce the potential for flood damage and benefit recreation.

Potential Benefits of CP3

Major potential benefits of CP3, related to contributions to the SLWRI objectives, are described below.

Increase Anadromous Fish Survival Water temperature is one of the most important factors in achieving recovery goals for anadromous fish in the Sacramento River. CP3 would increase the ability of Shasta Dam to make cold-water releases and regulate water temperatures for fish in the upper Sacramento River, primarily in dry and critically water dry years. This would be accomplished by raising Shasta Dam 18.5 feet, thus increasing the depth of the cold-water pool in Shasta Reservoir and resulting in an increase in seasonal cold-water volume below the thermocline (layer of greatest water temperature and density change). Cold water released from Shasta Dam significantly influences water temperature conditions in the Sacramento River between Keswick Dam and the RBDD. Hence, the most significant water temperature benefits to anadromous fish would occur upstream from the RBDD. It is estimated that improved water temperature conditions under CP3 could result in an average annual increase in the Chinook salmon population of about 607,000 out-migrating juvenile fish.

Increase Water Supply Reliability CP3 would increase water supply reliability by increasing firm water supplies for irrigation and M&I deliveries primarily during drought periods. This action would contribute to replacement of supplies redirected to other purposes in the CVPIA, which would help reduce estimated future water shortages by increasing the reliability of firm water supplies for agricultural and M&I deliveries by at least 133,400 acre-feet per year and average annual yield by about 75,800 acre-feet per year. For this PDEIS, firm yield is considered equivalent to the estimated increase in the

reliability of supplies during dry and critically dry periods. The majority of increased firm yield (103,800 acre-feet) would be for south-of-Delta agricultural and M&I deliveries. In addition, water use efficiency could help reduce current and future water shortages by allowing a more effective use of existing supplies. As population and resulting water demands continue to grow and available supplies continue to remain relatively static, more effectively using these supplies could reduce potential critical impacts to agricultural and urban areas resulting from water shortages. Under CP3, approximately $3.8 million would be allocated over an initial 10-year period to fund agricultural and M&I water conservation programs, focused on agencies benefiting from increased reliability of project water supplies.

Develop Additional Hydropower Generation Higher water surface elevations in the reservoir would result in a net increase in power generation of about 96 GWh per year. This generation value is the expected increased generation from Shasta Dam and other CVP/SWP facilities.

Maintain and Increase Recreation Opportunities CP3 includes features to, at a minimum, maintain the existing recreation capacity at Shasta Lake. Although CP3 does not include specific features to further benefit recreation resources, a small benefit would likely occur to the water-oriented recreation experience at Shasta Lake due to the increase in lake surface area and modernization of recreation facilities. The maximum surface area of the lake would increase by about 2,500 acres (8 percent), from 29,600 acres to about 32,100 acres. There is also limited potential for reservoir reoperation to provide additional benefits to recreation by raising the bottom of the flood control pool elevation and allowing more reliable filling of the reservoir during the spring.

Benefits Related to Other SLWRI Planning Objectives CP3 could also provide benefits related to flood damage reduction, ecosystem restoration, and water quality, as described for CP1, but to a greater extent because of increased capacity and associated overall system flexibility.

Construction for CP3

Construction activities for CP3 are described in Section 2.4.2, “Construction Activities Common to All Action Alternatives.” Information specific to CP3 construction activities is summarized in Tables 2-23 through 2-29.

Table 2-23. Reservoir Clearing Treatment Applied – CP3, CP4, and CP5

Landing	Complete Removal (acres)	Complete Removal Quantity (board feet)	Overstory Removal (acres)	Overstory Removal Quantity (board feet)
Antlers	17	109,300	12	75,100
Bailey Cove	37	333,700	15	91,300
Beehive Point	6	12,100	54	230,100
Bridge Bay	20	116,400	0	0
Digger Bay	19	62,400	70	208,300
Hirz Bay	49	474,900	49	381,200
Jones Valley	38	183,700	116	737,500
Lakeshore East	39	132,300	5	28,100
Lower Salt Creek	31	216,500	35	141,100
McCloud Arm	10	33,500	0	0
Packers Bay	16	65,600	50	177,100
Pit Arm	4	50,400	0	0
Shasta Marina	2	40,200	30	201,100
Silverthorn	37	265,200	41	258,800
Turntable	11	74,400	19	199,500
Total	**337**	**2,170,600**	**495**	**2,729,200**

Key:
CP = comprehensive plan

Table 2-24. Physical Features for Proposed Modifications of Shasta Dam and Appurtenances – CP3, CP4, and CP5

Physical Features	Quantities
Quantity of Concrete (cubic yards)	100,811
Quantity of Cement (tons)	213,039
Quantity of Metalwork (pounds)	21,751,199
Volume of Imported Fill Material (cubic yards)	130,470
Volume of Excavation to Waste Material (cubic yards)	1,610
Quantity of Demolished Material (cubic yards)	25,377
Area of Permanent Structures (square feet)	412,570
Area of Work Limits (square feet)	460,920

Key:
CP = comprehensive plan

Table 2-25. Physical Features for Proposed Dikes – CP3, CP4, and CP5

Dike Features	Quantities
Lakeshore Dikes	
Doney Creek Dike	
Volume of Fill Material (core, drain, filter) (cubic yards)	75,040
Volume of Riprap (cubic yards)	5,920
Volume of Excavated Material (cubic yards)	10,190
Site Clearing and Grubbing Below Dike (acres)	7.22
Antlers Dike	
Volume of Fill Material (core, drain, filter) (cubic yards)	4,910
Volume of Riprap (cubic yards)	380
Volume of Excavated Material (cubic yards)	340
Site Clearing and Grubbing Below Dike (acres)	0.92
North Railroad Dike	
Volume of Fill Material (core, filter) (cubic yards)	17,145
Volume of Riprap (cubic yards)	410
Volume of Excavated Material (cubic yards)	1,503
Site Clearing and Grubbing Below Dike (acres)	1.15
Middle Railroad Dike	
Volume of Fill Material (core, filter) (cubic yards)	13,350
Volume of Riprap (cubic yards)	320
Volume of Excavated Material (cubic yards)	3,985
Site Clearing and Grubbing Below Dike (acres)	2.88
South Railroad Dike	
Volume of Fill Material (core, filter) (cubic yards)	101,945
Volume of Riprap (cubic yards)	2,460
Volume of Excavated Material (cubic yards)	8,503
Site Clearing and Grubbing Below Dike (acres)	6.22
Bridge Bay Dikes	
West Dike	
Volume of Fill Material (core, drain, filter) (cubic yards)	69,000
Volume of Riprap (cubic yards)	23,630
Volume of Excavated Material (cubic yards)	15,280
Site Clearing and Grubbing Below Dike (acres)	2.2
East Dike	
Volume of Fill Material (core, drain, filter) (cubic yards)	40,100
Volume of Riprap (cubic yards)	7,440
Volume of Excavated Material (cubic yards)	16,880
Site Clearing and Grubbing Below Dike (acres)	1.12

Key:
CP = comprehensive plan

Table 2-26. Physical Features for Proposed Road Relocations by Major Road Focus Area – CP3, CP4, and CP5

Road Relocation Features	Relocation Amounts
Lakeshore Drive	
Length (linear feet)	13,743
Clearing and Grubbing (acres)	7
Excavation to Embankment (cubic yards)	55,500
Embankment Fill (cubic yards)	149,250
Number of Road Segments Affected	8
Closure Expected	No
Turntable Bay Area	
Length (linear feet)	6,190
Clearing and Grubbing (acres)	2
Excavation to Embankment (cubic yards)	19,000
Embankment Fill (cubic yards)	71,500
Number of Road Segments Affected	3
Closure Expected	Yes
Gillman Road	
Length (linear feet)	1,246
Clearing and Grubbing (acres)	1
Excavation to Embankment (cubic yards)	0
Embankment Fill (cubic yards)	28,500
Number of Road Segments Affected	3
Closure Expected	Yes
Jones Valley and Silverthorn Area	
Length (linear feet)	3,562
Clearing and Grubbing (acres)	2
Excavation to Embankment (cubic yards)	1,500
Embankment Fill (cubic yards)	54,500
Number of Road Segments Affected	4
Closure Expected	Yes
Salt Creek Road	
Length (linear feet)	5,108
Clearing and Grubbing (acres)	1
Excavation to Embankment (cubic yards)	5,540
Embankment Fill (cubic yards)	34,563
Number of Road Segments Affected	5
Closure Expected	Yes
Remaining Road Relocations	
Length (linear feet)	3,939
Clearing and Grubbing (acres)	2
Excavation to Embankment (cubic yards)	620
Embankment Fill (cubic yards)	89,251
Number of Road Segments Affected	7
Closure Expected	No

Key:
CP = comprehensive plan

Table 2-27. Recreation Facilities to Be Modified or Relocated – CP3, CP4, and CP5

Recreation Facilities	No. of Impacted Facilities	Relocation Needed[1]	CP5 Additional Recreation Enhancement[2]
Marinas/Boat Ramps	9/6	8.5 acres	-
Resorts/Campground and Day-Use Areas	6/328	56 acres	-
Trailheads	2	2	6
Trails	-	11.6 miles	18 miles

Notes:
[1]Does not include on-site modification of facilities.
[2]Additional recreation facilities for Alternative CP5 only.
Key:`
- = not applicable
CP = comprehensive plan

Table 2-28. Recreation Facilities Demolition and Construction Material Quantities – CP3, CP4, and CP5

Material	Quantity
Recreation Facilities	
Imported Fill (cubic yards)	552,829
Excavation to Waste (cubic yards)	315,396
Demolition (cubic yards)	105,220
Nonrecreation Structures	
Demolition (cubic yards)	26,960

Key:
CP = comprehensive plan

Table 2-29. Physical Features for Proposed Utilities Relocations for CP3, CP4, and CP5

Utility Type	Relocation Amounts
Potable Water Facilities	
Length of Waterlines Relocated (linear feet)	11,045
Wells/Tanks Relocated (number)	10
Pump Stations Relocated (number)	3
Length of Waterline Demolished (linear feet)	14,790
Wells/Tanks Demolished (number)	25
Pump Stations Demolished (number)	3
Gas/Petroleum Facilities	
Tanks Relocated (number)	10
Tanks Demolished (number)	10
Wastewater Facilities	
Septic Systems Relocated[1] (number)	19
Vault/Pit Toilets Relocated (number)	2
Pump Stations Relocated (number)	1
Length of Wastewater Pipe Relocated (linear feet)	430
Septic Systems Demolished[2] (number)	266
Vault/Pit Toilets Demolished (number)	2
Pump Stations Demolished (number)	2
Length of Wastewater Pipe Demolished (linear feet)	2,370
Package Wastewater Treatment Plants[3] (number)	Up to 6
Power Distribution Facilities	
Power Lines Relocated (linear feet)	37,790
Power Towers Relocated (number)	6
Power Lines Demolished (linear feet)	36,185
Power Towers Demolished (number)	6
Telecommunications	
Copper Wire Relocated (linear feet)	33,380
Fiber-Optic Cable Relocated (linear feet)	5,840
Copper Wire Demolished (linear feet)	31,245
Fiber-Optic Cable Demolished (linear feet)	5,180

Note:
[1] Does not include septic systems replaced with new sewer connections.
[2] Includes demolition of septic systems to be relocated, replaced with new sewer connections, and removed without relocation or replacement.
[3] Includes additional lift stations, force main, laterals, and holding tank pumps/valves not shown.
Key:
CP = comprehensive plan

Operations and Maintenance for CP3

Operations under CP3 are governed by the same regulatory constraints as described for CP1. Similar to CP1, under CP3, Shasta Dam operational guidelines would continue unchanged, with the additional storage retained for water supply reliability and to create an expanded cold-water pool for fisheries. For CP3, existing water quality and temperature requirements would be met in most years; therefore, additional water in storage would be released for water supply purposes. Accordingly, minimal increases in flow would be expected in months when Delta exports were constrained, or when flow was not usable for water supply purposes.

At a base level, CP3 would store some additional flows behind Shasta Dam during periods when downstream needs would have already been met, but flows would have been released because of storage limitations. The resulting increase in storage would be released downstream when there were opportunities for beneficial use of the water, either to meet water supply reliability demands or to improve Reclamation's abilities to meet its environmental objectives. The additional water in storage would also expand the cold-water pool, thus benefiting fisheries. Conversely, if water in storage were insufficient to meet all of the project purposes, the first increment to be reduced would be deliveries to water service contractors. Releases from Shasta Dam under CP3 would typically increase in the summer months, corresponding with the periods of greatest agricultural demands. Similarly, releases would be reduced in the winter months, when the increased storage space could be used to capture additional runoff rather than releasing water to the downstream river, as would occur with Shasta Reservoir's current operations.

Maintenance of facilities related to the proposed dam and reservoir enlargement would be similar to maintenance activities currently conducted at Shasta Dam and Reservoir.

2.4.8 Comprehensive Plan 4 (CP4) – 18.5-Foot Dam Raise, Anadromous Fish Focus with Water Supply Reliability

CP4 focuses on increasing anadromous fish survival by raising Shasta Dam 18.5 feet while also increasing water supply reliability.

Major Components of CP4

CP4 includes the following major components:

- Raising Shasta Dam and appurtenant facilities by 18.5 feet.
- Reserving 378,000 acre-feet of the increased storage in Shasta Lake for maintaining cold-water volume or augmenting flows as part of an adaptive management plan for anadromous fish survival.
- Augmenting spawning gravel in the upper Sacramento River.

- Restoring riparian, floodplain, and side channel habitat.

- Implementing the set of eight common management measures previously described.

By raising Shasta Dam 18.5 feet, from a crest at elevation 1,077.5 to elevation 1,096.0, CP4 would increase the height of the reservoir full pool by 20.5 feet. The additional 2-foot increase in the height of the full pool above the dam raise height would result from spillway modifications similar to CP1. This increase in full pool height would add approximately 634,000 acre-feet of storage to the reservoir's capacity. Accordingly, storage in the overall full pool would be increased from 4.55 MAF to 5.19 MAF.

The additional storage created by the 18.5-foot dam raise would be used to both improve the ability to meet temperature objectives for winter-run Chinook salmon and to meet habitat requirements for other anadromous fish during drought years and increase water supply reliability. Of the increased reservoir storage space, about 378,000 acre-feet would be dedicated to increasing the supply of cold water for anadromous fish survival purposes. Table 2-8 summarizes major components that would be associated with the CP4 dam raise.

Operations for the remaining portion of increased storage (approximately 256,000 acre-feet) would be the same as in CP1. The existing TCD would be extended to achieve efficient use of the expanded cold-water pool.

As described for the above alternatives, this alternative also would include the potential to revise the operational rules for flood control for Shasta Dam and Reservoir, which could reduce the potential for flood damage and benefit recreation.

CP4 also includes an adaptive management plan for the cold-water pool, and augmenting spawning gravel and restoring riparian, floodplain, and side channel habitat in the upper Sacramento River.

Adaptive Management of Cold-Water Pool The adaptive management plan may include operational changes to the timing and magnitude of releases from Shasta Dam to benefit anadromous fish, as long as there are no conflicts with current operational guidelines or adverse impacts to water supply reliability. Further discussion regarding adaptive management of the cold-water pool for anadromous fish is included below under "Operations and Maintenance."

Augment Spawning Gravel in Upper Sacramento River Gravel suitable for spawning has been identified as a significant influencing factor in the recovery of anadromous fish populations in the Sacramento River (USFWS 2001, NMFS 2009). Under CP4, spawning-sized gravel would be placed at multiple locations along the Sacramento River between Keswick Dam and the RBDD.

Gravel augmentation would occur at one to three locations every year, for a period of 10 years, unless unusual conditions or agency requests precluded placement during a single year. This program, in combination with the ongoing CVPIA gravel augmentation program, would help address the gravel debt in the upper Sacramento River, but this reach may continue to be gravel-starved into the future. Therefore, the gravel augmentation program proposed herein would be reevaluated after the 10-year period to assess the need for continued spawning gravel augmentation, and to identify opportunities for future actions or programs to do so.

On average, 5,000 to 10,000 tons of gravel would be placed each year, although the specific quantity of gravel placed in a given year may vary from that range. Gravel would be obtained as uncrushed, rounded river rock, free of debris and organic material, from local, commercial sources. To maximize the benefit to anadromous fish, gravel would be washed and sorted to meet specific size criteria. To minimize impacts to salmonid spawning activity, gravel applied to active river channels would be placed between August and September each year, consistent with the time frame for the ongoing CVPIA gravel augmentation program.

Fifteen preliminary locations for spawning gravel augmentation were identified in the Sacramento River between Keswick Dam and Shea Island. Each site would be eligible for gravel placement one or more times during the 10-year program. Selection of these locations was based on potential benefits to anadromous fish and site accessibility. Gravel placement would provide either immediate spawning habitat or long-term recruitment.

Although preliminary sites have been identified, specific gravel augmentation site(s) and volume(s) would be selected each year in the spring or early summer through discussions among Reclamation, USFWS, DFG, and NMFS. The discussions would include topics such as avoiding redundancy with planned CVPIA gravel augmentation activities in a given year; identifying hydrology or morphology issues that could impact the potential benefit of placing gravel at any particular site; identifying changes in spawning trends due to previous years' gravel augmentation activities; evaluating potential new sites; and appropriately distributing selected gravel sites along the river reach(es).

Restore Riparian, Floodplain, and Side Channel Habitat Under CP4, riparian, floodplain, and side channel habitat restoration would be constructed at a suitable location along the Sacramento River. The exact size, scope, and location of a suitable restoration site is still under development and will be provided future versions of this EIS (Draft EIS and/or FEIS). A description potential of riparian, floodplain, and side channel habitat restoration at Reading Island is provided below as an example restoration project. Restoration activities anticipated under CP4 are expected to be similar in size and scope to those described below.

Reading Island lies along the Sacramento River just north of Cottonwood Creek in Shasta County at River Mile 274. Reading Island is approximately 269 acres in area, with 46 acres on the south end of the island owned by U.S. Bureau of Land Management and managed as a day-use park (Figure 2-6). The remaining 223 acres are privately owned. The island is accessible by Adobe Road and a bridge crossing over the Anderson Creek Slough into the U.S. Bureau of Land Management day-use park. Historically, the channel that now forms the slough supported important habitat for anadromous salmonids, including rearing habitat for winter-run Chinook and spawning habitat for Central Valley steelhead.

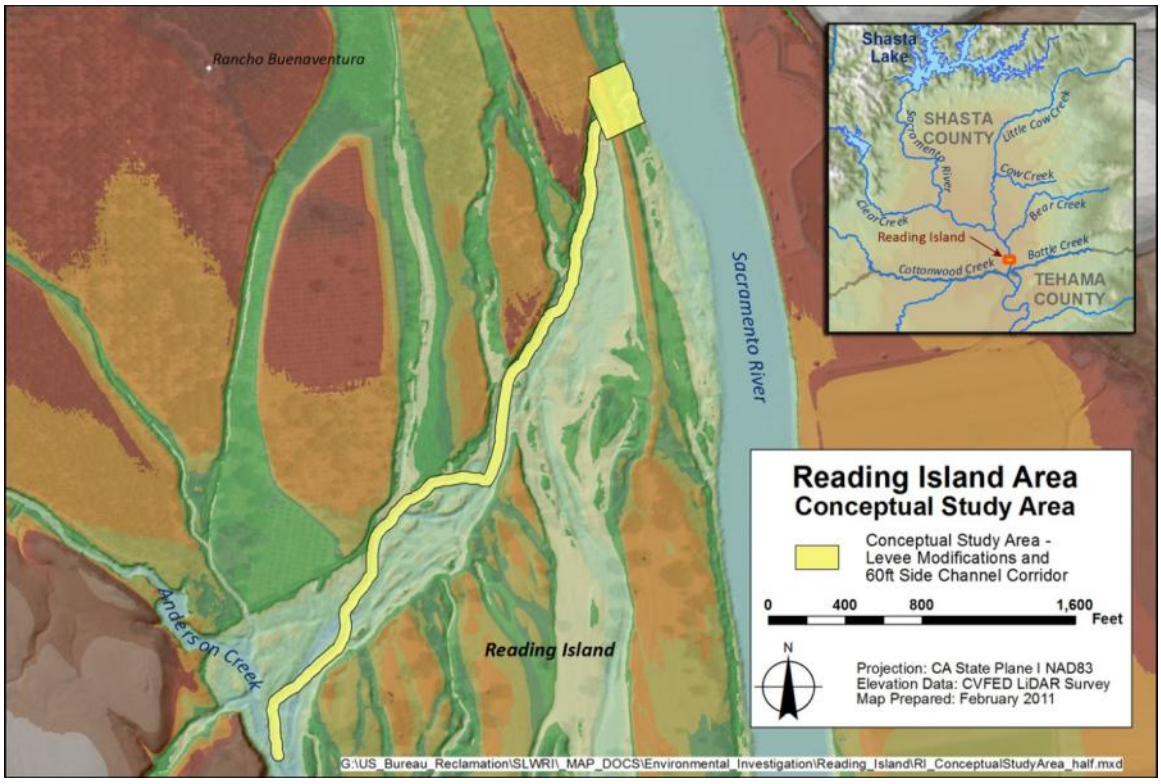


Figure 2-6. Reading Island Conceptual Study Area

At the Reading Island site, an approximately 0.8-mile-long historic Sacramento River channel/floodplain scour channel/side channel (hereafter referred to as "side channel") drains into the present-day Anderson Creek, a remnant Sacramento River side channel. Anderson Creek flows approximately 1.5 miles and then enters the Sacramento River about 0.3 miles upstream from Cottonwood Creek. Average channel width of the side channel is approximately 30 feet.

The Anderson Creek Slough, into which Anderson Creek empties, was blocked at the upstream end in the early 1970s by construction of a levee on the adjoining private property. A few years after construction of the levee, the slough became choked with various species of water plants, primarily primrose

creeper (*Ludwigia peploides).* Before levee construction, the Anderson Creek Slough captured a portion of the Sacramento River flow and functioned as side channel habitat.

After levee construction, water velocity in the side channel slowed substantially and water temperatures increased. Primrose creeper and warm-water nonnative fish species established within the channel. Currently, most of the water entering the slough comes from Anderson Creek and drainage wastewater from irrigation canals. An earthen embankment with two 36-inch-diameter culverts now restricts the flow of water into the side channel. The water surface elevation of the Sacramento River, with a flow rate of 8,500 cfs, is at the approximate elevation of the invert of the culverts, but even when discharge in the Sacramento River increases to approximately 12,000 cfs, there is minimal flow through the culverts into the side channel. Above the slough, Anderson Creek is known to provide rearing habitat for winter-run Chinook, and is managed for steelhead spawning habitat.

Floodplain, riparian, and side channel habitat restoration would involve acquiring property on Reading Island and revegetating floodplain terraces and adjacent riparian areas with native plants. In addition, the Reading Island side channel could be activated over a wider range of flows to provide juvenile salmonid rearing habitat in the side channel, and in Anderson Creek at the downstream end of the side channel. This would be accomplished by breaching the levee at the upstream end of the side channel to restore connectivity with the Sacramento River at flows greater than 4,000 to 6,000 cfs. Preliminary analysis indicates that in addition to breaching the levee, side channel clearing and excavation may be necessary to restore flows capable of supporting suitable spawning habitat. This would include vegetation and debris removal and deepening of the existing channel. At a maximum, side channel clearing and excavation would be performed along the entire 0.8-mile channel, requiring the removal of about 15,560 cubic yards of material.

Planting mix, composition, and density would be determined by a more detailed site analysis, but could include native cottonwood, willow, box elder, valley oak, western sycamore, elderberry, and a variety of understory brush species. Temporary irrigation would be provided on an as-needed basis with a temporary well powered from an existing nearby power supply. The revegetated areas are expected to develop into self-sustaining riparian habitats within 1 to 4 years of initial planting, based on results of previous riparian restoration projects along the Sacramento River. Regraded floodplain areas are expected to change over time depending on hydrologic conditions, but it is anticipated that no elements of this measure would need to be replaced or reapplied during the 50-year project life. The site would be fenced to reduce the potential for access by livestock.

Potential Benefits of CP4

Major potential benefits of CP4, related to the SLWRI objectives, are described below.

Increase Anadromous Fish Survival Water temperature is one of the most important factors in achieving recovery goals for anadromous fish in the Sacramento River. CP4 would significantly increase the ability of Shasta Dam to make cold-water releases and regulate water temperature in the upper Sacramento River, primarily in dry and critically dry water years. This would be accomplished by raising Shasta Dam 18.5 feet, thus increasing the depth of the cold-water pool in Shasta Reservoir and resulting in an increase in seasonal cold-water volume below the thermocline (layer of greatest water temperature and density change). Cold water released from Shasta Dam significantly influences water temperature conditions in the Sacramento River between Keswick Dam and the RBDD. Hence, the most significant water temperature benefits to anadromous fish would occur upstream from the RBDD. It is estimated that improved water temperature conditions under CP4 could result in an average annual increase in Chinook salmon population of nearly 1,199,000 out-migrating juvenile fish.

Under CP4, an increase in the cold-water pool would allow Reclamation to operate Shasta Reservoir to provide not only a more reliable source of water during dry and critical water years, but also to provide more cool water for release into the Sacramento River to improve conditions for anadromous fish. Of the increased storage space, about 378,000 acre-feet (60 percent) would be dedicated to increasing the cold-water supply for anadromous fish survival purposes.

In addition, CP4 includes a gravel augmentation program. Gravel augmentation would occur on average at one or more locations in the Sacramento River between Keswick Dam and the RBDD for a period of 10 years and, on average, 5,000 to 10,000 tons of gravel would be placed each year, although the specific quantity of gravel placed in a given year may vary from that range. Spawning gravel augmentation is expected to positively influence anadromous fish populations in the Sacramento River.

Increase Water Supply Reliability CP4 would increase water supply reliability by increasing firm water supplies for irrigation and M&I deliveries primarily during drought periods. This action would contribute to replacement of supplies redirected to other purposes in the CVPIA, which would help reduce estimated future water shortages by increasing the reliability of firm water supplies for agricultural and M&I deliveries by at least 76,400 acre-feet per year and average annual yield by about 46,400 acre-feet per year. For this PDEIS, firm yield is considered equivalent to the estimated increase in the reliability of supplies during dry and critically dry periods. The majority of increased firm yield (66,800 acre-feet) would be for south-of-Delta agricultural and M&I deliveries. In addition, water use efficiency could help reduce current and future

water shortages by allowing a more effective use of existing supplies. As population and resulting water demands continue to grow and available supplies continue to remain relatively static, more effectively using these supplies could reduce potential critical impacts to agricultural and urban areas resulting from water shortages. Under CP4 approximately $2.3 million would be allocated over an initial 10-year period to fund agricultural and M&I water conservation programs, focused on agencies benefiting from increased reliability of project water supplies.

Develop Additional Hydropower Generation Higher water surface elevations in the reservoir would result in a net increase in power generation of about 138 GWh per year. This generation value is the expected increased generation from Shasta Dam and other CVP/SWP facilities.

Conserve, Restore, and Enhance Ecosystem Resources In the upper Sacramento River, the addition of spawning gravel and the restoration of riparian, floodplain, and side channel habitat are expected to improve the complexity of aquatic habitat and its suitability for spawning and rearing. Riparian areas provide habitat for a diverse array of plant and animal communities along the Sacramento River, including numerous threatened or endangered species. Riparian areas also provide shade and woody debris that increase the complexity of aquatic habitat and its suitability for spawning and rearing. Lower floodplain areas, river terraces, and gravel bars play an important role in the health and succession of riparian habitat. Restoration would support the goals of the Sacramento River Conservation Area Forum and other programs associated with riparian restoration along the Sacramento River. In addition, improved fisheries conditions as a result of cold-water carryover storage in CP4, as described above, and increased flexibility to meet flow and temperature requirements, could also enhance overall ecosystem resources in the Sacramento River. Side channels can support important habitat for anadromous salmonids, including rearing and spawning habitat. Side channel habitats also provide refuge from predators and productive foraging habitat for juvenile anadromous salmonids.

Maintain and Increase Recreation Opportunities CP4 includes features to, at a minimum, maintain the existing recreation capacity at Shasta Lake. Potential recreation benefits would be as stated for CP3. The maximum surface area of the lake would increase by about 2,500 acres (8 percent), from 29,600 acres to about 32,100 acres. There is also limited potential for reservoir reoperation to provide additional benefits to recreation by raising the bottom of the flood control pool elevation and allowing more reliable filling of the reservoir during the spring.

Benefits Related to Other SLWRI Objectives CP4 could also provide benefits related to flood damage reduction and water quality, similar to CP1.

Construction for CP4

Construction activities related to enlarging the reservoir under CP4 are identical to those described for CP3, and are summarized in Tables 2-23 through 2-29. Additional construction effort would be required for the proposed spawning gravel augmentation, as described below.

Gravel augmentation would occur at one to three locations every year for a period of 10 years, unless unusual conditions or agency requests precluded placement during a single year. Construction activities would vary significantly by location, but generally would include clearing, grubbing, and some grading of new access routes to allow construction vehicles to access the river. At several sites, clearing and grubbing of the riverbank would be required to allow gravel to be placed on the bank for recruitment. Gravel would be delivered to the sites by dump trucks. In most cases, gravel would be stockpiled in a staging area and moved with bulldozers, loaders, and/or excavators. Dust control trucks would be present at all times when gravel is on site.

Several sites would require in-water construction work. Generally, this involves gravel being built out into the river channel "step-wise," meaning gravel is dumped and leveled, and the leveled area serves as a working platform for the next step of construction. This practice is common for spawning gravel placement, and minimizes the extent to which construction vehicles drive directly through an active river channel. One or two sites, however, would require construction activity in the active river channel, where construction vehicles would deposit gravel and grade a submerged riffle.

Riparian, Floodplain, and Side Channel Habitat Restoration Riparian, floodplain, and side channel habitat restoration at Reading Island would involve acquiring and revegetating floodplain terraces and adjacent riparian areas with native plants, and breaching the levee at the upstream end of the side channel. Planting mix, composition, and density would be determined by a more detailed site analysis, but could include native cottonwood, willow, box elder, valley oak, western sycamore, elderberry, and a variety of understory brush species.

Breaching the levee would include the use of an excavator, loader, and compaction equipment. For a 3:1 cut through the levee down to the invert elevations of the culvert, with a 60-foot-wide base, approximately 7,901 cubic yards of earthen material would be excavated. If side channel clearing and excavation are necessary, clearing would be performed along the 0.8-mile channel over a maximum average width of 30 feet plus an additional 10 feet for construction equipment access, covering a maximum area of 3.9 acres. Excavation would involve a maximum average width and depth of 20 and 5 feet, respectively, along the length of the channel for a maximum of 15,560 cubic yards of material removal. The transport of excavated material would likely be accomplished with loader and dump trucks. Excavated materials would be taken off site to commercially available, approved locations for safe storage, use, and/or disposal. A mechanical harvester would be used to remove

invasive aquatic vegetation from the side channel and Anderson Slough. In-water construction is expected to take place during periods of low flow in the Sacramento River (October to November) to minimize water quality impacts. Further construction methods, staging areas, and borrow sites would be identified by Reclamation and included in future versions of this document (Draft EIS or FEIS).

Operations and Maintenance for CP4

Operations under CP4 are governed by the same regulatory constraints as described for CP1. Similar to CP1, Shasta Dam operational guidelines would continue unchanged under CP4, with the additional storage retained for water supply reliability and to create an expanded cold-water pool for fisheries. Of the 634,000 acre-feet of additional storage, 378,000 acre-feet of water (60 percent) would be dedicated to increasing the cold-water supply for anadromous fish survival purposes. This would be in addition to any storage targets set by regulations described in Chapter 6, "Hydrology, Hydraulics, and Water Management."

As modeled, the 378,000 acre-feet of additional water would be the first increment of the reservoir filled after the reservoir was enlarged, and would be available as additional water for the cold-water pool each year regardless of water year type, unless Reclamation elected to use the additional water to augment flows protecting anadromous fish in the Sacramento River, as part of a proposed adaptive management plan, as explained below. An additional 256,000 acre-feet of the increased storage space would primarily be used to improve water supply reliability; operations of Shasta Dam related to the 256,000 acre-feet of storage would be identical to CP1.

As stated above, of the total 634,000 acre-feet of additional storage, 378,000 acre-feet of water would be used to increase the cold-water pool for fisheries. The additional 378,000 acre-feet of cold-water pool would be managed by Reclamation in coordination with the Sacramento River Temperature Task Group (SRTTG). Reclamation is currently working with NMFS, USFWS, and DFG through the SRTTG, which is a multiagency group established to adaptively manage flows and water temperatures in the Sacramento River to improve and stabilize Chinook salmon populations in the upper Sacramento River.

Current analysis indicates that the most beneficial use of the additional 378,000 acre-feet of storage for fisheries protection is as an expanded cold-water pool; however, Reclamation has agreed to adaptively manage the 378,000 acre-feet of water, as appropriate, to increase benefits to anadromous fish as part of CP4. Adaptive management is an approach allowing decision makers to take advantage of a variety of strategies and techniques that are adjusted, refined, and/or modified based on an improved understanding of system dynamics. Adaptive management, if applied appropriately, allows for flexible operations based on best available science and new information as it becomes available.

The adaptive management plan may include operational changes to the timing and magnitude of releases primarily to improve the quality and quantity of aquatic habitat. These changes may include increasing minimum flows, timing releases from Shasta Dam to mimic more natural seasonal flows, meeting flow targets for side channels, or retaining the additional 378,000 acre-feet of water in storage to meet temperature requirements. Reclamation would work cooperatively with the SRTTG to determine the best use of the cold-water pool each year under an adaptive management plan. Reclamation would manage the cold-water pool and operate Shasta Dam each year based on recommendations from the SRTTG. Because adaptive management is predicated on using best available science and new information to make decisions, a monitoring program would be implemented as part of the adaptive management plan. SRTTG would conduct monitoring, develop monitoring protocols, and set performance standards to determine the success of adaptive management actions.

Currently, the 378,000 acre-feet of additional storage would be the first increment of water in the reservoir to fill after dam enlargement, and would be available each year independent of water year type if used exclusively to enlarge the cold-water pool. If the 378,000 acre-feet of stored water is used to augment flows based on recommendations from the SRTTG, this water would not be guaranteed to be available for use the following year because of uncertainty in hydrologic conditions, although the potential to store the water, if available, would remain. Once water was released to augment flows as part of the adaptive management plan, the 378,000 acre-feet of additional storage space would be refilled after the 256,000 acre-feet of additional storage space was filled for the primary purpose of increasing water supply reliability. Each year that the 378,000 acre-feet of additional water was held in storage as part of an increase in the cold-water pool, the allocated amount would be available as long as the cold-water pool continued to provide benefits to fisheries.

Since SALMOD modeling and related analysis indicate that in most cases, providing an increased cold-water pool benefits Chinook salmon populations more than increasing flows, impacts and benefits of increasing flows under CP4 are not presented in this PDEIS. Per recommendations in Title 43 of the Code of Federal Regulations Part 46 Section 46.145, substantive increases in flows associated with the adaptive management plan would be evaluated in subsequent NEPA analysis.

Maintenance of facilities related to the proposed dam and reservoir enlargement would be similar to maintenance activities currently conducted at Shasta Dam and Reservoir.

2.4.9 Comprehensive Plan 5 (CP5) – 18.5-Foot Dam Raise, Combination Plan

CP5 primarily focuses on increased water supply reliability, anadromous fish survival, Shasta Lake area environmental resources, and increased recreation opportunities.

Major Components of CP5

CP5 includes the following major components:

- Raising Shasta Dam and appurtenant facilities by 18.5 feet.
- Constructing additional resident fish habitat in Shasta Lake and along the lower reaches of its tributaries (Sacramento River, McCloud River, and Squaw Creek).
- Constructing shoreline fish habitat around Shasta Lake.
- Augmenting spawning gravel in the upper Sacramento River.
- Restoring riparian, floodplain, and side channel habitat.
- Increasing recreation opportunities at Shasta Lake.
- Implementing the set of eight common management measures previously described.

By raising Shasta Dam 18.5 feet, from a crest at elevation 1,077.5 to elevation 1,096.0, CP5 would increase the height of the reservoir full pool by 20.5 feet. The additional 2-foot increase in the height of the full pool above the dam raise height would result from spillway modifications similar to CP1. This increase in full pool height would add approximately 634,000 acre-feet of storage to the reservoir's capacity. Accordingly, storage in the overall full pool would be increased from 4.55 MAF to 5.19 MAF. Table 2-8 summarizes major components that would be associated with the CP5 dam raise.

Under CP5, operations for water supply, hydropower, and environmental requirements would be similar to existing operations, with the additional storage retained for water supply reliability and as an expanded cold-water pool for fisheries benefits. The existing TCD would be extended to achieve efficient use of the expanded cold-water pool.

As described for the above alternatives, this alternative also would include the potential to revise the flood control operational rules for Shasta Dam and Reservoir, which could reduce the potential for flood damage and benefit recreation.

CP5 also includes (1) restoring resident fish habitat in Shasta Lake, (2) restoring fisheries and riparian habitat at several locations along the lower reaches of the tributaries to Shasta Lake, (3) augmenting spawning gravel in the upper

Sacramento River, (4) restoring riparian, floodplain, and side channel habitat in the upper Sacramento River, and (5) increasing recreation opportunities at Shasta Lake.

Construct Shoreline Enhancement The ecosystem enhancement goal for the shoreline environment of Shasta Lake is to improve warm-water fish habitat associated with the transition between the reservoir's aquatic and terrestrial habitats. Shoreline enhancement entails a range of enhancement opportunities along the Shasta Lake shoreline below the full pool elevation (1,090 feet) that would occur with an 18.5-foot dam raise. This area is typically between 0.1 and 1.5 miles upslope from the current full pool elevation of 1,070 feet. The shoreline is defined as the area encompassing nearshore aquatic habitat within the reservoir itself and vegetation and other habitat components adjacent to the reservoir.

Two categories of potential nearshore warm-water fish habitat enhancement activities are (1) structural enhancements, which entail placing artificial structures in the Shasta Lake littoral zone, and (2) vegetative enhancements, which entail planting and seeding to provide submerged and partly submerged vegetative cover when the reservoir is at full pool capacity during the winter/spring months.

Construction activities common to all action alternatives include stockpiling manzanita for fish habitat (see Section 2.4.2). CP5 would include clearing additional manzanita from above the new full pool inundation zone to create further structural enhancements for fish habitat in the Shasta Lake littoral zone.

Vegetative enhancements associated with CP5 would include planting willows (*Salix*) to enhance nearshore fish habitat, and single treatment aerial and hand seeding of annual cereal grains to treat shoreline areas at Shasta Lake. Treatment with cereal grains provides only short-term cover, but is cost-effective across large areas and can be implemented quickly and efficiently. The annual cereal grain grasses provide cover for young fish and also nutrients for plankton as the grasses decompose. The plankton in turn are a valuable food source for juvenile fish.

Construct Tributary Aquatic Habitat Enhancement The primary goal for the enhancement of aquatic habitat in the watershed is to improve the connectivity for native fish species and other aquatic organisms between Shasta Lake and its tributaries. Two categories of potential aquatic habitat enhancement in tributaries are (1) fish passage enhancements, which entail identifying and correcting barriers to fish passage, particularly at culverts and other human-made barriers, and (2) aquatic habitat enhancements, which entail identifying and implementing feasible habitat improvements intended to conserve or restore degraded aquatic and riparian habitat in tributaries to Shasta Lake.

Fish passage enhancements associated with CP5 include opportunities to restore and/or enhance five perennial stream crossings. Barriers to fish passage in the watersheds above Shasta Lake are primarily associated with culverts or other types of stream crossings.

Aquatic habitat enhancements associated with CP5 include enhancing aquatic connectivity and reducing sediment related to roads constructed across intermittent streams. The preliminary site survey identified opportunities to enhance 14 intermittent stream crossings. Based on the information obtained in the survey, these crossings provide opportunities for meeting the objectives of enhancing aquatic connectivity and/or reducing the potential for road-related sediment. Two sites have been identified in the Salt Creek watershed, two sites have been identified in the Sugarloaf Creek watershed, and ten sites have been identified in the McCloud Arm watershed.

Augment Spawning Gravel in Upper Sacramento River As described in CP4, spawning gravel will be added to the upper Sacramento River. This measure is identical to that proposed under CP4.

Restore Riparian, Floodplain, and Side Channel Habitat As described in CP4, riparian, floodplain, and side channel habitat restoration would be constructed at a suitable location along the Sacramento River. This measure is identical to that proposed under CP4.

Recreation Enhancements A total of 18 miles of new hiking trails and 6 trailheads would be constructed to enhance recreation under CP5. Descriptions have been developed for the trails and associated features, and are included in the Engineering Summary Appendix.

Potential Benefits of CP5

Major potential benefits of CP5, related to the SLWRI objectives, are described below.

Increase Anadromous Fish Survival Water temperature is one of the most important factors in achieving recovery goals for anadromous fish in the Sacramento River. CP5 would increase the ability of Shasta Dam to make cold-water releases and regulate water temperature in the upper Sacramento River, primarily in dry and critically dry water years. This would be accomplished by raising Shasta Dam 18.5 feet, thus increasing the depth of the cold-water pool in Shasta Reservoir and resulting in an increase in seasonal cold-water volume below the thermocline (layer of greatest water temperature and density change). Cold water released from Shasta Dam significantly influences water temperature conditions in the Sacramento River between Keswick Dam and the RBDD. Hence, the most significant water temperature benefits to anadromous fish would occur upstream from the RBDD. It is estimated that improved water temperature conditions under CP5 could result in an annual average increase in the Chinook salmon population of about 607,000 out-migrating juvenile fish.

Increase Water Supply Reliability CP5 would increase water supply reliability by increasing firm water supplies for irrigation and M&I deliveries primarily during drought periods. This action would contribute to replacement of supplies redirected to other purposes in the CVPIA, which would help reduce estimated future water shortages by increasing the reliability of firm water supplies for agricultural and M&I deliveries by at least 133,400 acre-feet per year, and average annual yield by about 75,800 acre-feet per year. For this PDEIS, firm yield is considered equivalent to the estimated increase in the reliability of supplies during dry and critically dry periods. The majority of increased firm yield (103,800 acre-feet) would be for south-of-Delta agricultural and M&I deliveries. In addition, increased water use efficiency could help reduce current and future water shortages by allowing a more effective use of existing supplies. As population and resulting water demands continue to grow and available supplies continue to remain relatively static, more effective use of these supplies may reduce potential critical impacts to agricultural and urban areas resulting from water shortages. Under CP5, approximately $3.8 million would be allocated over an initial 10-year period to fund agricultural and M&I water conservation programs, focused on agencies benefiting from increased reliability of project water supplies.

Develop Additional Hydropower Generation Higher water surface elevations in the reservoir would result in a net increase in power generation of about 96 GWh per year. This generation value is the expected increased generation from Shasta Dam and other CVP/SWP facilities.

Conserve, Restore, and Enhance Ecosystem Resources This component includes improving shallow, warm-water fish habitat by using manzanita cleared from above the inundation zone to create structural enhancements, and planting cereal grains to treat shoreline areas. These improvements would help provide favorable spawning conditions, and juvenile fish leaving the tributaries would benefit from improved adjacent shoreline habitat. Placing manzanita brush structures near the Shasta Lake shoreline would enhance the diversity of structural habitat available for the warm-water fish species that occupy Shasta Lake. Establishing vegetation also could benefit terrestrial species that inhabit the shoreline of Shasta Lake.

The lower reaches of perennial tributaries to Shasta Lake would be targeted for aquatic restoration because they provide year-round fish habitat. Native fish species require connectivity to the full range of habitats offered by Shasta Lake and its tributaries. Improved fish passage addresses the requirement to provide access and/or modify barriers to improve ecological conditions that support these native fish assemblages. Aquatic habitat improvements include enhancing aquatic connectivity and reducing sediment related to roads constructed across intermittent streams.

In the upper Sacramento River, the addition of spawning gravel and the restoration of riparian, floodplain, and side channel habitat are expected to

improve the complexity of aquatic habitat and its suitability for spawning and rearing. Riparian areas provide habitat for a diverse array of plant and animal communities along the Sacramento River, including numerous threatened or endangered species. Riparian areas also provide shade and woody debris that increase the complexity of aquatic habitat and its suitability for spawning and rearing. Lower floodplain areas, river terraces, and gravel bars play an important role in the health and succession of riparian habitat. Restoration would support the goals of the Sacramento River Conservation Area Forum and other programs associated with riparian restoration along the Sacramento River. Side channels can support important habitat for anadromous salmonids, including rearing and spawning habitat. Side channel habitats also provide refuge from predators and productive foraging habitat for juvenile anadromous salmonids.

Maintain and Increase Recreation Opportunities CP5 includes features to, at a minimum, maintain the existing recreation capacity at Shasta Lake. In addition, this alternative includes construction of 18 miles of new trails and 6 trailheads to enhance recreation opportunities at Shasta Lake. As with the other alternatives, a small benefit would likely occur to the water-oriented recreation experience at Shasta Lake due to the increase in lake surface area and modernization of recreation facilities. The maximum surface area of the lake would increase by about 2,500 acres (8 percent), from 29,600 acres to about 32,100 acres. There is also limited potential for reservoir reoperation to provide additional benefits to recreation by raising the bottom of the flood control pool elevation and allowing more reliable filling of the reservoir during the spring.

Benefits Related to Other SLWRI Objectives CP5 could also provide benefits related to flood damage reduction and water quality, similar to CP3.

Construction for CP5

Construction activities related to enlarging the reservoir under CP5 are identical to those described for CP3, and are summarized in Tables 2-23 through 2-29. Additional construction efforts would be required for the proposed spawning gravel augmentation and riparian, floodplain, and side channel habitat restoration, which are described under CP4. Construction activities associated with Shasta Lake tributary and shoreline enhancement are described below.

Shasta Lake Tributary and Shoreline Enhancement Structural enhancements associated with CP5 include placing brush structures constructed from whiteleaf manzanita (*Arctostaphylos manzanita*) in the Shasta Lake littoral zone. Because of manzanita's density, installation does not require using anchor or cabling techniques that could result in ancillary negative impacts (e.g., maintenance, hazards to boaters). The brush structures would be assembled in the drawdown zone of the reservoir in an area that would be inundated as the reservoir surface elevation rises in fall. The brush structures are expected to be about 1,800 cubic feet in size. The establishment period

would be the first year after construction; life span of the brush structures is projected to be 10 years.

Table 2-30 identifies the general area, number, and size of proposed structural enhancement locations for the main body of Shasta Lake, and the Pit, Sacramento, McCloud, Big Backbone, and Squaw arms. Selection of specific locations has been deferred so that enhancement locations are consistent with other objectives of the SLWRI. The level of proposed treatment is based on the proportion of available manzanita surrounding Shasta Lake. In general terms, these locations would incorporate available material at locations with preferred topographic features; preferred locations are coves that offer steep drawdown areas during the primary use period (spring, early summer).

Table 2-30. Proposed Structural Enhancement by Arm of Lake and by Arm

Area	Area Treated (acres)	Number of Locations
Main Body	17	595
Pit	12	420
Sacramento	43	1,505
McCloud	8	280
Big Backbone	3	105
Squaw	17	595
Total	**100**	**3,500**

Vegetative enhancements associated with CP5 include planting willows (*Salix*) to enhance nearshore fish habitat, and aerial and hand seeding of annual cereal grains to treat shoreline areas at Shasta Lake.

More than 30 acres could be available to enhance the willow recruitment adjacent to Shasta Lake. Rooted willows would be planted in draws and other moist sites, such as springs, to provide long-term live cover. The establishment period for willows would be the first year after construction; life span is projected to be 5 to 50 years. The establishment period for cereal grains would also be the first year of construction, with the life span projected to be 1 to 3 years. This approach would require native seed and nursery stock; several years of advanced preparation would be needed before planting could take place.

Table 2-31 summarizes proposed enhanced treatment with willows and native grasses by arm.

Table 2-31. Proposed Vegetative Enhancement Treatment of Lake and by Arm

Arm	Willow Planting (acres)	Native Grass Seeding (acres)
Main Body	1	2
Pit	1	4
Sacramento	7	4
McCloud	1	2
Big Backbone	3	2
Squaw	1	2
Total	**14**	**16**

Operations and Maintenance for CP5

Operations and maintenance of Shasta Dam and Reservoir under CP5 would be similar to the operations and maintenance discussed for CP3.

2.5 Comparison of Alternatives

Each of the alternatives has been evaluated against the specified objectives and four criteria of completeness, effectiveness, efficiency, and acceptability, as identified in the Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies (WRC 1983). Evaluation of environmental impacts and mitigation measures is an important subfactor of the completeness criterion. Table 2-32 summarizes the overall potential benefits of all alternatives. The quantified benefits were based on modeling efforts that are described in several parts of the PDEIS, including Chapter 6, "Hydrology, Hydraulics, and Water Management;" Chapter 11, "Fisheries and Aquatic Resources;" Chapter 23, "Power and Energy;" the Modeling Appendix; and the Economic Valuation Appendix.

As can be seen in Table 2-32, the alternatives differ in overall benefits.

2.5.1 Completeness

Completeness is a determination of whether a plan includes all elements necessary to realize planned effects, and the degree that intended benefits of the plan depend on the actions of others. Several subfactors that are important in measuring this criterion include (1) authorization, (2) spectrum of objectives being addressed, (3) reliability, (4) physical implementability, and (5) environmental effects and mitigation.

Table 2-32. Summary of Potential Features and Major Benefits of SLWRI Alternatives

Item	CP1	CP2	CP3	CP4	CP5
Raise Shasta Dam (feet)	**6.5**	**12.5**	**18.5**	**18.5**	**18.5**
Total Increased Storage (TAF)	256	443	634	634	634
Benefits					
Increase Anadromous Fish Survival					
Dedicated Storage (TAF)	-	-	-	378	-
Production Increase (thousand fish)[1]	366	234	607	1,199	607
Spawning Gravel Augmentation (tons)[2]				10,000	10,000
Side Channel Rearing Habitat Restoration (miles)				0.8	0.8
Increase Water Supply Reliability					
Total Increased Firm Water Supplies (TAF/year)[3]	76.4	105.1	133.4	76.4	133.4
Increased Firm Water Supplies NOD (TAF/year)[3]	9.6	19.8	29.6	9.6	29.6
Increased Firm Water Supplies SOD (TAF/year)[3]	66.8	85.3	103.8	66.8	103.8
Increased Water Use Efficiency Funding	Yes	Yes	Yes	Yes	Yes
Increased Emergency Water Supply Response Capability	Yes	Yes	Yes	Yes	Yes
Reduce Flood Damage					
Increased Reservoir Capacity for Capture of High Flood Flows	Yes	Yes	Yes	Yes	Yes
Develop Additional Hydropower Generation					
Increased Hydropower Generation (GWh/year)	42	68	96	138	96
Conserve, Restore, and Enhance Ecosystem Resources					
Shoreline Enhancement (acres)	-	-	-	-	130
Tributary Aquatic Habitat Enhancement (miles)[4]	-	-	-	-	6
Riparian, Floodplain, and Side Channel Restoration Habitat (acres)	-	-	-	2.9	2.9
Increased Ability to Meet Flow and Temperature Requirements Along Upper Sacramento River	Yes	Yes	Yes	Yes	Yes
Maintain or Improve Water Quality					
Improved Delta Water Quality	Yes	Yes	Yes	Yes	Yes
Increased Delta Emergency Response Capability	Yes	Yes	Yes	Yes	Yes
Maintain and Increase Recreation					
Recreation (increased user days, thousands)[5]	83	141	224	224	224
Modernization of Relocated Recreation Facilities	Yes	Yes	Yes	Yes	Yes

Notes:

[1] Average annual increase in juvenile Chinook salmon surviving to migrate downstream from the Red Bluff Diversion Dam. Numbers were derived from SALMOD.

[2] Average amount per year for 10-year period.

[3] Total drought period reliability to CVP and SWP. Does not reflect benefits related to water use efficiency actions included in all comprehensive plans.

[4] Tributary aquatic enhancement provides for the connectivity of native fish species and other aquatic organisms between Shasta Lake and its tributaries. Estimates of benefits reflect only connectivity with perennial streams and do not reflect additional miles of connectivity with intermittent streams.

[5] These values do not account for increased visitation due to modernization of recreation facilities associated with all comprehensive plans.

Key:
- = not applicable
CP = comprehensive plan
CVP = Central Valley Project
Delta = Sacramento-San Joaquin Delta
GWh/year = gigawatt-hours per year
NOD = north of Delta
SOD = south of Delta
SLWRI = Shasta Lake Water Resources Investigation
SWP = State Water Project
TAF = thousand acre feet

The No-Action Alternative rates very low for completeness, and each of the action alternatives rates from high to very high. Two distinguishing subfactors are (1) spectrum of objectives being addressed and (2) reliability. CP1, CP2, and CP3 primarily address anadromous fish survival and water supply reliability; however, each of these alternatives indirectly contributes to each of the other objectives, with the exception of ecosystem restoration. Further, the likely reliability and certainty of each of these three alternatives to meet its intended objectives is very high. These alternatives do not significantly rely on any other actions. However, CP4 specifically focuses on anadromous fish through increasing the minimum carryover storage space in Shasta Reservoir each year, and CP5 focuses on additional ecosystem restoration and recreation. With both CP4 and CP5, O&M requirements would increase. Accordingly, overall reliability would be reduced for each alternative.

Another significant subfactor is environmental effects and mitigation. Anticipated impacts are generally comparable between alternatives; some impacts are exacerbated by larger dam raises and the associated scale of those impacts, such as a prolonged construction period and increased area of inundation around Shasta Lake. Generally, the impacts would be mitigable with the measures identified in subsequent chapters. Some impacts, including short-term generation of construction-related emissions in excess of Shasta County Air Quality Management District thresholds, and the temporary exceedence of Shasta County noise level standards, could remain significant and unavoidable despite mitigation measures. Altered flow regimes, changes to the areas inundated by the Sacramento River and Shasta Lake, and disturbances associated with construction activities have the potential to impact environmental resources. These impacts would be largely mitigable. A detailed description and assessment of the impacts to environmental resources, and appropriate mitigation measures, are described by resource area in Chapters 4 through 25.

2.5.2 Effectiveness

Effectiveness is the extent to which an alternative alleviates problems and achieves objectives. For the primary objective of anadromous fish survival, two major relative ranking factors were considered: (1) increasing salmon survival (decreasing salmon mortality) and (2) increasing habitat for spawning. For the primary objective of increasing water supply reliability, ranking was based on the relative amount of new drought period (firm) yield that could be derived from each comprehensive plan. For the secondary objectives, four ranking factors were considered: (1) whether a comprehensive plan included ecosystem restoration, (2) potential to affect flood peaks downstream from Keswick Dam, (3) potential to increase net power generation, and (4) amount of increased recreation opportunities at Shasta Lake.

Comprehensive plans with the greatest effectiveness in meeting objectives appear, at this time, to be CP3, CP 4, and CP5. This is primarily because CP3 and CP5 would provide the largest contribution toward water supply reliability

and CP4 would provide the largest contribution toward anadromous fish survival. All three plans provide benefits to ecosystem restoration (via improved fisheries conditions), flood damage reduction, hydropower generation, recreation, and water quality.

2.5.3 Efficiency

Efficiency is the measure of how efficiently an alternative alleviates identified problems while realizing specified objectives consistent with protecting the Nation's environment. The relative rankings for efficiency are based primarily on likely net benefits obtained under each plan. Assuming the cost of water supplies increases at the same rate as inflation, CP1, CP3, CP4, and CP5 would be economically feasible, and assuming the cost of water supplies increases at 2 percent above inflation, all plans would be economically feasible. At this stage of analysis under either condition, it appears that CP4 has potential to provide the greatest net economic benefits. This is primarily because of the higher potential increase in anadromous fish survival.

2.5.4 Acceptability

Acceptability is the workability and viability of a plan with respect to its potential acceptance by other Federal agencies, State and local government agencies, and public interest groups and individuals. This evaluation criterion will be very important following completion of the Final Feasibility Report and endorsement by a non-Federal sponsor of the comprehensive plan recommended for implementation. It appears that all of the comprehensive plans would be similarly ranked for this criterion. Each of the plans needs to be coordinated with other agencies and public interests.

2.6 Preferred Alternative and Rationale for Selection

This section provides a summary of the comparison of alternatives, identifies the likely preferred alternative, and provides the rationale for selection.

2.6.1 Summary of Comparison

Each of the comprehensive plans is estimated to be complete, each appears to be effective in achieving its intended objectives, and each is cost-efficient. The three comprehensive plans involving a dam raise of 18.5 feet (CP3, CP4, and CP5) best address the planning objectives. This is primarily because of (1) high certainty (completeness) that the plans could achieve their intended benefits, and (2) relatively high effectiveness and economic efficiency.

2.6.2 Rationale for Plan Selection

A plan recommending Federal action should be the plan that best addresses the targeted water resources problems considering public benefits relative to costs. The basis for selecting the recommended plan is to be fully reported and documented, including the criteria and considerations used in selecting a recommended course of action by the Federal Government. It is recognized that

most of the activities pursued by the Federal Government will require assessing trade-offs by decision makers and that in many cases, the final decision will require judgment regarding the appropriate extent of monetized and nonmonetized effects.

The needed rationale to support Federal investment in water resources projects is described in the 2009 *Draft Proposed National Objectives, Principles, and Standards for Water and Related Resources Implementation Studies* (CEQ):

> *The presentations shall summarize and explain the decision rationale leading from the identification of need through the recommendation of a specific alternative. This shall include the steps, basic assumptions, analysis methods and results, criteria and results of various screenings and selections of alternatives, peer review proceedings and results, and the supporting reasons for other decisions necessary to execute the planning process. The information shall enable the public to understand the decision rationale, confirm the supporting analyses and findings, and develop their own fully-informed opinions and/or decisions regarding the validity of the study and its recommendations.*
>
> *Opportunities shall be provided for public reaction and input prior to key study decisions, particularly the tentative and final selection of recommended plans. The above information shall be presented in a decision document or documents, and made available to the public in draft and final forms. The document(s) shall demonstrate compliance with the National Environmental Policy Act (NEPA) and other pertinent Federal statutes and authorities.*

At this stage of the NEPA and Federal planning processes, the potential effects of the alternative plans have been evaluated and compared based on established criteria. As a result, alternatives involving an 18.5-foot raise of Shasta Dam appear to have the greatest environmental benefits, although no environmentally preferable alternative has been selected. It is recognized that further refinement and changes may occur to the comprehensive plans with changes in CVP/SWP operational conditions, and after updates to modeling studies and input from agencies, stakeholders, and the public. The results of these updated studies will be incorporated into the Draft EIS and other future SLWRI documents.

Ultimately, the alternative that best meets the stated objectives and maximizes net public benefits will be identified in the Final Feasibility Report and FEIS with supporting rationale and documentation. If determined to be feasible, it is expected that the plan recommended for implementation will meet all pertinent Federal, State, and local laws, policies, regulations, and other requirements so that it may be ideally recognized as the "Environmentally Preferred Plan"

consistent with NEPA, the "NED Plan" consistent with the Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies, the "Least Environmentally Damaging Practicable Alternative" consistent with the CWA, and the "Environmentally Superior Alternative" consistent with CEQA. Then, responsible Federal, State, and local decision makers will decide whether to approve, authorize, and/or appropriate funding for implementation of the preferred alternative.

Chapter 3
Considerations for Describing Affected Environment and Environmental Consequences

3.1 Introduction

Chapters 4 through 25 of this PDEIS are organized by environmental resource area. Each chapter discusses the affected environment and environmental consequences (short- and long-term impacts, direct and indirect impacts, and mitigation measures, and cumulative effects) of implementing the proposed comprehensive plans. Additional details about the affected environment are available for some resource areas in the technical reports; see the appendices to this PDEIS.

3.2 Chapter Contents and Definition of Terms

Chapters 4 through 25 are organized into the following resource and issue areas:

- **Chapter 4** – Geology, Geomorphology, Minerals, and Soils
- **Chapter 5** – Air Quality and Climate
- **Chapter 6** – Hydrology, Hydraulics, and Water Management
- **Chapter 7** – Water Quality
- **Chapter 8** – Noise and Vibration
- **Chapter 9** – Hazards and Hazardous Materials and Waste
- **Chapter 10** – Agriculture and Important Farmlands
- **Chapter 11** – Fisheries and Aquatic Ecosystems
- **Chapter 12** – Botanical Resources and Wetlands
- **Chapter 13** – Wildlife Resources
- **Chapter 14** – Cultural Resources
- **Chapter 15** – Indian Trust Assets
- **Chapter 16** – Socioeconomics, Population, and Housing

- **Chapter 17** – Land Use and Planning
- **Chapter 18** – Recreation and Public Access
- **Chapter 19** – Aesthetics and Visual Resources
- **Chapter 20** – Transportation and Traffic
- **Chapter 21** – Utilities and Service Systems
- **Chapter 22** – Public Services
- **Chapter 23** – Power and Energy
- **Chapter 24** – Environmental Justice
- **Chapter 25** – Wild and Scenic River Considerations for McCloud River

For some of these resource and issue areas, a technical report of the same name is presented in the appendices to this PDEIS. The technical reports describe the affected environment in more detail than the summarized information presented in the main body of this PDEIS.

3.2.1 NEPA Requirements

Council on Environmental Quality (CEQ) regulations for implementing NEPA include the following requirements for an Environmental Impact Statement (EIS) (Title 40, Section 1502.15 of the Code of Federal Regulations (40 CFR 1502.15)):

> *[An] EIS shall succinctly describe the environment of the area(s) to be affected or created by the alternatives under consideration. The descriptions shall be no longer than is necessary to understand the effects of the alternatives. Data and analyses in a statement shall be commensurate with the importance of the impact, with less important material summarized, consolidated, or simply referenced.*

Because of uneven treatment of climate change under NEPA, the International Center for Technology Assessment, Natural Resources Defense Council, and Sierra Club filed a petition with CEQ in March 2008. The petition requested that climate change analyses be included in all Federal environmental review documents. In October 2009, President Barack Obama signed Executive Order 13514, "Federal Leadership in Environmental, Energy, and Economic Performance." The goal of this executive order is "to establish an integrated strategy towards sustainability in the Federal Government and to make reduction of greenhouse gas (GHG) emissions a priority for Federal agencies" (FedCenter.gov 2011).

In response to the 2008 petition and subsequent Executive Order 13514, CEQ issued guidance on including GHG emissions and climate change impacts in environmental review documents under NEPA. CEQ guidance (issued February 18, 2010) suggests that Federal agencies consider opportunities to reduce GHG emissions caused by proposed Federal actions, adapt their actions to climate change impacts throughout the NEPA process, and address these issues in the agencies' NEPA procedures. Following are the two main factors to consider when addressing climate change in environmental documentation:

- Effects of a proposed action and alternative actions on GHG emissions
- Impacts of climate change on a proposed action or alternatives

CEQ notes that "significant" national policy decisions with "substantial" GHG impacts require analysis of their GHG effects. That is, the GHG effects of a Federal agency's proposed action must be analyzed if the action would cause "substantial" annual direct emissions; would implicate energy conservation or reduced energy use or GHG emissions; or would promote cleaner, more efficient renewable-energy technologies. Qualitative or quantitative information on GHG emissions that is useful and relevant to the decision should be used when deciding among alternatives.

CEQ suggests that if a proposed action would cause direct annual emissions of more than 25,000 metric tons of carbon dioxide equivalent, a quantitative and qualitative assessment may be meaningful to decision makers and the public. If annual direct emissions would be less than 25,000 metric tons of carbon dioxide equivalent, Federal agencies are encouraged to consider whether the action's long-term emissions should receive similar analysis.

3.2.2 Approach to Affected Environment

Chapters 4–25 provide an overview of the existing physical environment and socioeconomic conditions that the comprehensive plans could affect. This information was obtained from technical studies prepared by Reclamation for some resource and issue areas; those studies are attached to this PDEIS. Additional information was obtained from published environmental and planning documents, books, Web sites, journal articles, field surveys, and communications with technical experts. Descriptions of the affected environment are organized by geographic region. Conditions in the primary study area – Shasta Lake and vicinity and the upper Sacramento River (Shasta Dam to Red Bluff) – are described first. These discussions are followed by descriptions of conditions in the extended study area, which consists of the lower Sacramento River and Delta and CVP/SWP facilities and water service areas.

In certain resource areas, the geographic regions are organized slightly differently than how they are defined in Chapter 1. For example, when effects

are solely due to operational changes, the Trinity, American, and Feather rivers may all be discussed with the geography for CVP/SWP facilities and service areas, since the impacts would be similar in nature.

3.2.3 Methods and Assumptions

Chapters 4 through 25 analyze the direct and indirect effects of the No-Action Alternative and comprehensive plans (i.e., action alternatives) for each environmental resource area. Direct effects are those that would be caused by the action and would occur at the same time and place. Indirect effects are reasonably foreseeable consequences that may occur at a later time or at a distance from the project area. Examples of indirect effects are growth inducement or other effects related to changes in land use patterns, population density, or growth rate, and related effects on the physical environment.

The effects of the No-Action Alternative and action alternatives were determined by comparing estimates of resulting conditions with baseline conditions. These baseline conditions differ between NEPA and CEQA. Under NEPA, the No-Action Alternative (i.e., expected future conditions without the project) is the baseline to which the action alternatives are compared; the No-Action Alternative is also compared to existing conditions. Under CEQA, existing conditions are the baseline to which alternatives are compared.

An environmental document prepared to comply with NEPA must consider the context and intensity of the environmental effects that would be caused by, or result from, the proposed action. Under NEPA, the significance of an effect is a determining factor in whether an environmental impact statement must be prepared. An environmental document prepared to comply with CEQA must identify the significance of the environmental effects of a proposed project. As stated in State CEQA Guidelines, Section 15382, a "[s]ignificant effect on the environment" means a substantial, or potentially substantial, adverse change in any of the physical conditions within the area affected by the project."

Rationale for Use of 2004 Biological Assessment for Water Operation Models

In June 2004, Reclamation prepared the 2004 Operations Criteria and Plan (OCAP) to provide a baseline description of facilities and the operating environment of the CVP and SWP. Using operational information in the 2004 OCAP, Reclamation and DWR developed the 2004 OCAP Biological Assessment (BA), prepared as part of the consultation process required by Section 7 of the Endangered Species Act (ESA).

Planning assumptions and information on water operations used to develop alternatives for the SLWRI were developed in 2006, and reflect the coordinated CVP and SWP operational conditions and criteria described in the 2004 OCAP. In addition, the model package used to evaluate potential effects of the alternatives included in this PDEIS was based on operations described in the

2004 OCAP BA and the Coordinated Operations Agreement between Reclamation and DWR for the CVP and SWP, as ratified by Congress.

As Reclamation has proceeded with the SLWRI, essential environmental, hydrologic, and regulatory conditions in the Sacramento River basin and Delta have changed significantly, including substantial declines in key fish populations that use the Sacramento River basin waterways and Delta, such as the delta smelt and Chinook salmon.

Reclamation consulted with the NMFS and USFWS on the 2004 OCAP, and the two agencies issued the 2004 NMFS Biological Opinion (BO) (NMFS 2004) and 2005 USFWS BO (USFWS 2005), respectively. In 2007, the District Court for the Eastern District of California (District Court), in *Natural Resources Defense Council v. Kempthorne*, found the 2005 USFWS BO to be unlawful and inadequate. In May 2008, in *Pacific Coast Federation of Fishermen's Associations v. Gutierrez*, the District Court found the 2004 NMFS BO to be unlawful and inadequate. The District Court remanded both BOs to the fishery agencies.

In August 2008, Reclamation reinitiated consultation with the fishery agencies based on the 2008 *Biological Assessment on the Continued Long-Term Operations of the CVP and SWP* (2008 OCAP BA). USFWS issued the 2008 USFWS BO, finding that the long-term operations of the CVP and SWP, as described in the 2004 OCAP BA, would jeopardize the continued existence of the delta smelt (USFWS 2008). In June 2009, NMFS issued the 2009 NMFS BO (NMFS 2009) finding that the same operations would jeopardize populations of listed salmonids, steelhead, green sturgeon, and orcas. Because both agencies made jeopardy determinations, both agencies included a Reasonable and Prudent Alternative (RPA) in their BOs.

Several lawsuits were filed challenging the validity of the 2008 USFWS BO and 2009 NMFS BO and Reclamation's acceptance of the RPA included with each BO (*Consolidated Salmonid Cases, Delta Smelt Consolidated Cases*). On November 13, 2009, and March 5, 2010, the District Court concluded that Reclamation had violated NEPA by failing to perform any NEPA analysis before provisionally adopting the 2008 USFWS RPA and 2009 NMFS RPA. On December 14, 2010, the District Court found the 2008 USFWS BO to be unlawful and remanded the BO to USFWS. The District Court issued a similar ruling for the 2009 NMFS BO on September 20, 2011. On May 4, 2011, in the *Delta Smelt Consolidated Cases*, the District Court ordered USFWS to prepare a draft BO by October 1, 2011, which was subsequently extended to an unspecified date to be agreed upon by involved parties. Reclamation and USFWS must prepare a final BO and final NEPA document by November 1, 2013, and December 1, 2013, respectively.

The ongoing OCAP reconsultation process is not the only uncertainty facing future water operations in California. In addition to changes in regulatory conditions, California experienced a severe drought from 2007 through 2009. Although the 2010–2011 water year brought water supplies to normal levels, California's complex water supply issues remain. Increased water needs for environmental purposes, regulatory cutbacks on water supplies, and population growth have created more serious water problems than the State faced in the early 1990s drought. In the future, impacts of climate change will further complicate California's water supply difficulties. In response to these issues, plans have been proposed to update California's water system by increasing storage, improving conveyance, protecting the Delta's ecosystem and promoting greater water conservation, and planning assumptions originally used to predict hydrologic conditions in the Sacramento River and Delta have changed.

Reclamation and DWR use CalSim-II to study operations, benefits, and effects of new facilities and operational parameters for the CVP and SWP. A set of operational assumptions was developed in 2006 based on operations described in the 2004 OCAP BA and the Coordinated Operations Agreement between Reclamation and DWR for the CVP and SWP. These assumptions were used to guide development, modeling, and evaluation of potential effects of the No-Action Alternative and action alternatives included in this PDEIS. These existing evaluations were used as the basis of analysis in the PDEIS.

The legal challenges and changing environmental conditions result in uncertainty with regard to both current and future operations. These operational uncertainties are likely to continue, and current and future water operation conditions may be different because operational constraints governing water operations are likely to change with release of revised USFWS and NMFS BOs. The existing SLWRI modeling analysis is being used for comparison purposes, and reflects expected variation among the alternatives, including the type and relative magnitude of anticipated impacts and benefits. Because of the lingering uncertainty about future water operations, the PDEIS is based on existing studies.

Modeling studies will be updated to reflect changes in water operations resulting from ongoing OCAP reconsultation and other relevant water resources projects and programs, including, potentially, Bay-Delta Conservation Plan (BDCP)/Delta Habitat Conservation and Conveyance Plan (DHCCP) efforts. The results of these updated studies will be incorporated into the Draft EIS and other future SLWRI documents.

3.2.4 Significance Criteria

Significance criteria for each resource area are provided in each resource chapter of this PDEIS. These criteria are based on the checklist presented in Appendix G of the State CEQA Guidelines; factual or scientific information and data; and regulatory standards of Federal, State, and local agencies. These

criteria also encompass the factors taken into account under NEPA to determine the significance of an action in terms of the context and the intensity of its effects.

3.2.5 Impact Comparisons and Definitions

Mechanisms that could cause impacts are discussed for each issue area. General categories of impact mechanisms are construction and activities related to future operation and maintenance, as described in Chapter 2, "Alternatives." Project-related impacts are categorized as follows, to describe the intensity or duration of the impact:

- A **temporary** impact would last less than 3 to 4 years and typically would occur only during construction.
- A **short-term** impact could occur during construction and could last from the time construction ceases to within 3 to 5 years after construction.
- A **long-term** impact would last longer than 5 years after the completion of construction. In some cases, a long-term impact could be a permanent impact.
- A **direct** impact is an impact that would be caused by an action and would occur at the same time and place as the action.
- An **indirect** impact is an impact that would be caused by an action but would occur later in time or at another location, yet is reasonably foreseeable in the future.
- A **cumulative** impact is a project's impacts combined with impacts from other past, present, and reasonably foreseeable future projects. A project's incremental impacts are not "cumulatively considerable" solely because other projects would have a significant cumulative impact; rather, the project would also need to contribute considerably to a significant cumulative impact (State CEQA Guidelines, Section 15064(h)(1)).

3.2.6 Impact Levels

The terminology listed below is used to denote the significance of environmental impacts of the No-Action Alternative and action alternatives. These levels of significance are listed for purposes of CEQA only.

- **No impact** would occur if the construction, operation, and maintenance of the alternative under consideration would not have any direct or indirect effects on the environment. "No impact" means no change from existing conditions. This impact level does not need mitigation.

- An impact that would not result in a substantial and adverse change in the environment would be **less than significant**. This impact level does not require mitigation under CEQA, even if applicable measures are available.

- A **significant** impact is defined by Section 21068 of the California Public Resources Code as "a substantial, or potentially substantial, adverse change in the environment." Levels of significance can vary by project, based on the change in the existing physical condition. This PDEIS uses the CEQA definition of "significant impact."

- A **potentially significant** impact is one that, if it were to occur, would be considered a significant impact as described above; however, the occurrence of the impact cannot be immediately determined with certainty. For CEQA purposes, a potentially significant impact is treated as if it were a significant impact. Therefore, under CEQA, feasible mitigation measures or alternatives to the proposed action must be identified, where applicable, to reduce the magnitude of potentially significant impacts.

- A **significant and unavoidable** impact is a substantial or potentially substantial adverse effect on the environment that cannot be reduced to a less-than-significant level even with any feasible mitigation. Under CEQA, a project with significant and unavoidable impacts could proceed, but the lead agency would be required to do the following:

    - Conclude in findings that there are no feasible means of substantially lessening or avoiding the significant impact in accordance with Section 15091(a)(3) of the State CEQA Guidelines (i.e., Title 14, Section 15091(a)(3) of the California Code of Regulations (CCR)).

    - Prepare a statement of overriding considerations, in accordance with Section 15093 of the State CEQA Guidelines, explaining why the lead agency would proceed with a project in spite of the potential for significant impacts.

- A **significant cumulative** impact occurs when the project would make a "cumulatively considerable incremental contribution" to an overall significant cumulative impact. If an overall cumulative impact would not be significant, even when the project would make a cumulatively considerable incremental contribution to the cumulative impact, then it is determined that the project would not cause a significant cumulative impact.

- A **beneficial** impact is a positive change or improvement in the environment and for which no mitigation measures are required.

- An impact may have a level of significance that is too uncertain to be reasonably determined. Such an impact would be designated **too speculative for meaningful evaluation**, in accordance with Section 15145 of the State CEQA Guidelines. Where some degree of evidence points to the reasonable potential for a significant effect, the EIS may explain that a determination of significance is uncertain, but is still assumed to be "potentially significant," as described above. In other circumstances, after thorough investigation, the determination of significance may still be too speculative to be meaningful. This is an effect for which the degree of significance cannot be determined for specific reasons. For example, aspects of the impact itself may be unpredictable or the severity of consequences cannot be known at this time.

3.2.7 Mitigation Development Process and Objectives

Mitigation measures are presented where feasible to avoid, minimize, rectify, reduce, or compensate for significant and potentially significant impacts of the proposed action and alternatives, in accordance with Section 15126.4 of the State CEQA Guidelines and NEPA regulations (40 CFR 1508.20). Each mitigation measure is identified numerically to correspond with the number of the impact being mitigated by the measure. No mitigation measures are needed when an impact is determined to be "less than significant" or "beneficial," or where no impact would occur. Where sufficient feasible mitigation is not available to reduce an impact to a less-than-significant level, the impact is identified as "significant and unavoidable."

3.2.8 Significance after Mitigation

For every impact that would be significant or potentially significant, feasible mitigation is applied to avoid or reduce the impact to a less-than-significant level and one of two conclusions is reached:

1. The mitigation would reduce the impact to a less-than-significant level.

2. No feasible mitigation exists to reduce the impact to a less-than-significant level, and thus the impact would be significant and unavoidable.

Impact significance is reevaluated after application of mitigation in this PDEIS.

3.2.9 Cumulative Effects

This section provides an analysis of overall cumulative effects of the project alternatives and the No-Action Alternative, determined by combining project impacts with other past, present, and reasonably foreseeable probable future

projects producing related impacts (as defined above). This analysis follows applicable guidance provided by CEQ in *Considering Cumulative Effects under the National Environmental Policy Act* (CEQ 1997) and *Guidance on the Consideration of Past Actions in Cumulative Effects Analysis* (CEQ 2005).

Definitions of Cumulative Effects

The CEQ regulations that implement NEPA provisions define cumulative effects as "the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (federal or nonfederal) or person undertakes such other actions" (40 CFR 1508.7). Cumulative effects can result from individually minor, but collectively significant, actions over time and differ from indirect impacts (40 CFR 1508.8). They are caused by the incremental increase in total environmental effects when the evaluated project is added to other past, present, and reasonably foreseeable future actions. Cumulative effects can thus arise from causes that are totally unrelated to the project being evaluated, and the analysis of cumulative effects looks at the life cycle of the effects, not the project at issue. These effects can be either adverse or beneficial.

Cumulative impacts are defined in the State CEQA Guidelines (14 CCR Section 15355) as "two or more individual effects which, when considered together, are considerable or which compound or increase other environmental impacts." A cumulative impact occurs from "the change in the environment which results from the incremental impact of the project when added to other closely related past, present, and reasonably foreseeable probable future projects. Cumulative impacts can result from individually minor but collectively significant projects taking place over a period of time" (14 CCR Section 15355(b)).

Consistent with the State CEQA Guidelines (14 CCR Section 15130(a)), the discussion of cumulative impacts in this chapter focuses on significant and potentially significant cumulative impacts. The State CEQA Guidelines (14 CCR Section 15130(b)) state that:

> *The discussion of cumulative impacts shall reflect the severity of the impacts and their likelihood of occurrence, but the discussion need not provide as great detail as is provided for the effects attributable to the project alone. The discussion should be guided by the standards of practicality and reasonableness, and should focus on the cumulative impact to which the identified other projects contribute rather than the attributes of other projects which do not contribute to the cumulative impact.*

Effects of Project Implementation with Climate Change

Each resource area evaluates the effects of SLWRI actions combined with predicted effects of climate change. The ways SLWRI could affect GHG production are included in Chapter 5, "Air Quality and Climate." The Climate Change Projection Appendix provides a summary of global climate forecasts and a discussion of climate change implications for California water resources, particularly those of Shasta Lake, including predictions about changes in monthly and annual natural runoff, reservoir storage and temperature, flood management, power generation, fish conservation, and water supply and quality. The discussion of climate change implications provided in the Climate Change Projection Appendix provides context for consideration of cumulative conditions.

Relationship to CALFED Programmatic Cumulative Effects Analysis

This analysis of cumulative effects in this PDEIS considers but does not tier from the cumulative impacts assessment in the CALFED Programmatic Environmental Impact Statement/Environmental Impact Report (EIR) (CALFED 2000a). The "Shasta Lake Enlargement" project was included in the cumulative impacts analysis of the CALFED Programmatic EIS/EIR as a project in CALFED's Storage Program (CALFED 2000a). This project-specific analysis considers, but stands alone from and refines, the analysis of cumulative effects in the CALFED Programmatic EIS/EIR (CALFED 2000a). This analysis focuses on issues resulting from the effects of this project combined with other reasonably foreseeable projects. This PDEIS considers CALFED projects that have been implemented, are being implemented, or are reasonably foreseeable future projects. The projects that have been implemented are considered as part of existing conditions; reasonably foreseeable future projects are considered as part of future conditions.

Methods and Assumptions

Following CEQ guidance, Reclamation has identified associated actions (past, present, or future) that, when viewed with the proposed or alternative actions, may have significant cumulative impacts. Table 3-1 lists the plans, projects, and programs that were considered for each resource area. Cumulative impacts should not be speculative; rather, they should be based on known long-range plans, regulations, or operating agreements.

Table 3-1. Present and Reasonably Foreseeable Future Actions Included in the Qualitative Analysis of Cumulative Impacts, by Resource Area

Actions	Geology, Geomorphology, Minerals, and Soils	Air Quality and Climate	Hydrology, Hydraulics, and Water Management	Water Quality	Noise and Vibration	Hazards and Hazardous Materials and Waste	Agriculture and Important Farmlands	Fisheries and Aquatic Ecosystems	Botanical Resources and Wetlands	Wildlife Resources	Cultural Resources	Indian Trust Assets	Socioeconomics, Population, and Housing	Land Use and Planning	Recreation and Public Access	Aesthetics and Visual Resources	Transportation and Traffic	Utilities and Service Systems	Public Services	Power and Energy	Environmental Justice	Wild and Scenic River Considerations for McCloud River	Notes
Forecasted 2030 Water Supply Demand			×					×	×	×					×					×			Considered in quantitative assessment of actions related to water resources
Delta-Mendota Canal Intertie			×					×	×	×	×	×			×					×			Considered in quantitative assessment of actions related to water resources
Sacramento Valley Water Management—Phase 8 Short-Term Agreement			×					×	×	×					×					×			Considered in quantitative assessment of actions related to water resources
San Joaquin River Salinity Management Plan			×	×				×	×	×					×					×			Considered in quantitative assessment of actions related to water resources
South Bay Aqueduct Enlargement Project			×					×	×	×	×	×			×					×			Considered in quantitative assessment of actions related to water resources

Table 3-1. Present and Reasonably Foreseeable Future Actions Included in the Qualitative Analysis of Cumulative Impacts, by Resource Area (contd.)

Actions	Geology, Geomorphology, Minerals, and Soils	Air Quality and Climate	Hydrology, Hydraulics, and Water Management	Water Quality	Noise and Vibration	Hazards and Hazardous Materials and Waste	Agriculture and Important Farmlands	Fisheries and Aquatic Ecosystems	Botanical Resources and Wetlands	Wildlife Resources	Cultural Resources	Indian Trust Assets	Socioeconomics, Population, and Housing	Land Use and Planning	Recreation and Public Access	Aesthetics and Visual Resources	Transportation and Traffic	Utilities and Service Systems	Public Services	Power and Energy	Environmental Justice	Wild and Scenic River Considerations for McCloud River	Notes
Integration of CVP and SWP Operations			×					×	×	×					×					×			Considered in quantitative assessment of actions related to water resources
Red Bluff Diversion Dam Pumping Plant	×		×						×		×	×								×			
North-of-Delta Offstream Storage Investigation	×		×	×	×	×	×	×	×	×	×	×			×					×			
Folsom Dam Raise Project	×		×					×	×	×	×	×			×					×			
Bay Delta Conservation Plan	×		×						×		×	×								×			
Franks Tract Project	×		×	×					×		×									×			
In-Delta Storage Program (Delta Wetlands Project)	×		×					×	×	×	×	×			×					×			
Los Vaqueros Reservoir Expansion Project	×		×	×				×	×	×	×	×			×					×			

Table 3-1. Present and Reasonably Foreseeable Future Actions Included in the Qualitative Analysis of Cumulative Impacts, by Resource Area (contd.)

Actions	Geology, Geomorphology, Minerals, and Soils	Air Quality and Climate	Hydrology, Hydraulics, and Water Management	Water Quality	Noise and Vibration	Hazards and Hazardous Materials and Waste	Agriculture and Important Farmlands	Fisheries and Aquatic Ecosystems	Botanical Resources and Wetlands	Wildlife Resources	Cultural Resources	Indian Trust Assets	Socioeconomics, Population, and Housing	Land Use and Planning	Recreation and Public Access	Aesthetics and Visual Resources	Transportation and Traffic	Utilities and Service Systems	Public Services	Power and Energy	Environmental Justice	Wild and Scenic River Considerations for McCloud River	Notes
South Delta Improvements Program	×		×					×	×	×	×				×								
Central Valley Flood Protection Plan	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×		×		
Trinity River Mainstream Fishery Restoration Program	×		×	×				×	×	×	×	×			×								
Central Valley Project Improvement Act	×	×	×	×				×	×	×	×	×			×	×					×		
CALFED Ecosystem Restoration Program								×	×	×	×				×								
Environmental Water Account			×	×				×	×														
San Luis Reservoir Low Point Improvement Project			×	×			×	×	×	×	×												

Table 3-1. Present and Reasonably Foreseeable Future Actions Included in the Qualitative Analysis of Cumulative Impacts, by Resource Area (contd.)

Actions	Geology, Geomorphology, Minerals, and Soils	Air Quality and Climate	Hydrology, Hydraulics, and Water Management	Water Quality	Noise and Vibration	Hazards and Hazardous Materials and Waste	Agriculture and Important Farmlands	Fisheries and Aquatic Ecosystems	Botanical Resources and Wetlands	Wildlife Resources	Cultural Resources	Indian Trust Assets	Socioeconomics, Population, and Housing	Land Use and Planning	Recreation and Public Access	Aesthetics and Visual Resources	Transportation and Traffic	Utilities and Service Systems	Public Services	Power and Energy	Environmental Justice	Wild and Scenic River Considerations for McCloud River	Notes
B.F. Sisk Dam Corrective Action Project	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×				
Shasta-Trinity National Forest Land and Resource Management Plan	×		×	×				×	×	×	×	×		×	×	×	×	×	×				
Iron Mountain Mine Restoration Plan	×	×	×	×	×	×		×	×	×					×		×	×	×				
Mendocino National Forest Land and Resource Management Plan	×		×	×				×	×	×	×	×		×		×	×	×	×				
Sacramento River Conservation Area Forum Program			×	×			×	×	×	×													
U.S. Bureau of Land Management Redding Resource Management Plan	×		×	×				×	×	×	×	×		×	×	×	×	×	×			×	

Table 3-1. Present and Reasonably Foreseeable Future Actions Included in the Qualitative Analysis of Cumulative Impacts, by Resource Area (contd.)

Actions	Geology, Geomorphology, Minerals, and Soils	Air Quality and Climate	Hydrology, Hydraulics, and Water Management	Water Quality	Noise and Vibration	Hazards and Hazardous Materials and Waste	Agriculture and Important Farmlands	Fisheries and Aquatic Ecosystems	Botanical Resources and Wetlands	Wildlife Resources	Cultural Resources	Indian Trust Assets	Socioeconomics, Population, and Housing	Land Use and Planning	Recreation and Public Access	Aesthetics and Visual Resources	Transportation and Traffic	Utilities and Service Systems	Public Services	Power and Energy	Environmental Justice	Wild and Scenic River Considerations for McCloud River	Notes
Sacramento River National Wildlife Refuge Draft Comprehensive Conservation Plan							X	X	X	X					X								
Comprehensive Management Plan for the Sacramento River Wildlife Area							X	X	X	X					X								
North Delta Flood Control and Ecosystem Restoration Project							X	X	X		X												
California Department of Water Resources Levee Repair			X				X	X	X		X		X										
CALFED Levee System Integrity Program			X				X	X	X		X												

Table 3-1. Present and Reasonably Foreseeable Future Actions Included in the Qualitative Analysis of Cumulative Impacts, by Resource Area (contd.)

Actions	Geology, Geomorphology, Minerals, and Soils	Air Quality and Climate	Hydrology, Hydraulics, and Water Management	Water Quality	Noise and Vibration	Hazards and Hazardous Materials and Waste	Agriculture and Important Farmlands	Fisheries and Aquatic Ecosystems	Botanical Resources and Wetlands	Wildlife Resources	Cultural Resources	Indian Trust Assets	Socioeconomics, Population, and Housing	Land Use and Planning	Recreation and Public Access	Aesthetics and Visual Resources	Transportation and Traffic	Utilities and Service Systems	Public Services	Power and Energy	Environmental Justice	Wild and Scenic River Considerations for McCloud River	Notes
Natomas Levee Improvement Program Landside Improvement Project			×				×	×	×		×			×							×		
West Sacramento Levee Improvement Program			×				×	×	×		×			×							×		
General Plans for Shasta and Tehama Counties		×			×						×						×						
City of Shasta Lake General Plan		×			×						×						×						
City of Redding General Plan		×			×						×						×						
City of Anderson General Plan		×			×						×						×						
City of Red Bluff General Plan		×			×						×						×						

Table 3-1. Present and Reasonably Foreseeable Future Actions Included in the Qualitative Analysis of Cumulative Impacts, by Resource Area (contd.)

Actions	Geology, Geomorphology, Minerals, and Soils	Air Quality and Climate	Hydrology, Hydraulics, and Water Management	Water Quality	Noise and Vibration	Hazards and Hazardous Materials and Waste	Agriculture and Important Farmlands	Fisheries and Aquatic Ecosystems	Botanical Resources and Wetlands	Wildlife Resources	Cultural Resources	Indian Trust Assets	Socioeconomics, Population, and Housing	Land Use and Planning	Recreation and Public Access	Aesthetics and Visual Resources	Transportation and Traffic	Utilities and Service Systems	Public Services	Power and Energy	Environmental Justice	Wild and Scenic River Considerations for McCloud River	Notes
Antlers Bridge Replacement		X					X	X	X		X		X		X								
Stillwater Business Park		X			X		X	X	X		X		X		X		X						
Shasta Metro Enterprise Zone Program		X					X	X	X				X										

Key:
CALFED = CALFED Bay-Delta Program
CVP = Central Valley Project
SWP = State Water Project

The State CEQA Guidelines identify two basic methods for establishing the cumulative environment in which the project is to be considered: using a list of past, present, and probable future projects (the "list approach") or using adopted projections from a general plan, other regional planning document, or certified EIR for such a planning document (the "plan approach"). For this analysis of cumulative effects, the list approach and the plan approach have been combined in quantitative and qualitative assessments to generate the most comprehensive future projections possible. The methodology for each of these assessments is described below.

Quantitative Assessments Quantitative assessments were completed for each of the resource areas in this PDEIS, where feasible. The effects of actions related to water resources and effects of development projects were assessed quantitatively. The methodologies for these quantitative assessments are described below.

Quantitative Assessment of Actions Related to Water Resources In this PDEIS, the quantitative assessment of actions related to water resources relied primarily on CalSim-II modeling of hydrologic conditions that could affect vegetation and habitat types or special-status plant species. The model was run using two different baselines: modeling runs of "existing conditions," based on 2005 facilities and demands (a 2005 baseline); and modeling runs of "future conditions," based on forecasted 2030 demands and reasonably foreseeable projects and facilities (a 2030 baseline). The 2030 baseline does not account for potential changes in water demands resulting from the effects of climate change. Potential changes in water demand are described qualitatively in the "Qualitative Assessment of Other Actions" section. In this modeling of the 2030 baseline, reasonably foreseeable projects and facilities were as follows:

- Forecasted 2030 level of demands for water supplies
- Delta-Mendota Canal Intertie Project
- Sacramento Valley Water Management – Phase 8 Short-Term Agreement regarding water transfer supplies
- San Joaquin River Salinity Management Plan
- South Bay Aqueduct Enlargement Project
- Integration of CVP and SWP Operations

Forecasted 2030 Level of Demands for Water Supplies A detailed description of the CalSim-II model, the modeling methodology used in evaluations, and key assumptions (including a description of forecasted 2030 facilities and demands) are provided in the Modeling Appendix. The analysis and modeling results are summarized in the Hydrology, Hydraulics, and Water Management Technical Report. Moreover, Reclamation and DWR have developed "common assumptions" – reasonable assumptions built into the

CalSim-II model that are the standard for evaluating systemwide hydrologic and water supply conditions under existing and future conditions.

Cumulative effects on hydrologic conditions were quantified by comparing modeling runs with No-Action Alternative (2030) conditions to modeling runs with the 2005 baseline. For example, the No-Action Alternative (2030) was compared to existing conditions (the 2005 baseline) to identify the cumulative effects of reasonably foreseeable projects and facilities on hydrologic conditions. Similarly, project alternatives were compared to existing conditions (thus satisfying CEQA requirements) and to the No-Action Alternative (2030) (satisfying NEPA requirements) to identify the combined cumulative effect of project alternatives and other foreseeable projects and facilities. Forecasted year-2030 demands for water were used in the CalSim-II model runs for this PDEIS and are considered to be reasonably foreseeable for determining cumulative impacts, as are all projects included as "common assumptions."

Delta-Mendota Canal Intertie The Delta-Mendota Canal Intertie Project involves constructing and operating a pumping plant and a pipeline connecting the Delta-Mendota Canal with the California Aqueduct in the Delta (extended study area), in accordance with the OCAP. The intertie would be used to meet current water supply demands, allow for maintenance and repair of the CVP Delta export and conveyance facilities, and provide operational flexibility for responding to CVP- or SWP-related emergencies. The intertie would include a 450-cubic-foot-per-second (cfs) pumping plant at the Delta-Mendota Canal that would allow water to be pumped from the canal to the California Aqueduct via an underground pipeline. Reclamation and DWR have completed NEPA and CEQA documentation for this project. The notice of intent/notice of preparation (NOI/NOP) was released in 2006, public scoping meetings were held in August 2006, and the DEIS/EIR was released for public comment in July 2009. The FEIS/EIR and ROD were filed in December 2009 and construction began in October 2010.

Sacramento Valley Water Management—Phase 8 Short-Term Agreement The Phase 8 Short-Term Agreement is a commitment by Reclamation and DWR to meet the flow-related standards of State Water Resources Control Board (SWRCB) Water Right Decision 1641 (DWR 2002). The agreement provides for collaboration among interested parties to develop projects to meet water supply, water quality, and environmental needs in the Sacramento Valley and Bay-Delta areas, and throughout California. The parties to the Phase 8 Short-Term Agreement are more than 40 water suppliers in the Sacramento Valley, DWR, Reclamation, and downstream water users. These parties developed a cooperative water management partnership to better manage water and provide a mechanism for satisfying Bay-Delta water quality and flow objectives. The actions in the agreement consist of locally proposed groundwater projects, reservoir reoperation, system improvements, and surface water and groundwater planning studies. These short-term projects and actions

would be implemented for 10 years in Shasta, Butte, Sutter, Glenn, Tehama, Colusa, Sacramento, Placer, and Yolo counties.

The Phase 8 Short-Term Agreement was signed in December 2002 and the NOI/NOP was published in August 2003.

San Joaquin River Salinity Management Plan This plan outlines actions used for water quality management to improve salt and boron conditions on the lower San Joaquin River. Developed in conjunction with the management agency agreement between Reclamation and the Central Valley Regional Water Quality Control Board, the plan describes current actions and proposed mitigation. The plan focuses on three major groups of actions taken by Reclamation:

- Providing flows to the system
- Reducing salt load to the river
- Facilitating mitigation

Actions to reduce salt loads include the Grassland Bypass Project, which is designed to improve water quality in the channels used to deliver water to wetland areas and the San Joaquin River. Before the Grassland Bypass Project was implemented, drainage water from farms in the 97,000-acre Grassland Drainage Area was discharged into the San Joaquin River through Salt Slough and other channels used to deliver water to wetland areas. This drainage water contains high concentrations of selenium, salts, boron, and other constituents that are harmful to wildlife.

South Bay Aqueduct Enlargement Project The South Bay Aqueduct conveys water from the Delta through more than 40 miles of pipelines and canals to the Zone 7, Alameda County, and Santa Clara Valley water districts. Those water districts, in turn, serve the cities of Livermore, Dublin, Pleasanton, San Ramon, Fremont, Newark, Union City, Milpitas, Santa Clara, and San Jose. The first conveyance facility constructed for the SWP, the South Bay Aqueduct was designed for a capacity of 300 cfs. Recent flow tests and studies have shown that the actual capacity is 270 cfs.

The purpose of the South Bay Aqueduct Enlargement Project is to increase the aqueduct's capacity to 430 cfs to meet Zone 7 Water Agency's future needs and provide operational flexibility to reduce the SWP's peak power consumption.

The following are the principal features of this project:

- Add four 45-cfs pumps to the South Bay Pumping Plant, and expand the existing plant structure and add a new service bay and switchyard

- Construct a third (Stage 3) Brushy Creek pipeline and surge tank parallel to the existing two barrels

- Construct a 500-acre-foot reservoir (425 acre-feet of active storage) to be served by the Stage 3 Brushy Creek Pipeline

- Raise the height of the canal embankments, canal lining, and canal overcrossing structures and bridges along the Dyer, Livermore, and Alameda canals and at the Patterson Reservoir

- Modify check structures and siphons along the Dyer, Livermore, and Alameda canals

- Construct new drainage overcrossing structures to eliminate drainage into the canals

Construction is proceeding on enlargement of the South Bay Pumping Plant to make room for the four new pump units being fabricated (DWR 2011a). Project completion is expected in 2012.

Integration of CVP and SWP Operations For many years, Reclamation and DWR have attempted to increase coordination and integration of CVP and SWP operations. Such coordination allows one project to use the other's resources to improve water supply reliability and reduce costs. Reclamation and DWR plan to integrate the strengths of the CVP and SWP (storage and conveyance, respectively) to maximize water supplies for the benefit of both CVP and SWP contractors that rely on water delivered from the Bay-Delta. The agencies will ensure that such integration will not impair in-Delta uses and will be consistent with fishery, water quality, and other flow and operational requirements of the Clean Water Act (CWA) and the Federal and California endangered species acts. The project agencies have agreed to pursue the following actions:

- *Convey water for Reclamation at the SWP* Upon implementation of the increase to 8,500 cfs at the Harvey O. Banks Pumping Plant (Banks), DWR will divert and pump 100 thousand acre-feet (TAF) of Reclamation's Level 2 refuge water before September 1. This commitment will allow Reclamation to commit up to 100 TAF of conveyance capacity at the C.W. "Bill" Jones (formerly Tracy) Pumping Plant, previously reserved for wheeling refuge supplies, for CVP supplies.

- *Adjust in-basin obligations* Upon implementation of the increase to 8,500 cfs at Banks, Reclamation will supply up to 75 TAF from its upstream reservoirs to alleviate a portion of the SWP's in-basin obligation.

- *Provide extra conveyance and storage* Before the increase to 8,500 cfs at Banks, DWR will provide up to 50 TAF for pumping and conveyance of Reclamation's Level 2 refuge water. Likewise, Reclamation will supply up to 37,500 acre-feet from its upstream storage to alleviate a portion of the SWP's obligation to meet in-basin uses. The biological effects analyzed in this PDEIS are for the full 100 TAF of conveyance and up to 75 TAF of storage, as may occur when the 8,500 cfs at Banks is operational. The biological effects of the 50 TAF of conveyance and up to 37,500 acre-feet of storage that may occur at the existing permitted Banks capacity are not analyzed separately; it is assumed that those effects are encompassed by the analysis of the larger amounts and capacities that may occur when the 8,500 cfs at Banks is operational.

- *Coordinate operation of upstream reservoirs* Under certain limited hydrologic and storage conditions, when water supply is relatively high in Shasta Lake yet relatively low in Lake Oroville, the SWP may rely on Shasta storage to support February allocations based on 90-percent-exceedence projections. When the CVP's and SWP's February 90-percent-exceedence forecasts project that CVP storage in Shasta Lake will be greater than approximately 2.4 million acre-feet and SWP storage in Lake Oroville on September 30 will be less than 1.5 million acre-feet, the SWP may rely on Shasta Lake water to provide allocations. The following conditions apply:

    - Should the actual hydrology be drier than the February 90-percent-exceedence forecast, the SWP may borrow Shasta Lake water equal to the amount needed to maintain the allocation made under the 80-percent-exceedence forecast, not to exceed 200 TAF.

    - Borrowing of stored water will be requested by April 1. Reclamation and DWR will develop a plan within 15 days of the date of the request to determine the potential amount of water to be borrowed. The plan will identify the amounts, timing, and any limitation or risk to implementation and will comply with conditions on Shasta Lake and Sacramento River operations imposed by applicable BOs. Water borrowed by the SWP will be provided by making adjustments to the accounting of responsibilities in Article 6 of the Coordinated Operations Agreement.

- *Maximize use of San Luis Reservoir storage* DWR, in coordination with Reclamation and their respective contractors, will develop an annual contingency plan to ensure that storage in San Luis Reservoir remains adequate to avoid water quality problems for CVP contractors diverting directly from the reservoir. The plan will identify actions and triggers to provide up to 200 TAF of source shifting, allowing

Reclamation to use the CVP share of San Luis Reservoir more effectively to increase CVP allocations.

Additionally, a solution to the San Luis Reservoir low-point problem is in the long-term operation of the CVP and SWP and is part of this consultation. The CALFED ROD (August 28, 2000) identified solving the low-point problem in San Luis Reservoir as a complementary action that would avoid water quality problems associated with the low point and increase the effective storage capacity in San Luis Reservoir up to 200 TAF. This action, though not implemented at present, is part of the future proposed action on which Reclamation is consulting. All site-specific and localized actions related to implementing a solution to the San Luis Reservoir low-point problem, such as constructing physical facilities in or around San Luis Reservoir and any other site-specific effects, will be addressed in a separate consultation.

Quantitative Assessment of Effects on Air Quality For this cumulative effects analysis, regional impacts on air quality have been addressed through a quantitative analysis using the plan approach. As described in Chapter 5, "Air Quality and Climate," significance thresholds for the Shasta County Air Quality Management District (SCAQMD) are defined in the Shasta County General Plan. Analysis of local cumulative impacts is based on both the plan approach, which defines impact thresholds, and the list approach, which identifies projects that may emit pollutants in the same area as the proposed action. SCAQMD standards for criteria pollutants have been established to limit the emissions of individual projects when considering the cumulative effect of all projects on regional pollutant concentrations. Therefore, a significant direct project impact would also be a significant cumulative impact.

The URBEMIS2007 emissions model was used to estimate emissions of pollutants from construction activities. Among the inputs to the model for construction analysis were the types and quantities of construction equipment to be used, along with the hours of use; areas of land to be graded; number of truck trips and trip distances for export of spoils and import of materials; volumes of buildings to be demolished; areas of buildings to be built; and areas of land to be paved. For postconstruction activities, principal inputs were the number of vehicle trips and average trip distances. The methods and results of this analysis are described in greater detail in Chapter 5, "Air Quality and Climate."

Qualitative Assessment of Other Actions Past, present, and reasonably foreseeable future actions were also assessed qualitatively. Information on current and historical conditions was used to evaluate combined effects of past actions on botanical resources. For present and reasonably foreseeable future actions, a list of related actions was compiled. The combined effects of past, present, and reasonably foreseeable future actions were then evaluated with effects of the project. The combined effects of past actions and the list of related present and reasonably foreseeable future projects are described further below.

Past Actions A large number of past actions have occurred in the study area. These past actions have strongly influenced existing conditions, and some past actions created "legacies" that are still affecting resources. Among the legacies are the sediment released by hydraulic mining and the metal contamination that is still being generated by abandoned mines. The following are the most important of these past actions:

- Population growth and associated development of socioeconomic resources and infrastructure
- Conversion of natural vegetation to agricultural and developed land uses
- Introduction of nonnative plant and animal species
- Resource extraction (e.g., mining, grazing, and timber harvests)
- Water development actions, particularly the construction and operation of Shasta Dam, the rest of the CVP, and the SWP

Present and Reasonably Foreseeable Future Actions Present projects and reasonably foreseeable (probable) future projects are those projects that are currently under construction, approved for construction, or in final stages of formal planning.

The present or reasonably foreseeable (probable) future actions considered in this cumulative effects analysis are those actions located within the primary or extended study area that have been identified as potentially affecting resources that also may be affected by the SLWRI. These actions were identified by compiling and then reviewing a preliminary list of actions. A preliminary list of actions was compiled by reviewing available information regarding planned projects (including agency Web sites). Actions were then reviewed for inclusion in the cumulative effects analysis based on three criteria:

- The action has an identified sponsor actively pursuing project development; the sponsor has completed or issued NEPA and/or CEQA compliance documents such as a DEIS or DEIR; and the action appears to be "reasonably foreseeable," given other considerations such as public and stakeholder controversy.
- Available information defines the action in sufficient detail to allow meaningful analysis.
- The action could affect resources potentially affected by the SLWRI.

Any action that could affect resources potentially affected by the SLWRI and was under construction was considered "reasonably foreseeable."

Based on this review, the effects of the following actions were qualitatively considered in the assessment of cumulative effects of the SLWRI. This list is organized into four categories of actions: water resources, resource management and restoration, levee, and development actions. Some unknown subset of the following projects, while not strictly meeting the criteria above, would likely be implemented: the *Bay Delta Conservation Plan* (and associated alternative Delta conveyance facilities), the North-of-Delta Offstream Storage Facility (Sites Reservoir), the Upper San Joaquin River Basin Storage Investigation (Temperance Flat Reservoir), and the South Delta Improvements Program. It would be speculative to consider these projects at any more than a conceptual basis because these projects and their effects are not defined in sufficient detail to allow meaningful analysis.

Water Resources Actions In addition to the water resources actions described above in the section "Quantitative Assessment of Actions Related to Water Resources," the water resources–related actions described below were identified as reasonably foreseeable.

Red Bluff Diversion Dam Pumping Plant In 2002 and again in 2006, Reclamation circulated a DEIS/EIR that analyzed various options for improving fish passage at Red Bluff Diversion Dam (RBDD) and requested public comments. Shortly after the 2006 release of the DEIS/EIR, Reclamation stated that Alternative 2B, featuring construction of a new pumping plant and operation of the RBDD gates in the out position for approximately 10 months of the year, was its Preferred Alternative (72 *Federal Register* 4292, January 30, 2007). Reclamation subsequently prepared an FEIS/EIR and ROD calling for a pumping plant to be constructed upstream from the dam to improve the ability to divert water into the Tehama-Colusa Canal when gravity diversion is not possible because the RBDD gates are out. Reclamation completed consultations with the USFWS and NMFS under Section 7 of the Federal ESA regarding construction of the new plant. The new pumping plant would be capable of operating throughout the year, providing water diversions for Tehama-Colusa Canal Authority customers.

Green sturgeon spawn upstream from RBDD; most upstream and downstream migration by adults occurs before July and after August. Once the new pumping plant has been constructed and is operational, RBDD would cease operations with the gates permanently open to improve passage by adult green sturgeon and other spawning fish.

The pumping plant project will occur in three phases. The first, completion of the NEPA/CEQA process, has already been accomplished. The design and permitting phase is commencing, subject to the availability of funding, and is anticipated to take about 18 months. As funding permits, property acquisition will also occur during this phase, and further funding commitments will be secured during this time. The final phase, facilities construction, is anticipated

to take approximately 18 months, but this timeline will be updated during final design and permitting.

North-of-Delta Offstream Storage Investigation The North-of-Delta Offstream Storage Investigation is a feasibility study being performed by Reclamation and DWR, in partnership with local interests and pursuant to the ROD for the CALFED Programmatic EIS/EIR (DWR 2011b). This study is evaluating potential projects for offstream storage of surface water at Sites Reservoir in the upper Sacramento River Basin. Such storage could increase water supply reliability for all beneficial uses (agricultural, urban, and environmental).

The Sites Reservoir Project could contribute to cumulative effects on water supplies and associated resources. The project could increase water supplies available for export in years when export supplies otherwise would be limited. This project also could modify the timing and magnitude of upstream reservoir releases in wet years.

An NOI/NOP for this project was issued in November 2001 and public scoping for the environmental document occurred in January 2002. The complete plan formulation report was published in September 2008 and the EIS/EIR is scheduled to be completed by December 2011.

Folsom Dam Raise Project USACE, sponsored by the Sacramento Area Flood Control Agency (SAFCA) and the Central Valley Flood Protection Board, is responsible for the Folsom Dam Raise Project in the CVP service area on the American River. This project will raise Folsom Dam 7 feet to reduce the Sacramento area's flood risks. The Folsom Dam Raise Project involves raising Folsom Dam and the related dikes/auxiliary dam, modifying L. L. Anderson Dam, constructing a bridge downstream from Folsom Dam, completing temperature shutter modifications, and restoring the area's ecosystem (USACE et al. 2009). Construction on the dam raise began in December 2007 and is expected to be completed in 2015.

Bay Delta Conservation Plan (and Alternative Delta Conveyance Facilities) Four broad concepts have been studied to address urban water quality, water supply reliability, and environmental concerns in the Delta: physical barriers, hydraulic barriers, through-Delta facilities, and isolated facilities. During the last 50 years, a variety of proposals modifying or combining all these concepts have been suggested to improve Delta conditions and allow for beneficial use of Delta water supplies. The *Bay Delta Conservation Plan* is currently being developed. Several alternative Delta conveyance facilities are being evaluated as part of the plan. Among these alternatives is an isolated facility that would convey water around the Delta for local supply and export through a hydraulically isolated channel.

An isolated facility similar to that currently proposed in the *Bay Delta Conservation Plan* was proposed previously, formulated in a plan proposed by the Interagency Delta Committee in 1965 as the Peripheral Canal. A statute that would have authorized this and many other additions to the SWP was rejected by California voters in 1982. That proposal consisted of constructing an isolated canal from near Hood on the Sacramento River to Clifton Court Forebay (with a fish screen near Hood), siphons, and the capability to release water to Delta channels to improve water circulation in Delta channels.

An isolated facility that would convey water around the Delta could improve water quality for urban and agricultural water users; the facility would also eliminate reverse flow in the Delta and improve Delta water quality and flow by releasing water to south Delta channels. Because the intake gate for this facility would be upstream from much of the Delta along the Sacramento River, it would substantially reduce impacts of bromide and agricultural drainage on water delivered to urban water purveyors.

Possible collateral measures to improve water quality at the intake gate would be to divert major agricultural drainage from the Sacramento Valley and effluent from the Sacramento Regional Water Treatment Plant to the Yolo Bypass. This option would also reduce the effects of CVP and SWP export facilities on fish by eliminating predation in Clifton Court Forebay, closing the Delta Cross Channel gates to improve fish migration, and eliminating reverse flow. Implementing this project would result in substantial changes to CVP and SWP system operations and cause a potentially significant impact on hydropower generation and facilities.

Franks Tract Project Reclamation and DWR propose to implement the Franks Tract Project to improve water quality and fisheries conditions in the Delta. Reclamation and DWR are evaluating installing operable gates to control the flow of water at key locations (Threemile Slough and/or West False River) to limit the entry of fish species of concern and higher salinity water into Franks Tract. In addition to improving water quality, the gates would limit migration of delta smelt into the central and south Delta, where their survival rates are reduced. By protecting fish resources, this project also would improve the operational reliability of the CVP and SWP because curtailments (pumping restrictions) in project operations would likely be less frequent.

The project gates would be operated seasonally (January through September) and during certain hours of the day, depending on fisheries and tidal conditions. Boat passage facilities would be included to allow watercraft to pass through when the gates are in operation. The Franks Tract Project is consistent with ongoing planning efforts for the Delta to help balance competing uses and create a more sustainable system for the future. Public scoping meetings were held in October 2008 and preparation of a joint EIS/EIR for the project is under way. The EIS/EIR is expected to be published in fall 2011, with a ROD to be issued and CEQA certification to occur in spring 2012.

Reclamation and DWR have conducted studies to evaluate the feasibility of modifying hydrodynamic conditions near Franks Tract to improve Delta water quality and enhance the aquatic ecosystem. The results of these studies indicate that modifying hydrodynamic conditions near Franks Tract may substantially reduce the Delta's salinity and protect its fishery resources, including the sharply declining populations of delta smelt, a Federally listed and State-listed species that is endemic to the Delta.

The goals of the Franks Tract Project are as follows:

- Modify hydrodynamic conditions to protect fish species of concern, particularly delta and longfin smelt.

- Improve operational flexibility of the CVP and SWP by protecting Delta fish resources; reduce intrusion of higher salinity water resulting from normal tidal influences, sea level rise, or catastrophic levee failures; and protect water quality during extended closures of the Delta Cross Channel.

- Develop water quality and fish protection measures consistent with long-term planning efforts.

In-Delta Storage Program (Delta Wetlands Project) DWR, in coordination with the California Bay-Delta Authority and with technical assistance from Reclamation, completed the State feasibility study for the In-Delta Storage Program in the south Delta, within the extended study area. The In-Delta Storage Project would provide capacity to store approximately 217 TAF of water in the south Delta for a wide array of water supply, water quality, and ecosystem benefits. The project would consist of two storage islands (Webb Tract and Bacon Island) and two habitat islands (Holland Tract and Bouldin Island), an embankment design, consolidated inlet and outlet structures, project operations, and habitat management plans. The objectives of the project are to enhance water supply reliability and the operational flexibility of the CVP/SWP system, contribute to ecosystem restoration, and provide water for the Environmental Water Account (EWA) (DWR 2011c). (See the discussion of the EWA below.)

Detailed planning work on the In-Delta Storage Project has been suspended since July 2006 when State funding was cut (DWR 2011c).

Los Vaqueros Reservoir Expansion Project Reclamation, DWR, and Contra Costa Water District are implementing the Los Vaqueros Reservoir Expansion Project in the Delta, within the extended study area. The project's goal is to improve water quality and water supply reliability for Bay Area water users while enhancing the Delta's environment. The existing Los Vaqueros Reservoir storage will be expanded from the existing 100 TAF to 160 TAF to improve water quality and water supply reliability. The Contra Costa Water

District's board of directors certified the EIR and approved the Los Vaqueros Reservoir Expansion Project on March 31, 2010. Construction began in March 2011 (Reclamation and CCWD 2011).

South Delta Improvements Program DWR and Reclamation are seeking permits for the installation and operation of permanent operable gates to implement improvements in the south Delta for protection of local water levels, water quality, and Chinook salmon (DWR 2010). Construction of operable gates at four locations in the south Delta under the South Delta Improvements Program (SDIP) incorporates dredging and extension of agricultural intakes. These proposed actions are intended to maximize diversion capability into Clifton Court Forebay while providing an adequate water supply for South Delta Water Agency and reducing adverse effects of SWP exports on aquatic resources. The SDIP includes physical/structural improvements and operational changes (Reclamation and DWR 2005).

The SDIP was included in the OCAP, which covers SWP and CVP operations. Both USFWS and NMFS rendered jeopardy BOs on the OCAP. The NMFS opinion, issued in June 2009, specifically directs DWR to halt implementation of the SDIP. NMFS indicates that consultation for the SDIP cannot be reinitiated until after 3 years of fish predation studies at the South Delta temporary barriers are completed. After all permits have been acquired, DWR can proceed with construction. No schedule has been established for project completion.

Central Valley Flood Protection Plan Legislation passed in 2007 directs DWR to develop three documents that will guide improvement of integrated flood management:

- *State Plan of Flood Control Descriptive Document* to inventory and describe the flood management facilities, land, programs, conditions, and mode of operations and maintenance for the State/Federal flood protection system in the Central Valley.

- *Flood Control System Status Report* to assess the status of the facilities included in the State Plan of Flood Control Descriptive Document, identify deficiencies, and make recommendations.

- *Central Valley Flood Protection Plan* (CVFPP) to describe a sustainable, integrated flood management plan that reflects a systemwide approach for protecting areas of the Central Valley that currently receive protection from flooding by existing facilities of the State Plan of Flood Control. The plan will incorporate the State Plan of Flood Control and Flood Control System Status Update. The CVFPP must be prepared by January 1, 2012, and is scheduled for adoption by the Central Valley Flood Control Board by July 1, 2012.

The CVFPP will be a sustainable, integrated flood management plan that describes the existing flood risk in the Central Valley and recommends actions to reduce the probability and consequences of flooding. Produced in partnership with Federal, tribal, local, and regional partners and other interested parties, the CVFPP will also identify the mutual goals, objectives, and constraints important in the planning process; distinguish plan elements that address mutual flood risks; and, finally, recommend improvements to the State/Federal flood protection system.

Resource Management and Restoration Actions The actions related to resource management and restoration that are described below were identified as reasonably foreseeable.

Trinity River Mainstem Fishery Restoration Program The Trinity River Restoration Program staff, funded by Federal, State, and local agencies, is responsible for implementing the Trinity River Mainstem Fishery Restoration Program in the CVP service area at Lewiston Dam on the Trinity River. The program plans to implement recovery actions for the Trinity River and its fish and wildlife populations. This plan includes direct in-channel actions, continued watershed restoration activities, replacement of bridges and structures within the floodplain, and a program to monitor and improve restoration activities. Some of the actions and activities have been implemented and are operational. The plan has two restoration goals: reestablish the natural physical processes that create and maintain high-quality aquatic habitat; and create spawning and rearing conditions downstream from the dams, including adequate water temperatures, that best compensate for lost habitat upstream.

The ROD for the Trinity River Restoration Program was signed in December 2000 and, after various legislative delays, was put into action after November 2004. Full implementation of the releases specified in the ROD and construction of the channel rehabilitation sites depend on identifying and implementing an appropriate realty strategy for private landowners along the river (TRRP 2011).

Central Valley Project Improvement Act The Central Valley Project Improvement Act (Title 34, Sections 3401–3408(h) of Public Law 102-575) is concerned with restoring anadromous fish populations, providing water supplies for Federal and State refuges, mitigating effects of the CVP on other fish and wildlife, and retiring drainage-impaired farmlands. To fulfill these provisions, the Central Valley Project Improvement Act established an ongoing program creating a fund for restoration actions. The program is financed by the CVP's water and power users and administered by Reclamation. Funds are contributed to multiple restoration actions annually to finance restoration of aquatic, riparian, and other habitats and modify CVP operations.

CALFED Ecosystem Restoration Program DFG, USFWS, and NMFS implement the CALFED Ecosystem Restoration Program (CALFED 2000b), which works to improve the ecological health of the Bay-Delta

watershed by restoring and protecting habitats, ecosystem functions, and native species. The program includes all projects authorized, funded, and permitted (even if not constructed) to date, particularly in the Delta, that aim to do any of the following:

- Recover at-risk native species dependent on the Delta, Suisun Bay, and San Francisco Bay
- Minimize the downward population trends of native species that are not listed
- Protect and restore functional habitat types in the Bay-Delta estuary and its watershed for ecological and public values
- Prevent the establishment of additional nonnative invasive species and reduce the negative ecological and economic impacts of established nonnative species in the Bay-Delta estuary
- Improve and/or maintain water and sediment quality conditions that fully support healthy and diverse aquatic ecosystems in the Bay-Delta estuary and watershed

Since its inception, Ecosystem Restoration Program agencies have consolidated their vision into a single "blueprint" for ecosystem restoration. They further identified more than 600 programmatic actions and the 119 milestones throughout the Bay-Delta watershed. The blueprint has been implemented through a large number of competitive and directed grants.

Environmental Water Account The EWA Operating Principles Agreement has provided the basis for the operation of the EWA Program since the CALFED ROD was signed in August 2000. The EWA is described below, followed by a discussion of the limited EWA that resulted from the OCAP biological assessment.

EWA Overview The five EWA agencies (DWR, DFG, NMFS, USFWS, and Reclamation) all signed the EWA Operating Principles Agreement, giving the program its operational guidance through September 2004. The five agencies signed a memorandum of understanding (MOU) extending the EWA through December 31, 2007. The principle underlying the EWA was that Reclamation and DWR would operate the CVP and SWP in response to requests by DFG, NMFS, and USFWS to provide protections to fish beyond those required in existing regulatory standards. Specifically, additional water would be provided to the projects later in the season at no extra cost to the Federal and State water contractors.

In 2006, the EWA agencies were cooperating on development of an EIS/EIR for a long-term extension of the EWA Program. However, because Reclamation

decided to pursue reconsultation on the OCAP for the CVP and SWP Delta facilities, the agencies suspended work on the long-term EWA EIS/EIR and instead developed a supplement to the EIS/EIR covering EWA operations through 2011. That supplement was completed in early summer 2008 and was certified by DWR.

The supplemental EWA EIS/EIR was originally intended to facilitate another MOU among the five EWA agencies extending the EWA on a short-term basis through 2011. However, the decision of the U.S. District Court in *NRDC v. Kempthorne* (2007 WL 4462395 (E.D. Cal., December 14, 2007)) placed constraints on the CVP's and SWP's Delta export pumps, in the form of prescribed pumping limits that essentially replace most of the voluntary adaptive decisions on pumping curtailments made under the EWA Program.

In *NRDC v. Kempthorne*, the court directed USFWS to complete and issue a new BO addressing the OCAP, with emphasis on protection of delta smelt. The uncertainty of the resulting requirements on Delta export operations of the CVP and SWP is a major unknown factor in assessing the role of a continued EWA Program.

In 2007, the EWA agencies used new scientific information to reduce pumping based on criteria different from those used in previous EWA operational years; this action was similar to those prescribed by the decision in *NRDC v. Kempthorne*. Pumping from the CVP and SWP pumps was curtailed by 501,500 acre-feet during the 2007 water year, the largest curtailment made during the 7-year history of the EWA Program.

DWR and DFG are also discussing measures to protect longfin smelt. Additional constraints to protect salmon and longfin smelt could further constrain Delta exports and increase the EWA-type water cost to provide such protection.

The intent for the EWA Program was to use public funding during the program's initial years to provide the replacement water required to meet the program goal of no uncompensated water cost to CVP and SWP water users. Substantial public funding was provided in several bond issues; however, most of that funding has been used, and the remaining public funding for the continuation of the EWA is very limited.

There is no plan at this time to provide additional public funding to continue the EWA Program. Since 2008, public funding has been insufficient to provide replacement water to compensate for reductions in Delta pumping to protect Delta fish species, as was done in prior years. In addition, some of the pumping reductions that were previously voluntary may became mandatory. Thus, the nature of the future EWA Program, if any, is subject to further discussion among the five EWA agencies.

DWR has executed an agreement with Yuba County Water Agency to implement a portion of the Yuba Accord, providing about 60 TAF of water per year to DWR for EWA purposes through 2015. DWR also retained enough funds to provide a one-time purchase of up to about 150 TAF for EWA purposes in 2009. Reclamation had some funding from congressional authorization of the EWA Program through 2010, and expected to receive additional appropriations through that period, optimistically enough to purchase about 25 TAF for the next few years.

DWR envisions that Federal resources will be used to address additional fisheries issues in the Delta while funding is available, and that State resources will be used for the Vernalis Adaptive Management Program and its shoulders.

While developing the OCAP project description as the basis for the USFWS and NMFS reconsultation, Reclamation and DWR defined a "limited EWA" as being part of that project description. It is described below.

Limited Environmental Water Account per OCAP Biological Assessment The original EWA was established in 2000 by the CALFED ROD, and operating criteria are described in detail in the EWA Operating Principles Agreement attachment to the ROD. In 2004, the EWA was extended to operate through the end of 2007. Reclamation, USFWS, and NMFS received congressional authorization to participate in the EWA at least through September 30, 2010, per the CALFED Bay-Delta Authorization Act (Public Law 108-361). However, for these Federal agencies to continue participation in the EWA beyond 2010, additional authorization will be required, and continued program activities and funding are highly uncertain.

The EWA agencies acquire assets and determine how the assets should be used to benefit the at-risk native fish species of the Bay-Delta estuary. Operation of the EWA Program is guided by the EWA Team, which comprises technical and policy representatives from each of the five EWA agencies. The EWA Team coordinates its activities with the Water Operations Management Team.

The original purpose of the EWA was to enable diversion of water by the CVP and SWP from the Delta, with diversions to be reduced when at-risk fish species may be harmed, but without uncompensated loss of water to CVP and SWP contractors. Typically, when pumping was curtailed, the EWA replaced the lost water by purchasing surface water or groundwater supplies from willing sellers and by taking advantage of regulatory flexibility and certain operational assets. From 2001 through 2007, when pumping at Banks was curtailed to protect Delta fish, the EWA often owed a debt of water to the SWP, usually reflected in San Luis Reservoir.

The EWA agencies are undertaking environmental review to determine the future of the EWA. No decision has yet been made about the EWA; therefore, for the purposes of this PDEIS, the EWA has been analyzed with limited assets,

focusing on providing assets to support the Vernalis Adaptive Management Program and, in some years, the "post-Vernalis Adaptive Management Program shoulder." The following are the EWA's assets:

- Releases of water described in Component 1 of the Yuba Accord – that is, annual release of an average of 60 TAF of water from the Yuba River to the Delta. Such releases are an EWA asset through 2015, with a possible extension through 2025. In most years the 60 TAF is expected to be reduced by carriage-water costs estimated at 20 percent, leaving an EWA asset of 48 TAF per year. The SWP will provide the 48 TAF per year from project supplies beyond 2015 if releases of Yuba Accord Component 1 water are not extended.

- Purchases of assets, to the extent that funds are available.

- Operational assets granted to the EWA in the CALFED ROD, as follows:

  - A 50 percent share of SWP export pumping of Central Valley Project Improvement Act Section 3406(b)(2) water and Environmental Restoration Program water from upstream releases

  - A share of the use of SWP pumping capacity in excess of the SWP's needs to meet contractor requirements with the CVP on an equal basis, as needed. (Such use may be under the Joint Point of Diversion.)

  - Any water acquired through flexibility in the export/inflow ratio.

  - Use of a 500-cfs increase in authorized Banks capacity from July through September (from 6,680 to 7,180 cfs).

  - Storage in project reservoirs upstream from the Delta and in San Luis Reservoir, with a lower priority than project water. Such stored water will share storage priority with water acquired for Level 4 refuge needs.

- Operational assets averaged 82 TAF from 2001 through 2006, and ranged from 0 to 150 TAF.

San Luis Reservoir Low Point Improvement Project As part of this project, Reclamation is investigating three alternatives to address the water quality problems within the CVP's San Felipe Division (Santa Clara and San Benito counties) that arise when San Luis Reservoir levels drop below 300 TAF during late summer in dry water years, resulting in large algal blooms. The alternatives being considered are to (1) expand the 6-TAF Pacheco Reservoir to 80 TAF or 130 TAF, (2) lower the San Felipe Intake at San Luis Reservoir, or (3) implement a combination comprehensive plan. The combination

comprehensive plan would involve increasing groundwater recharge and recovery capacity, implementing desalination measures, reoperating Santa Clara Valley Water District's raw- and treated-water systems, and implementing institutional measures. If Pacheco Reservoir were to be enlarged, the reservoir would be filled with Delta water; thus, additional impacts on Delta aquatic species (e.g., juvenile salmonids and delta smelt) could result from an increase in Delta exports. The environmental scoping report for the San Luis Reservoir Low Point Improvement Project was released in January 2009 and the plan formulation report was published in January 2011.

B. F. Sisk Dam Corrective Action Project B.F. Sisk Dam (also known as San Luis Dam) is a 300-foot-high, compacted earthfill embankment located on the west side of California's Central Valley approximately 12 miles west of Los Banos. Owned by Reclamation and operated by DWR, the dam is more than 3½ miles long. B.F. Sisk Dam impounds San Luis Reservoir, which has a total capacity of more than 2 million acre-feet. The dam was built between 1963 and 1967 to provide supplemental storage of irrigation water for the CVP and municipal and industrial water for the SWP. The Gianelli Pumping-Generating Plant lifts water from both the California Aqueduct and the Delta-Mendota Canal (via O'Neill Forebay) into San Luis Reservoir for storage.

The dam and reservoir are located in an area of high potential for severe earthquakes on active faults, primarily the Ortigalita Fault, which crosses the reservoir. In the early 1980s, Reclamation conducted an extensive investigation of the seismic safety of B. F. Sisk Dam. The general conclusion was that some of the less dense soils could undergo liquefaction in a major earthquake. However, the investigation determined that liquefaction would not be sufficiently widespread to cause the dam's slopes to become unstable. Using the methods available at the time, Reclamation predicted that the amount of deformation that would occur under severe shaking would be small, and concluded that the dam had no safety deficiencies.

By 2005, the state of the art in seismic analysis of dams had changed substantially, and additional investigations of dam safety were performed. With the updated methodology and earthquake loadings, the dam crest was predicted to settle during the most severe earthquakes, causing the height of the dam's crest to be at the reservoir's maximum water level. It is possible (although not likely) that the embankment deformation would exceed the available freeboard, which would cause the reservoir to overtop the embankment and erode a breach of the dam. Even without overtopping, it is possible that water flowing through cracks in the dam embankment could erode a breach as well.

Reclamation and DWR are conducting engineering and economic studies to determine alternatives for corrective actions that would address potential safety concerns related to structural stability under extreme seismic loading conditions. The agencies will prepare a joint EIS/EIR to evaluate the effects of implementing the B. F. Sisk Dam Corrective Action Project.

Shasta-Trinity National Forest Land and Resource Management Plan USFS has prepared the Shasta-Trinity National Forest (STNF) Land and Resource Management Plan (LRMP) to guide the management of the Shasta and Trinity national forests in the vicinity of Shasta Lake, in the primary study area. The primary goals of the STNF LRMP are to integrate a mix of management activities that allow use and protection of forest resources; meet the needs of guiding legislation; and address national, regional, and local issues. The plan also includes goals to do all of the following:

- Protect unique landscapes and their wild and scenic characteristics for the indefinite future
- Maintain a rich diversity of plants, fish, and wildlife
- Provide high-quality recreational experiences
- Provide a long-term sustained yield of timber, forage, and other resource products and services consumed by society

The plan also includes specific goals relating to wildlife, habitat, water quality, fires and fuel management, visual quality, recreation, minerals, law enforcement, and cultural resources (USFS 1995a). The STNF proposes projects to implement the LRMP, and publishes a list of those projects in the quarterly Schedule of Proposed Actions (USFS 2011). Proposed actions within the analysis area are included in the cumulative effects analysis.

Iron Mountain Mine Restoration Plan The Iron Mountain Mine Trustee Council developed the *Iron Mountain Mine Restoration Plan*. This plan identifies restoration actions to address injuries to or lost use of natural resources from acid mine drainage from the Iron Mountain Mine complex, located west of the upper Sacramento River in the primary study area. The plan involves restoring salmonid populations, riparian habitat, and instream ecological functions. The plan also involves implementing restoration projects to compensate for the lost use of public areas and public services. The aquatic and riparian habitats affected by releases of hazardous substances at or from the Iron Mountain Mine site include the site creeks (Boulder, Slickrock, Flat, and Spring) and the mainstem and tributaries of the Sacramento River from Keswick Reservoir to RBDD. As additional compensation for damage to natural resources, this project includes an option for the Federal government to acquire approximately 1,250 acres for transferring into public ownership and to be administered by the U.S. Bureau of Land Management (BLM) (IMMTC 2002, NOAA 2009). The Iron Mountain Mine Trustee Council has allocated funds to several projects designed to meet the goals of the *Iron Mountain Mine Restoration Plan*.

Mendocino National Forest Land and Resource Management Plan USFS developed the *Mendocino National Forest Land and Resource Management*

Plan (Mendocino National Forest LRMP) to direct the management program for use and protection of the Mendocino National Forest in the primary and extended study areas. The plan fulfills legislative requirements while addressing national, regional, and local issues. The Mendocino National Forest LRMP also includes goals for fish and wildlife, wild and scenic rivers, minerals and energy, law enforcement, heritage resources, fire and fuels, facilities, air quality and diversity (USFS 1995b). The Mendocino National Forest LRMP is currently being implemented.

Sacramento River Conservation Area Forum Program The Sacramento River Conservation Area Forum is a nonprofit organization that works to protect, restore, and enhance the fisheries and riparian habitat along the Sacramento River in the primary and extended study areas, from Keswick Dam downriver to Verona. This is a cooperative effort that works to ensure that habitat restoration and management addresses not only the dynamics of riparian ecosystems, but also the realities of local agricultural and recreational issues associated with land use changes occurring along the river. The program (Resources Agency 2003) has goals to protect, restore, and enhance fisheries and riparian habitat along the Sacramento River and its tributaries and develops and implements site-specific and subreach plans for areas within the conservation area.

U.S. Bureau of Land Management Redding Resource Management Plan BLM prepared this plan (BLM 1992) to identify the direction for the proposed management of public lands and Federal mineral estate it administers within the primary study area and the extended study area along the middle Sacramento River. The primary goal of BLM's Redding Resource Management Plan is to manage public lands to prevent deterioration of habitat for special-status species, thereby precluding the need for Federal or State listing of those species. In 1993, BLM issued a ROD announcing its intent to implement the plan.

Sacramento River National Wildlife Refuge Draft Comprehensive Conservation Plan This plan, put forth by USFWS, provides a 15-year strategy for achieving the goals of the Sacramento River National Wildlife Refuge, located between Red Bluff and Colusa along the middle Sacramento River in the extended study area. One of the plan's goals is to contribute to the recovery of endangered and threatened species and provide natural diversity and abundance of migratory birds and anadromous fish by restoring and managing viable riparian habitats along the Sacramento River, using the principles of landscape ecology. The plan also seeks to provide high-quality opportunities for hunting, fishing, wildlife viewing, and photographic visits; provide visitor safety; and ensure compliance with regulations through law enforcement (USFWS 2005b).

The *Draft Comprehensive Conservation Plan and Environmental Assessment for the Sacramento National Wildlife Refuge* (USFWS 2005b) became available for review and comment in July 2008, with the review period scheduled to end

in September 2008. The final conservation plan will be developed through modifications made during the internal and public review processes.

Comprehensive Management Plan for the Sacramento River Wildlife Area DFG has prepared a this plan for the 3,770-acre Sacramento River Wildlife Area between Red Bluff and Colusa along the middle Sacramento River in the extended study area. This plan provides an ecosystem approach to managing the Great Valley riparian habitat communities in the wildlife area for their ecological values and the enjoyment of the public (DFG 2004).

North Delta Flood Control and Ecosystem Restoration Project Reclamation and DWR propose the North Delta Flood Control and Ecosystem Restoration Project in the north Delta, within the extended study area (DWR 2011d). The goal of this project is to implement flood control improvements in a manner that benefits aquatic and terrestrial habitats, species, and ecological processes. Components being considered for flood control include setback levees, detention basins, dredging, and levee degradation for floodplain expansion, which may also be configured to create quality habitat for species of concern in the north Delta area. These goals would be accomplished by using McCormick-Williamson Tract and Staten Island in the Delta.

The DEIR was released in January 2008, followed by the FEIR in 2010. The design will be completed by fall 2011, with construction expected to be complete in summer 2013.

Levee Actions The actions related to levees that are described below were identified as reasonably foreseeable.

California Department of Water Resources Levee Repair DWR and USACE are responsible for repairing critical erosion sites on California's Federal/State levee system throughout the primary and extended study areas, including the CVP and SWP service areas. Repairs are necessary to keep the levee systems functioning. Some of these systems have deteriorated over time or do not meet current design standards, or both. In general, repairs to Federal and State project levees are being made under three main programs: the Critical Erosion Repairs Program, the Sacramento River Bank Protection Project, and the Public Law 84-99 Rehabilitation Program. A fourth program to repair critically damaged levees in the San Joaquin Flood Control System is under development by DWR. DWR is also working with local agencies to survey and document damage from erosion at additional sites that are under local control (not part of the Federal/State flood control system). The aim is also to assist local jurisdictions in determining the best approach for needed repairs (DWR 2011e).

Nearly 300 levee repair sites have been identified to date. More than 100 of the most critical sites have been repaired. Repairs to others are either in progress or

scheduled to be completed in the near future, and still more repair sites are in the process of being identified, planned, and prioritized (DWR 2011e).

CALFED Levee System Integrity Program DWR, DFG, and USACE implement the CALFED Levee System Integrity Program, which maintains and improves the integrity of the Bay-Delta estuary's levee system. The goal of the Levee System Integrity Program is to reduce risk to land use and associated economic activities, water supply, agriculture and residential use, infrastructure, and the ecosystem from the effects of catastrophic breaching of Delta levees. Resources protected by the program include water quality, ecosystem health, infrastructure such as utilities and transportation corridors, agriculture, and recreational industries.

Since 2000, protection for and maintenance of nearly 700 miles of Delta levees has been increased, with ongoing maintenance undertaken along more than 600 miles of eligible project and nonproject levees. Further, stability was improved for more than 45 additional miles of levees. Large levee rehabilitation projects have been undertaken on numerous islands, along with projects to grow native vegetation, reuse more than 2 million cubic yards of dredge material for levee stability and habitat development, and develop approximately 50 acres of riparian and wetland habitat and 3,000 linear feet of shaded riverine aquatic habitat (CALFED 2011).

Natomas Levee Improvement Program Landside Improvement Project SAFCA is implementing the multiple-phase Natomas Levee Improvement Program Landside Improvements Project along the lower Sacramento River in the extended study area, in conjunction with USACE. The project involves implementing improvements to the perimeter levee system of the Natomas Basin in Sutter and Sacramento counties and modifying associated landscaping and irrigation/drainage infrastructure. The project objectives are to provide at least a 100-year level of flood protection to the Natomas Basin as quickly as possible, provide "200-year" protection to the basin over time, and avoid any substantial increase in expected annual damages as new development occurs in the basin (SAFCA 2007).

Multiple CEQA and NEPA documents have been issued by SAFCA and USACE for various phases of this project since 2008. The FEIS for Phase 4a of the project was issued by USACE in February 2010. Construction of some phases of the project is in progress. All construction is expected to be completed by 2014 (SAFCA 2010).

West Sacramento Levee Improvement Program The West Sacramento Levee Improvement Program involves constructing improvements to the levees that protect West Sacramento to meet local and Federal flood protection criteria. The program area includes the entire boundaries of the West Sacramento Area Flood Control Agency, which encompass portions of the Sacramento River, the Yolo Bypass, the Sacramento Bypass, and the

Sacramento Deep Water Ship Channel. The levee system associated with these waterways includes more than 50 miles of levees in Reclamation Districts 900, 537, and 811; DWR's Maintenance Area 4; and the Sacramento Deep Water Ship Channel. These levees completely surround West Sacramento. For the purposes of this program, the levees have been generally divided into nine reaches: Sacramento River Levee North, Sacramento River Levee South, Port North Levee, Port South Levee, South Cross Levee, Deep Water Ship Channel Levee East, Deep Water Ship Channel Levee West, Yolo Bypass Levee, and Sacramento Bypass Levee. Construction began in 2008 and will continue through 2012 (City of West Sacramento 2010).

Land Use Planning Actions Land use plans and policies are described in Chapter 17, "Land Use and Planning"; applicable plans are listed in this section with brief summaries. Inconsistency with land use plans and policies does not necessarily indicate that adverse affects on the environment would occur; however, land use plans and policies guide development and land management activities that would affect the physical environment, and SLWRI actions could have additive or combined effects.

Federal Land Use Planning Federal lands are not subject to county or city general plans. Land use planning direction for the Whiskeytown-Shasta-Trinity National Recreation Area (NRA) is guided by national legislation, regional forest directives, and forest-specific management directives found in the STNF LRMP.

County and City Land Use Planning Land use planning is the province of local governments in California. All cities and counties in California are required by the State to adopt a general plan that establishes goals and policies for long-term development, protection from environmental hazards, and conservation of identified natural resources (California Government Code, Section 65300). General plans lay out the pattern of future residential, commercial, industrial, agricultural, open-space, and recreational land uses within a community. To facilitate implementation of planned growth patterns, general plans identify goals and/or policies to establish land use patterns.

The *Shasta County General Plan* (2004) provides planning guidance for privately owned land in Shasta County. Land use directives are provided in the form of goals, policies, objectives, standards, and guidelines. The *Shasta County General Plan* designates the following land uses along the Sacramento River from Shasta Dam south to the Tehama County line:

- Rural residential
- Greenway
- Habitat resource
- Natural habitat

- Agricultural – cropland
- Agricultural – small-scale crops, grazing
- Mineral resources

The *Tehama County General Plan* (2009) designates the following land uses along the Sacramento River from the Shasta County line in the north to Red Bluff:

- Habitat resource, resource lands, and public/wilderness
- Cropland and grazing
- General commercial
- Scenic easement and open space
- Commercial recreation
- Urban and city
- Rural small lot, rural large lot, and suburban

The *City of Shasta Lake General Plan* (1999)designates the following land uses along Shasta Dam Boulevard, the primary roadway leading up to Shasta Dam:

- Community Park
- 100-Year Floodplain
- Public Facilities
- Commercial
- Mixed Use
- Rural Residential (1 unit/2 acres; 1 unit/5 acres)
- Suburban Residential (3 units/acre)
- Urban Residential (10 units/acre)
- Urban Residential – High (20 units/acre)

The City of Redding adopted an updated general plan in 2000 (City of Redding 2000). This general plan designates the following land uses along the Sacramento River within the city limits and sphere of influence:

- Greenway
- Park, Park-Golf
- Public Facility; Public Facility–School
- Recreational

- General Office
- General Commercial
- Neighborhood Commercial
- Residential (2 to 3.5, 3.5 to 6, 6–10 units/acre)
- Critical Mineral Resource Overlay
- Mixed Use Neighborhood Overlay

The City of Anderson released its updated general plan in May 2007 (City of Anderson 2007). This general plan designates the following land uses along the Sacramento River within the city limits and sphere of influence:

- Commercial
- Industrial
- Public/Quasi-Public
- Medium-Density Residential
- Rural Residential/Rural Estate

The City of Red Bluff most recently amended the Land Use Element of its general plan in 1993. The general plan designates the following land uses along the Sacramento River within the city limits and sphere of influence:

- Primary Floodplain
- Exclusive Agriculture
- General Commercial
- Central Business Districts
- Single-Family Residential
- General and Neighborhood Apartment Districts
- General Industrial
- Public Agency District
- Park

The lower Sacramento River and Delta portions of the extended study area are within the planning jurisdiction of Butte, Colusa, Contra Costa, Glenn, Sacramento, Solano, Sutter, Yolo, and Yuba counties. The largest cities in this region are Antioch, Chico, Davis, Fairfield, Martinez, Marysville, Pittsburg, Sacramento, Vacaville, Vallejo, West Sacramento, and Woodland. Each of these entities currently has an adopted general plan and zoning ordinance. Land

use planning documents are adopted by Federal agencies for Federally managed lands in the lower Sacramento River and Delta areas.

The CVP extends from the Cascade Range near Redding in the north to the Tehachapi Mountains near Bakersfield in the south. The CVP serves farms, homes, and industry in California's Central Valley as well as major urban centers in the San Francisco Bay Area. SWP contractors are located in the southern San Joaquin Valley, along the central coast, and in Southern California. The CVP and SWP service areas include portions of both the primary and extended study areas. CVP water irrigates more than 3 million acres of farmland and provides drinking water to nearly 2 million consumers. SWP deliveries are 70 percent urban and 30 percent agriculture, serving 20 million Californians and more than 600,000 irrigated acres, respectively. Each of the counties and incorporated cities in the CVP and SWP service areas has its own adopted general plan and zoning ordinance. Federally managed lands in the service areas are managed in accordance with land use and planning documents similar to the STNF LRMP and BLM's resource management plan, and military installations located in the service areas have their own planning processes.

Development The development actions that are described below were identified as reasonably foreseeable.

Antlers Bridge Replacement The California Department of Transportation (Caltrans), in cooperation with the Federal Transit Administration, is replacing Antlers Bridge over Shasta Lake, which is located on Interstate 5 near the community of Lakehead in Shasta County, in the primary study area. This project involves constructing a 1,942-foot, five-lane segmental bridge with deep-pile foundations that are 12 feet in diameter. The project also includes realignment of a 0.4-mile-long segment of Interstate 5, requiring hillside excavation, construction of a five-lane freeway section, and demolition of the existing 1,500 feet of steel deck truss bridge. The new bridge is being constructed next to the existing bridge, which will remain open to traffic until the new bridge is completed. This project will affect visual resources, fish and wildlife, and water quality standards. However, incorporation of mitigation will reduce these impacts to a less-than-significant level. The project is not expected to have any other significant impacts (Caltrans and FHWA 2007). Construction began in 2009 and will be completed in 2014.

Stillwater Business Park The City of Redding is constructing the Stillwater Business Park (City of Redding 2011), a 700-acre master-planned business park with corporate, manufacturing, and office uses within the Redding city limits in the primary study area. Phase 1 of the project entails developing up to 3,245,300 square feet of primarily light industrial, general industrial, and high-tech cluster uses throughout the entire site. Phase 2 will involve developing up to 1,165,100 square feet of the same uses on the remaining parcels that have not been developed under Phase 1. Developable land includes 16 parcels ranging in size from 5 acres to 100 acres. Two parcels totaling 186

acres will be designated for open space. Currently, 16 lots are available for development.

Shasta Metro Enterprise Zone Program The Economic Development Corporation of Shasta County is responsible for the Shasta Metro Enterprise Zone Program, implemented around Shasta Lake and the upper Sacramento River, in the primary study area. Enterprise zones are designated by the State as economic development areas created to encourage and stimulate economically depressed areas. This is generally achieved via tax, hiring, and financial incentives from the State, in combination with local assistance. On November 6, 1991, the State designated the Shasta Metro Enterprise Zone, which expired on November 5, 2006. Shasta County applied for a new zone and received final designation effective November 6, 2006, to November 5, 2021 (EDC 2011). The Shasta Metro Enterprise Zone is intended to stimulate development and redevelopment projects within the project area.

The Shasta Metro Enterprise Zone covers more than 11,000 parcels, or more than 50 percent of all business entities in Shasta County. An EIR for the Shasta Metro Enterprise Zone was certified and approved by the Shasta County Board of Supervisors on January 15, 2008 (Shasta County 2008).

Significance Criteria For purposes of this PDEIS, cumulative impacts of an alternative under the SLWRI would be significant if implementing the alternative would make a considerable incremental contribution to a significant cumulative effect. The alternative's contribution is evaluated in combination with the effects of other past, present, and reasonably foreseeable future projects to determine whether (1) the overall cumulative effect would be significant and (2) the alternative's contribution would be considerable. Cumulatively significant impacts would do any of the following:

- Cause a significant adverse effect on a resource (using the criteria for significance described in the "Environmental Consequences and Mitigation Measures" sections of Chapters 4 through 25 of this PDEIS)
- Adversely affect a resource that already has a degraded or declining condition because of substantial adverse effects that have already occurred
- Cause effects that were initially not significant, but that would be part of an irreversible degrading or declining trend

3.3 Resources Eliminated from Further Consideration

CEQA and the State CEQA Guidelines provide for identification and elimination from detailed study of the issues that are not significant or that have been covered by prior environmental review (Public Resources Code, Section

21002.1; State CEQA Guidelines, Section 15143). The NEPA regulations provide similar provisions (40 CFR 1501.7(a)(3)).

During initial scoping with the public and governmental agencies, and based on information obtained through literature review, agency correspondence, consultations, and field data collection, it was determined that no resource areas were able to be eliminated from detailed study. Therefore, all resource areas covered by NEPA and CEQA are addressed in this PDEIS.

3.4 Regulatory Framework

3.4.1 Federal

National Environmental Policy Act

NEPA is the nation's broadest environmental law, applying to all Federal agencies and most of the activities they manage, regulate, or fund that affect the environment. This law requires Federal agencies to disclose and consider the environmental implications of their proposed actions. NEPA establishes environmental policies for the nation, provides an interdisciplinary framework for Federal agencies to avoid or minimize environmental impacts, and contains action-forcing procedures to ensure that Federal agency decision-makers take environmental factors into account.

Clean Water Act

Section 404 Section 404 of the CWA requires that a permit be obtained from USACE for the discharge of dredged or fill material into "waters of the United States, including wetlands." Waters of the United States include wetlands and lakes, rivers, streams, and their tributaries. Waters of the United States are defined for regulatory purposes, at 33 CFR 328.3, as follows:

> *(1) All waters which are currently used, or were used in the past, or may be susceptible to use in interstate or foreign commerce, including all waters which are subject to the ebb and flow of tide; (2) All interstate waters, including interstate wetlands; (3) All other waters such as intrastate lakes, rivers, streams, mudflats, sandflats, wetlands, sloughs, prairie potholes, wet meadows, playa lakes, or natural ponds, the use, degradation or destruction of which could affect interstate or foreign commerce; (4) All impoundments of waters otherwise defined as waters of the United States under the definition; (5) Tributaries of waters identified in paragraphs 1–4 in this section; (6) The territorial seas; and (7) Wetlands adjacent to waters identified in paragraphs 1–6 in this section.*

CWA Section 404(b) requires that USACE process permits in compliance with guidelines developed by the U.S. Environmental Protection Agency (EPA).

These guidelines (the CWA Section 404(b)(1) Guidelines) require the analysis of alternatives available to meet the project's purpose and need, including those alternatives that avoid and minimize discharges of dredged or fill materials in waters. Once alternatives deemed to be practicable have been identified, the only action that USACE can permit must be the least environmentally damaging practical alternative.

Actions typically subject to Section 404 requirements are those that would take place in wetlands or stream channels, including intermittent streams, even if they have been realigned. Within stream channels, a permit under Section 404 would be needed for any discharge activity below the ordinary high-water mark. (The ordinary high-water mark is the line on the shore established by the fluctuations of water. It is indicated by physical characteristics such as a clear, natural line impressed on the bank; shelving; changes in the character of soil; destruction of terrestrial vegetation; or the presence of litter or debris.)

The ROD for the CALFED final programmatic EIS/EIR includes a CWA Section 404 MOU signed by Reclamation, EPA, USACE, and DWR. Under the terms of the MOU, when a project proponent applies for a Section 404 individual permit for CALFED projects, the proponent is not required to reexamine program alternatives already analyzed in the programmatic EIS/EIR. USACE and EPA will focus on project-level alternatives that are consistent with the programmatic EIS/EIR when they select the least environmentally damaging practicable alternative at the time of a Section 404 permit decision.

Section 401 Under CWA Section 401, applicants for a Federal license or permit to conduct activities that may discharge a pollutant into waters of the United States must obtain certification from the state in which the discharge would originate. If appropriate, the certification must be obtained from the interstate water pollution control agency with jurisdiction over affected waters at the point where the discharge would originate. Therefore, all projects that have a Federal component and may affect state water quality (including projects that require a Federal agency approval such as issuance of a Section 404 permit) must also comply with CWA Section 401.

In California, the authority to grant water quality certification has been delegated to the SWRCB. Applications for water quality certification under CWA Section 401 are typically processed by the regional water quality control board with local jurisdiction—in this case the Central Valley Regional Water Quality Control Board. For a project to receive water quality certification, the project's potential impacts must be evaluated in light of water quality standards and CWA Section 404 criteria that govern discharges of dredged and fill materials into waters of the United States.

Federal Endangered Species Act

USFWS and NMFS share responsibility for implementing the ESA. Generally, USFWS manages terrestrial and freshwater species, while NMFS manages

marine and "anadromous" species (species that migrate from salt water to spawn in freshwater), such as Chinook salmon. Both agencies ensure that ESA requirements are followed and evaluate projects that may affect the continued existence of a Federally listed (threatened or endangered) species.

Section 9 of the ESA prohibits the take of Federally listed species. "Take" is defined under the ESA, in part, as killing, harming, or harassing. Under Federal regulations, take is further defined to include habitat modification or degradation where it actually results in death or injury to wildlife by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering.

Section 7 of the ESA outlines procedures for Federal interagency cooperation to conserve Federally listed species and designated critical habitat. Section 7(a)(2) requires Federal agencies to consult with USFWS to ensure that they are not undertaking, funding, permitting, or authorizing actions likely to jeopardize the continued existence of listed species. NMFS also ensures that projects will not adversely affect essential fish habitat, as defined in the 1996 Sustainable Fisheries Act (Public Law 104-297). The goal is to stop or reverse the continued loss of fish habitats by protecting, conserving, and enhancing habitat.

Magnuson-Stevens Fishery Conservation and Management Act

The Magnuson-Stevens Fishery Conservation and Management Act (commonly known as Magnuson-Stevens Act) establishes a management system for national marine and estuarine fishery resources. This legislation requires Federal agencies to consult with NMFS regarding actions or proposed actions permitted, funded, or undertaken that may adversely affect "essential fish habitat." Essential fish habitat is defined as "waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity."

The Magnuson-Stevens Act states that migratory routes to and from the spawning grounds of anadromous fish are considered essential fish habitat. The phrase "adversely affect" refers to the creation of any impact that reduces the quality or quantity of essential fish habitat. The concept of essential fish habitat is similar to that of "critical habitat" under the ESA; however, measures recommended to protect essential fish habitat by NMFS are advisory, not prescriptive. Federal activities that occur outside of essential fish habitat but that may nonetheless affect waters and substrate that constitute essential fish habitat must also be considered in the consultation process.

Under the Magnuson-Stevens Act, effects on habitat managed under the *Pacific Salmon Fishery Management Plan* must also be considered. The Magnuson-Stevens Act states that consultation regarding essential fish habitat should be consolidated, where appropriate, with the interagency consultation, coordination, and environmental review procedures required by other Federal statutes, such as NEPA, the Federal Wildlife Coordination Act, the CWA, and the ESA.

Fish and Wildlife Coordination Act

Coordination under the Fish and Wildlife Coordination Act is intended to promote conservation of fish and wildlife resources by preventing their loss or damage. It also provides for development and improvement of fish and wildlife resources in connection with water projects. Federal agencies that undertake water projects must fully consider recommendations made by USFWS, NMFS, and the appropriate fish and wildlife agency – in this case, DFG – in their project reports and include measures to reduce impacts on fish and wildlife in project plans.

Federal Clean Air Act

The Federal Clean Air Act (CAA) was enacted to protect and enhance the nation's air quality to promote public health and welfare and the productive capacity of the nation's population. The CAA requires that Federal actions be evaluated to determine their potential impacts on air quality in the project region. California has a corresponding law, which also must be considered during the EIS/EIR process.

For specific projects, Federal agencies must coordinate with the appropriate air quality management district and EPA. This coordination determines whether the project conforms with the CAA and the state implementation plan.

Section 176 of the CAA prohibits Federal agencies from engaging in or supporting an action or activity that does not conform with an applicable state implementation plan. Actions and activities must conform to the plan's purposes of eliminating or reducing violations of national ambient air quality standards, reducing the severity of violations, and attaining those standards expeditiously.

Federal Water Project Recreation Act

The Federal Water Project Recreation Act requires Federal agencies with authority to approve water projects to include recreation development as a condition of approving permits. Recreation development must be considered along with any navigation, flood control, reclamation, hydroelectric, or multipurpose water resource project. The act states that "consideration shall be given to the opportunities, if any, which the project affords for outdoor recreation and for fish and wildlife enhancement…wherever any such project can reasonably serve either or both of these purposes consistently" (Title 16, Section 460l-12 of the U.S. Code (16 USC 460l-12)).

Safe Drinking Water Act

The Safe Drinking Water Act mandates that EPA establish regulations to protect human health from contaminants in drinking water. This law authorizes EPA to develop national standards for drinking water and to create a joint Federal/state-tribal system to ensure compliance with these standards. The law also directs EPA to protect underground sources of drinking water through the control of underground injection of liquid wastes.

EPA has developed primary and secondary drinking water standards under its Safe Drinking Water Act authority. EPA and authorized states/tribes enforce the primary drinking water standards, which are contaminant-specific concentration limits that apply to certain public supplies of drinking water. The primary standards consist of two elements: goals for maximum contaminant levels, which are nonenforceable health-based goals; and maximum contaminant levels, which are enforceable limits set as close to the maximum contaminant level goals as possible, considering cost and feasibility of attainment.

National Historic Preservation Act

Section 106 of the National Historic Preservation Act of 1966 and its implementing regulations (36 CFR Part 800, as amended in 2004) requires Federal agencies to consider the effects of their actions, or those they fund or permit, on properties that are listed or eligible for listing in the National Register of Historic Places (commonly known as the National Register). The National Register is a register of districts, sites, buildings, structures, and objects of significance in American history, architecture, archaeology, engineering, and culture. The regulations provided in 36 CFR Part 60.4 describe the criteria to evaluate cultural resources for inclusion in the National Register. Cultural resources can be significant on the national, state, or local level. Properties may be listed in the National Register if they possess integrity of location, design, setting, materials, workmanship, feeling, and association, and meet any one of the following criteria:

(A) Are associated with events that have made a significant contribution to the broad patterns of our history

(B) Are associated with the lives of persons significant in our past

(C) Embody the distinctive characteristics of a type, period, or method of construction, or represent the work of a master, or possess high artistic values, or represent a significant and distinguishable entity whose components may lack individual distinction

(D) Have yielded, or may be likely to yield, information important in prehistory or history

Generally, properties are not considered eligible for the National Register if they have achieved significance within the past 50 years. Certain exceptions are made in the regulation, such as a religious property deriving primary significance from architectural distinction, or a grave of a historical figure of outstanding importance if there is no appropriate site directly associated with his productive life.

Farmland Protection Policy Act

The Farmland Protection Policy Act requires that a Federal agency examine the potential impacts of a proposed action on prime and unique farmland, as defined

by the U.S. Natural Resources Conservation Service. If the action would adversely affect farmland preservation, the Federal agency must consider alternatives to lessen the adverse effects.

Rivers and Harbors Appropriation Act of 1899

The River and Harbors Appropriation Act of 1899 (commonly known as the Rivers and Harbors Act) addresses activities that involve constructing dams, bridges, dikes, or other obstructions across any navigable water. To place any obstruction to navigation outside established Federal lines, or to excavate from or deposit material in such waters, a permit must be obtained from USACE. Navigable waters are defined in 33 CFR 329.4 as follows:

> *Those waters that are subject to the ebb and flow of the tide and/or are presently used, or have been used in the past, or may be susceptible for use to transport interstate or foreign commerce. A determination of navigability, once made, applies laterally over the entire surface of the waterbody, and is not extinguished by later actions or events which impede or destroy navigable capacity.*

Sections of the River and Harbors Act applicable to the proposed action are described below.

Section 9 Section 9 (33 USC 401) prohibits the construction of any dam or dike across any navigable water of the United States without consent from Congress and approval of the plans by the Chief of Engineers and the Secretary of the Army. Where the navigable portions of the water body lie wholly within the limits of a single state, the structure may be built under authority of the legislature of that state if the location and plans or any modification thereof are approved by the Chief of Engineers and by the Secretary of the Army.

Section 10 Section 10 (33 USC 403) prohibits the unauthorized obstruction or alteration of any navigable water of the United States. Construction of any structure in or over any navigable water of the United States, or the accomplishment of other work affecting the course, location, condition, or physical capacity of such waters, is unlawful unless the work has been authorized by the Chief of Engineers.

Section 13 Section 13 (33 USC 407) states that the Secretary of the Army may permit the discharge of refuse into navigable waters if the Chief of Engineers has determined that the discharge will not injure anchorage and navigation. Discharges of refuse are prohibited unless a permit has been obtained. Although the prohibition in this section – known as the Refuse Act – is still in effect, the Secretary of the Army's permit authority has been superseded by the permit authority given to the EPA Administrator and the states under Sections 402 and 405 of the CWA, respectively.

Migratory Bird Treaty Act

The Migratory Bird Treaty Act, first enacted in 1918, implements domestically a series of treaties between the United States and Great Britain (on behalf of Canada), Mexico, Japan, and the former Soviet Union that provide international protection of migratory birds. The act authorizes the Secretary of the Interior to regulate the taking of migratory birds; it is unlawful, except as permitted by regulations, "to pursue, take, or kill any migratory bird, or any part, nest or egg of any such bird…" (16 USC 703). This prohibition includes both direct and indirect acts, although harassment and habitat modification are not included unless they result in direct loss of birds, nests, or eggs. The current list of species protected by the Migratory Bird Treaty Act includes several hundred species and essentially includes all native birds. The act offers no statutory or regulatory mechanism for obtaining an incidental take permit for the loss of nongame migratory birds.

Bald and Golden Eagle Protection Act

The Bald and Golden Eagle Protection Act, enacted in 1940 and amended multiple times since, prohibits the taking of bald and golden eagles without a permit from the Secretary of the Interior. Similar to the ESA, the Bald and Golden Eagle Protection Act defines "take" to include "pursue, shoot, shoot at, poison, wound, kill, capture, trap, collect, molest or disturb" (16 USC 668-668c). Any disturbance that would injure an eagle, decrease productivity, or cause nest abandonment—including habitat alterations that could have these results—is considered take and can result in civil or criminal penalties.

National Forest Management Act

The National Forest Management Act requires USFS to "provide for a diversity of plant and animal communities" (16 USC 1604(g)(3)(B)) as part of its multiple-use mandate. USFS must maintain "viable populations of existing native and desired non-native species in the planning area" (36 CFR 219.19). The Sensitive Species program is designed to meet this mandate and to demonstrate USFS's commitment to maintaining biodiversity on National Forest System lands.

A key requirement of National Forest Management Act is preparation of land and resource management plans that establish the goals, objectives, and standards and guidelines for managing the lands and resources of National Forest System lands managed by the various National Forests.

Federal Land Policy and Management Act

Sections 201 and 202 of the Federal Land Policy and Management Act of 1976 (FLPMA) (43 USC 1711–1712) and the regulations in 43 CFR 1600 provide guidance and direction for implementing BLM's land use planning requirements established by resource management plans. Resource management plans and subsequent planning decisions are the basis for every on-the-ground action undertaken by BLM.

Resource management plans ensure that public lands are managed in accordance with the intent of Congress as stated in the FLPMA, under the principles of multiple use and sustained yield. As required by the FLPMA and BLM policy, public lands must be managed in a manner that will do all of the following:

- Protect the quality of ecological and scientific values
- Preserve and protect certain public lands in their natural condition, where appropriate
- Provide food and habitat for fish and wildlife and domestic animals
- Provide for outdoor recreation and human occupancy and use
- Recognize the nation's need for domestic sources of minerals, food, timber, and fiber from the public lands by encouraging collaboration and public participation throughout the planning process

Resource management plans are among the primary mechanisms for guiding BLM activities to achieve compliance with the FLPMA.

National Wild and Scenic Rivers Act

The National Wild and Scenic Rivers Act of 1968, as amended (Public Law 90-542; 16 USC 1271–1287), established the National Wild and Scenic Rivers System. This system identifies distinguished rivers of the nation that possess outstandingly remarkable scenic, recreational, geologic, fish and wildlife, historic, cultural, or other similar values. The National Wild and Scenic Rivers Act preserves the free-flowing condition of designated rivers and protects their local environments. Section 5(d)(1) of the act requires Federal agencies to consider potential national wild, scenic, and recreational river areas when planning for the use and development of water and related land resources. Wild, scenic, and recreational river areas are defined as follows:

- *"Wild" river areas* are rivers or sections of rivers that are free of impoundments and generally inaccessible except by trail, with watersheds or shorelines essentially primitive and waters unpolluted. These represent vestiges of primitive America.
- *"Scenic" river areas* are rivers or sections of rivers that are free of impoundments, with shorelines or watersheds still largely primitive and shorelines largely undeveloped, but accessible by roads in places.
- *"Recreational" river areas* are rivers or sections of rivers that are readily accessible by road or railroad, that may have some development along their shorelines, and that may have undergone some impoundment or diversion in the past.

Designation as a National Wild and Scenic River explicitly prohibits the Federal government from licensing or permitting new hydroelectric dams or major diversions on these rivers. Federal agencies are also prohibited from assisting any water resource projects that may directly affect the resources for which the river was designated. Public lands within a corridor averaging one-quarter mile on both sides of the rivers are managed to protect resources designated as outstandingly remarkable for their scenic, recreational, historical/cultural, fish, wildlife, ecological, geological, or hydrologic value.

Indian Trust Assets

All Federal agencies have a responsibility to protect Indian trust assets. Indian trust assets are legal interests in assets held in trust by the Federal government for Native American tribes or individuals. Assets may be owned property, physical assets, intangible property rights, a lease, or the right to use something. Typically they include lands, minerals, water rights, hunting and fishing rights, natural resources, money, and claims.

Executive Order 11988 (Flood Hazard Policy)

Executive Order 11988 is a flood hazard policy for all Federal agencies that manage Federal lands, sponsor Federal projects, or provide Federal funds to state or local projects. The order requires that all Federal agencies take necessary action to reduce the risk of flood loss; restore and preserve the natural and beneficial values served by floodplains; and minimize the impacts of floods on human safety, health, and welfare.

Executive Order 11990 (Protection of Wetlands)

Executive Order 11990 is an overall wetlands policy for all agencies that manage Federal lands, sponsor Federal projects, or provide Federal funds to state or local projects. The order requires Federal agencies to follow avoidance, mitigation, and preservation procedures with public input before they propose new construction in wetlands. Executive Order 11990 can restrict the sale of Federal land containing wetlands; however, it does not apply to Federal discretionary authority for non-Federal projects (other than funding) on non-Federal land.

Executive Order 12898 (Environmental Justice Policy)

Executive Order 12898 requires Federal agencies to identify and address disproportionately high and adverse human health and environmental effects of Federal programs, policies, and activities on minority and low-income populations. The requirements of Executive Order 12898 apply to all Federal actions that are located on Federal lands, sponsored by a Federal agency, or funded with Federal monies and may affect minority or low-income populations.

Executive Order 13007 (Indian Sacred Sites) and April 29, 1994, Executive Memorandum

Executive Order 13007 (May 24, 1996) requires Federal agencies with land management responsibilities to accommodate access to and ceremonial use of Indian sacred sites by Indian religious practitioners and avoid adversely affecting the physical integrity of such sacred sites. Where appropriate, agencies are to maintain the confidentiality of sacred sites. Among other things, Federal agencies must provide reasonable notice of proposed actions or land management policies that may restrict future access to or ceremonial use of, or adversely affect the physical integrity of, sacred sites. The agencies must comply with the April 29, 1994, executive memorandum, "Government-to-Government Relations with Native American Tribal Governments."

Executive Order 13112 (National Invasive Species Management Plan)

Executive Order 11312 directs all Federal agencies to prevent and control introductions of invasive nonnative species in a cost-effective and environmentally sound manner to minimize their economic, ecological, and human health impacts. Executive Order 11312 established the national Invasive Species Council, made up of Federal agencies and departments, and the supporting Invasive Species Advisory Committee, composed of state, local, and private entities. The Invasive Species Council and Advisory Committee oversee and facilitate implementation of the executive order, including preparation of a national invasive-species management plan.

Federal Transit Administration

To address the human response to groundborne vibration, the Federal Transit Administration has set forth guidelines for maximum acceptable vibration criteria for different types of land uses. These include 65 vibration decibels for land uses where low ambient vibration is essential for interior operations (e.g., hospitals, high-tech manufacturing, and laboratory facilities), 80 vibration decibels for residential uses and buildings where people normally sleep, and 83 vibration decibels for institutional land uses with primarily daytime operations (e.g., schools, churches, clinics, and offices) (FTA 2006).

Standards have also been established to address the potential for groundborne vibration to cause structural damage to buildings. These standards were developed by the Committee of Hearing, Bio Acoustics, and Bio Mechanics at the request of EPA (FTA 2006). For fragile structures, this committee recommends a maximum limit of 0.25 inch per second peak particle velocity (FTA 2006). (Peak particle velocity is a measure of the intensity of ground vibration, specifically the time rate of change of the amplitude of ground vibration.)

Federal Land Use Policies

Federal land use policies apply only to actions on or affecting the uses of Federal lands. The Federal lands in the vicinity of the study area include the following:

- National Forest System lands administered by the Shasta-Trinity National Forest
- Reclamation-owned lands along the Sacramento River just south of Shasta Dam
- BLM-owned lands along the Sacramento River, just north of Red Bluff

Encroachment within these Federal properties would require approval from these entities.

Shasta-Trinity National Forest Management Plan

The *Shasta-Trinity National Forest Management Plan* was most recently revised in 1995. This document is revised every 10 to 15 years; it supersedes any previous forest plans, timber management plans, or NRA plans. It contains the goals and objectives for Shasta-Trinity National Forest, its standards and guidelines, management prescriptions to be applied to land areas, and management area direction. It also sets forth requirements for monitoring and implementation of the plan. The allocations associated with this plan not only reflect the capability and suitability of the land for various uses, but also respond to the public issues (such as recommendations for Wild and Scenic River designations) and development opportunities identified during the planning process.

Whiskeytown-Shasta-Trinity National Recreation Area Management Plan

The Whiskeytown-Shasta-Trinity NRA consists of the Shasta and Trinity units (managed by USFS) and the Whiskeytown Unit (managed by the National Park Service). Shasta-Trinity National Forest has initiated the scheduled revision of the management plan for the Shasta and Trinity units of the Whiskeytown-Shasta-Trinity NRA. Congress established the NRA on November 8, 1965, in Public Law 89-336. USFS and the National Park Service are required under the act to carry out administration under management plans, which must be revised periodically. The management plan was most recently revised in 1996. Through a series of amendments, USFS is now proceeding to update the *Shasta-Trinity National Recreation Area Management Guide*, with completion anticipated within the next 2 years. This plan is typically revised every 10 to 15 years.

The Shasta-Trinity National Recreation Area Management Guide guides the management of the NRA by interpreting the goals, objectives, standards, guidelines, and management prescriptions from the enabling legislation, Federal regulations, and the Forest Land and Resource Management Plan. It will address the management of resources, changes in technology, and recreation trends in Shasta-Trinity National Forest and the vicinity. Plan amendments may occur whenever monitoring requirements indicate a need for change. The Forest Supervisor can approve amendments to the plan if they are determined not to be significant; significant amendments require approval of the Regional Forester. Public notification and adherence to NEPA is required in any case.

Redding Resource Management Plan

BLM owns and manages lands along the Sacramento River just north of Red Bluff. This land is managed by BLM in accordance with the *Redding Resource Management Plan*. This plan covers more than 250,000 acres in north central California within Butte, Shasta, Siskiyou, Tehama, and Trinity counties. Many Areas of Critical Environmental Concern and National Wild and Scenic River corridors are included within these easily accessed and heavily used public lands. Completed in 1993, the *Redding Resource Management Plan* primarily addresses recreation, land tenure, access, and forest management.

Federal Energy Regulatory Commission

Changes to hydroelectric facilities on the Pit River – Instream flow releases or modifications to downstream structures – may necessitate an amendment to a Federal Energy Regulatory Commission (FERC) license. Typical modifications that require an amendment to a license or exemption include capacity changes, design changes, operational changes, land status changes, and time extensions. Before issuing a license amendment, FERC ensures that proposed changes to hydropower facilities comply with NEPA. For noncapacity-related amendments, the nature of the proposed change, the project type (based on proposed capacity), and the project's construction status determine which items outlined in the FERC Division of Hydropower Administration and Compliance's *Compliance Handbook* to include in the amendment application. Any item in the original license that would be modified as a result of the project would require that a revised version be filed along with the amendment application.

Once the need for an amendment is determined, the appropriate resource agencies are consulted. The extent of agency consultation depends on whether the amendment is capacity-related or noncapacity-related. After prefiling consultation is completed, the licensee files the amendment application. The FERC Division of Hydropower Administration and Compliance then determines whether a public notice is warranted and whether NEPA review is required. NEPA review entails preparing an environmental assessment and/or an EIS. The license amendment process is detailed in the *Compliance Handbook*.

U.S. Coast Guard

The U.S. Coast Guard is responsible for approving the locations of and plans for bridges and causeways constructed across navigable waters of United States. The Coast Guard also approves the locations of and plans for international bridges and the alteration of bridges found to be unreasonable obstructions to navigation.

3.4.2 State

California Environmental Quality Act

Prompted by the passage of NEPA in 1969, CEQA was signed into law in 1970 as California's counterpart to NEPA. CEQA requires State and local agencies to identify the significant environmental impacts of their actions and to avoid or mitigate those impacts, if feasible. The objectives of CEQA are to do all of the following:

- Disclose to decision makers and the public the significant environmental effects of proposed activities
- Identify ways to avoid or reduce environmental damage
- Prevent environmental damage by requiring implementation of feasible alternatives or mitigation measures
- Disclose to the public the reasons for agency approval of projects with significant environmental effects
- Foster interagency coordination in the review of projects
- Enhance public participation in the planning process

California Endangered Species Act

Pursuant to the California Endangered Species Act (CESA), a permit from DFG is required for projects that could result in the take of a plant or animal species that is State-listed as threatened or endangered. Under the CESA, "take" is defined as an activity that would directly or indirectly kill an individual of a species, but the CESA definition of take does not include "harming" or "harassing," as the Federal ESA definition does. As a result, the threshold for take is higher under the CESA than under the ESA (i.e., habitat modification is not necessarily considered take under the CESA).

Sections 3503 and 3503.5 of the California Fish and Game Code state that it is unlawful to take, possess, or needlessly destroy the nest or eggs of any bird, or to take, possess, or destroy any raptors (i.e., species in the orders Falconiformes and Strigiformes), including their nests or eggs. Destruction of active nests caused by removal of vegetation in which the nests are located is a typical violation of these codes. Violation of Section 3503.5 could also include failure of active raptor nests that results from disturbance of nesting pairs by nearby project construction. This statute does not provide for the issuance of any type of incidental take permit.

California Fish and Game Code—Fully Protected Species

Protection of fully protected species is described in Sections 3511, 4700, 5050, and 5515 of the California Fish and Game Code. These statutes prohibit take or

possession of fully protected species. DFG is unable to authorize incidental take of fully protected species when activities are proposed in areas inhabited by those species. DFG has informed non-Federal agencies and private parties that they must avoid take of any fully protected species in carrying out projects.

California Fish and Game Code Section 1602—Streambed Alteration

All diversions, obstructions, or changes to the natural flow or bed, channel, or bank of any river, stream, or lake in California that supports wildlife resources are subject to regulation by DFG under Section 1602 of the California Fish and Game Code. Under Section 1602, it is unlawful for any person, governmental agency, or public utility to do the following without first notifying DFG:

> …*substantially divert or obstruct the natural flow of, or substantially change or use any material from the bed, channel, or bank of any river, stream, or lake, or deposit or dispose of debris, waste, or other material containing crumbled, flaked, or ground pavement where it may pass into any river, stream, or lake.*

A stream is defined as a body of water that flows at least periodically or intermittently through a bed or channel that has banks and supports fish or other aquatic life. This definition includes watercourses with a surface or subsurface flow that supports or has supported riparian vegetation. DFG's jurisdiction within altered or artificial waterways is based on the value of those waterways to fish and wildlife.

California Fish and Game Code Sections 5900–5904, 5930–5948, 7261, and 7370—Fish Passage

The California Fish and Game Code include the following provisions intended to protect fish passage:

- *Sections 5900–5904* prohibit constructing or maintaining any device or contrivance in any stream that prevents, impedes, or tends to prevent or impede the passing of fish upstream and downstream.

- *Sections 5930–5948* require DFG to inspect California's dams to ensure that dam owners are maintaining fish passage. DFG may require dam owners to install a suitable fishway if passage is impeded.

- *Section 7261* authorizes the California Fish and Game Commission to designate as "Heritage Trout Waters" any waters that provide anglers with an opportunity to catch native trout, consistent with the conservation of the California native trout. The McCloud River redband trout occurs in the McCloud River upstream from McCloud Dam.

- *Section 7370* prohibits taking or possessing for commercial purposes, buying or selling, or offering to buy or sell all or part of any sturgeon, including its eggs, unless the sturgeon was cultured, taken from another state, or taken pursuant to a sport fishing license. Green sturgeon occurs in the primary and extended study areas in the Sacramento River, tributaries, and Delta.

Central Valley Flood Protection Board Encroachment Permit

Under Title 23 of the California Code of Regulations, the Central Valley Flood Protection Board (formerly called the State of California Reclamation Board) issues encroachment permits to maintain the integrity and safety of flood control project levees and floodways that were constructed according to the flood control plans adopted by the board or the California Legislature.

California Water Rights

A water right is a legally granted and protected right to take possession of water and put it to beneficial use. As authorized by the California Water Code, the SWRCB allocates surface water rights and permits the diversion and use of water throughout the state. Through its Division of Water Rights, the SWRCB issues permits to divert water for new appropriations, change existing water rights, or store water for a certain length of time. The SWRCB attaches conditions to these permits to ensure that the water user prevents waste, conserves water, does not infringe on the rights of others, and puts the State's water resources to the most beneficial use in the best interest of the public.

California Public Resources Code

The California Public Resources Code, Section 5093.542, established through enactment of the California Wild and Scenic Rivers Act, as amended (Sections 5093.50 – 5093.70), aims to preserve designated rivers that possess extraordinary scenic, recreation, fishery, or wildlife values. With the act's passage, the California system protected segments of the Smith and Klamath river and their tributaries, and the Scott, Salmon, Trinity, Eel, Van Duzen, and American rivers. Segments of the McCloud River, Deer Creek, and Mill Creek were subsequently protected under the act in 1989 and 1995, respectively, although these segments were not formally designated as components of the State's Wild and Scenic Rivers System.

No dam, reservoir, diversion, or other water impoundment facility may be constructed on any river segment included in the State system. No water diversion facility may be constructed on any river segment included in the State system unless the Resources Secretary determines that the facility is needed to supply domestic water to local residents and that the facility will not adversely affect the river's free-flowing condition and natural character. In reference to the McCloud River, Section 5093.542(c) of the Public Resources Code states the following:

> *Except for participation by the [California] Department of Water Resources in studies involving the technical and economic feasibility of enlargement of Shasta Dam, no department or agency of the state shall assist or cooperate with, whether by loan, grant, license, or otherwise, any agency of the federal, state, or local government in the planning or construction of any dam, reservoir, diversion, or other water impoundment facility that could have an adverse effect on the free-flowing condition of the McCloud River, or on its wild trout fishery.*

Designation as a Wild and Scenic River does not affect existing water rights and facilities. Proposed changes in existing rights and facilities or applications for new water rights and facilities on designated segments are subject to the domestic-use restriction and the nondegradation standard. Designated segments are considered fully appropriated streams by the SWRCB.

The California Public Resources Code, Section 5093.542, shares similar criteria and definitions in regard to the purpose of protecting rivers with the National Wild and Scenic Rivers Act: identifying free-flowing rivers with extraordinary values suitable for protection, establishing a study process to include rivers in the system, and classifying river segments as either wild, scenic, or recreational based largely on the degree of development along each river segment included in the system. The primary purpose of both the Federal Wild and Scenic Rivers Act and State Public Resources Code is to prohibit new water impoundments on designated rivers.

The California Public Resources Code also contains several other sections relevant to the project. Some examples include Section 5096.225 (California Park and Recreational Facilities Act of 1984), Section 5094 (Federal Water Project Recreation Act), and the CWA.

California Harbors and Navigation Code

The California Harbors and Navigation Code details the jurisdiction of the California Department of Boating and Waterways, which is focused on the development of public access to waterways, the safety of vessels and boating facilities, and on-the-water safety.

Porter-Cologne Water Quality Control Act

Under the Porter-Cologne Water Quality Control Act, “waters of the State” fall under the jurisdiction of the appropriate regional water quality control board (in this case, the Central Valley Regional Water Quality Control Board). Under the act, the regional water quality control board must prepare and periodically update water quality control basin plans. Each basin plan sets forth water quality standards for surface water and groundwater, and actions to control nonpoint and point sources of pollution to achieve and maintain these standards. Projects that affect wetlands or waters must meet the regional water quality

control board's waste discharge requirements, which may be issued in addition to a water quality certification under Section 401 of the CWA.

California Land Conservation Act of 1965 (Williamson Act)

The California Land Conservation Act of 1965, commonly known as the Williamson Act, is the principal method for encouraging preservation of agricultural lands in California. The Williamson Act enables local governments to enter into contracts with private landowners that restrict specific parcels of land to agricultural or related open space use for 10 years. In return, landowners receive property tax assessments that are based on farming and open space uses rather than full market value. Local governments receive an annual subvention (subsidy) of forgone property tax revenues from the State via the Open Space Subvention Act of 1971.

The Williamson Act empowers local governments to establish "agricultural preserves" consisting of lands devoted to agricultural uses and other compatible uses. When establishing such preserves, the locality may offer to owners of included agricultural land the opportunity to enter into annually renewable contracts that restrict the land for at least 10 years. In return, the landowner is guaranteed a relatively stable tax base, founded on the value of the land for agricultural/open space use only and unaffected by its development potential.

Cancelling a Williamson Act contract requires the landowner to undergo an extensive review and approval process and pay fees of up to 12.5 percent of the property value. The local jurisdiction approving the cancellation must find that the cancellation is consistent with the purpose of the California Land Conservation Act or is in the public interest. Several subfindings must be made to support either finding, as defined in Section 51282 of the California Government Code.

California Clean Air Act

The California Clean Air Act of 1988 requires nonattainment areas to achieve and maintain the State ambient air quality standards by the earliest practicable date and local air districts to develop plans for attaining the State ozone, carbon monoxide, sulfur dioxide, and nitrogen dioxide standards.

California Native Plant Protection Act

In addition to the CESA, the California Native Plant Protection Act provides protection to endangered and "rare" plant species, subspecies, and varieties of wild native plants in California. The definitions of "endangered" and "rare" in the California Native Plant Protection Act closely parallel the CESA definitions of "endangered" and "threatened" plant species.

California Surface Mining and Reclamation Act

The California Surface Mining and Reclamation Act of 1975 (SMARA) (Public Resources Code, Section 2710 et seq.) addresses surface mining. Activities subject to SMARA include but are not limited to mining of minerals, gravel,

and borrow material. SMARA requires mitigation to reduce adverse impacts on public health, property, and the environment. Because the SLWRI may obtain borrow material for project construction from sites not previously permitted, Reclamation must comply with SMARA. SMARA applies to an individual or entity that would disturb more than 1 acre or remove more than 1,000 cubic yards of material through surface mining activities, including the excavation of borrow pits for soil material. SMARA is implemented through ordinances for permitting developed by local government "lead agencies" that provide the regulatory framework under which local mining and reclamation activities are conducted. The State Mining and Geology Board reviews the local ordinances to ensure that they meet the procedures established by SMARA.

California Native Plant Society Species Designations

The California Native Plant Society is a statewide nonprofit organization that seeks to increase understanding of California's native flora and to preserve this rich resource for future generations. California Native Plant Society has developed and maintains lists of vascular plants of special concern in California. California Native Plant Society-listed species have no formal legal protection, but the values and importance of these lists are widely recognized.

California Scenic Highway Program

The Scenic Highways Element is an optional element of the *California Highway Designs Manual* authorized by Section 65303 of the Government Code. The stated intent (Streets and Highways Code, Section 260) of the California Scenic Highway Program is to protect and enhance California's natural scenic beauty and to protect the social and economic values provided by the state's scenic resources. Official designation requires a local jurisdiction to enact a scenic corridor protection program that protects and enhances scenic resources. A properly enforced program can do all of the following:

- Protect against encroachment of inappropriate land uses
- Mitigate uses that detract from scenic values by proper siting, landscaping, or screening
- Make development more compatible with the environment by requiring building siting, height, colors, and materials that are harmonious with the surroundings
- Regulate grading to cause minimal alteration of existing contours and to preserve important vegetative features along the highway

State Lands Commission Land Use Lease

The California State Lands Commission was given authority and responsibility to manage and protect the important natural and cultural resources on certain public lands within the state and the public's rights to access these lands. Two distinct types of public lands are under the commission's jurisdiction: sovereign

lands and school lands. Sovereign lands encompass approximately 4 million acres. These lands include the beds of California's naturally navigable rivers, lakes, and streams, and the state's tidal and submerged lands along the coastline, extending from the shoreline out to 3 miles offshore.

State of California General Plan Guidelines

The State of California has developed land-use compatibility guidelines for community-noise environments. The *State of California General Plan Guidelines*, published by the Governor's Office of Planning and Research (OPR 2003), provides guidance for the acceptability of projects within specific community-noise-equivalent-level/day-night noise level (L_{dn}) contours. With regard to this project, water recreational uses are considered to be acceptable in areas where exterior noise levels do not exceed 75 A-weighted decibels community-noise-equivalent-level/L_{dn}. Water recreational uses are normally unacceptable in areas exceeding 70 A-weighted decibel L_{dn} and clearly unacceptable in excess of 80 A-weighted decibel L_{dn}. The guidelines also present adjustment factors that may be used to arrive at noise-acceptability standards that reflect the noise-control goals of the community, the particular community's sensitivity to noise, and the community's assessment of the relative importance of noise issues.

California Department of Transportation

Caltrans recommends a threshold of 0.2 inch per second peak particle velocity for normal residential buildings and 0.08 inch per second peak particle velocity for old or historically significant structures (Caltrans 2002). These standards are more stringent than the Federal standard established by the Committee of Hearing, Bio Acoustics, and Bio Mechanics, presented above under "Federal Transit Administration."

Caltrans is responsible for planning, designing, construction, operating, and maintaining all State-owned roadways in California. The *Caltrans Highway Designs Manual* establishes uniform policies and procedures to carry out Caltrans's highway design functions. The highway design criteria and policies in the manual provide a guide for applying standards in the design of projects and, rather than implementing enforceable regulations, present information and guidance.

3.4.3 Regional and Local

Shasta County Air Quality Management District's Authority to Construct and Permit to Operate

Facilities with equipment that may emit air pollution or would be used for controlling air pollution are subject to SCAQMD permit requirements. SCAQMD grants two types of permits: Authority to Construct, and Permit to Operate. An Authority to Construct permit must be obtained before building or installing a new emissions unit or modifying an existing emissions unit that

requires a permit. A Permit to Operate is issued after all construction is completed and the emission unit is ready for operation.

Other Local Permits and Requirements

Several other local permits and requirements may apply to the proposed action. Shasta and Tehama counties and their public works departments will require compliance with local plans and ordinances, such as the county general plan, zoning ordinances, grading plan, and various use permits. Utility easements and various encroachments also may be required.

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Chapter 4
Geology, Geomorphology, Minerals, and Soils

The evaluation in this chapter is based on a review of existing literature and data, along with information obtained from the shoreline erosion surveys, wetland delineation, and geotechnical investigations and surveys. The information included in the technical analysis is also derived from the following sources:

- CALFED Bay-Delta Program (CALFED). 2000a. CALFED Bay Delta Program Final Programmatic Environmental Impact Statement/Environmental Impact Report. Available at: http://calwater.ca.gov/CALFEDDocuments/Final_EIS_EIR.shtml. Accessed August 29, 2007.

- California Department of Water Resources. 2006. North-of-the-Delta Offstream Storage Investigation Initial Alternatives Information Report. Available at: http://www.usbr.gov/mp/nodos/docs/index.html. Accessed August 29, 2007.

- Contra Costa Water District. 2006. Contra Costa Water District Alternative Intake Project Draft Environmental Impact Report/Environmental Impact Statement.

4.1 Affected Environment

This section describes the affected environment related to geology, seismicity, soils/erosion, mineral resources, and geomorphology for the dam and reservoir modifications proposed under the SLWRI. The following evaluation is based on a review of existing literature and data, along with information obtained from shoreline erosion surveys, wetland delineation, and geotechnical investigations and surveys. For a more in-depth description, see the *Geology, Geomorphology, Minerals, and Soils Technical Report.*

The environmental setting for the geology, seismicity, soils/erosion, mineral resources, and geomorphology assessment of the Shasta Lake and vicinity portion of the primary study area comprises the watersheds draining to Shasta Lake, and the land area forming the shoreline of Shasta Lake. Five major drainages flow into Shasta Lake and form “arms” of the lake: Big Backbone Creek, the Sacramento River, the McCloud River, Squaw Creek, and the Pit River. This section also refers to the East and West “arms” of the main body of the lake as Main Body East Arm and Main Body West Arm.

4.1.1 Geology

The geology of the study area is described below for both the primary and extended study areas. The bedrock geology of the project study area is described in the following paragraphs. Boundaries of geomorphic provinces referenced in Section 4.1.1 are shown in Figure 4-1.

Shasta Lake and Vicinity

The Shasta Lake and vicinity portion of the primary study area is illustrated in Figure 4-2. The drainages contributing to Shasta Lake cover a broad expanse of land with a widely diverse and complicated geology. Shasta Lake is situated geographically at the interface between the Central Valley, Klamath Mountains, and Modoc Plateau and Cascades geomorphic provinces.

The bedrock geology for the Shasta Lake and vicinity area is shown in Figure 4-3. The mapping legend that accompanies Figure 4-3 is presented in Table 4-1. Shasta Lake itself and adjacent lands (i.e., Shasta Lake and Vicinity) are underlain by rocks of the Klamath Mountains and, to a much more limited extent, the Modoc Plateau and Cascades geomorphic provinces. The regional topography is highly dissected, consisting predominantly of ridges and canyons with vertical relief ranging from the surface of Shasta Lake at 1,070 feet above mean sea level (msl) to ridges and promontories more than 6,000 feet above msl. This diversity in topography is primarily a result of the structural and erosional characteristics of rock units in the Shasta Lake and vicinity area.

Klamath Mountains Geomorphic Province The Klamath Mountains Geomorphic Province is located in northwestern California between the Coast Range on the west and the Cascade Range on the east. The Klamath Mountains consist of Paleozoic metasedimentary and metavolcanic rocks and Mesozoic igneous rocks that make up individual mountain ranges extending to the north. The Klamath Mountain Geomorphic Province consists of four mountain belts: the eastern Klamath Mountain belt, central metamorphic belt, western Paleozoic and Triassic belt, and western Jurassic belt. Low-angle thrust faults occur between the belts and allow the eastern blocks to be pushed westward and upward. The central metamorphic belt consists of Paleozoic hornblende, mica schists, and ultramafic rocks. The western Paleozoic and Triassic belt, and the western Jurassic belt consist of slightly metamorphosed sedimentary and volcanic rocks.

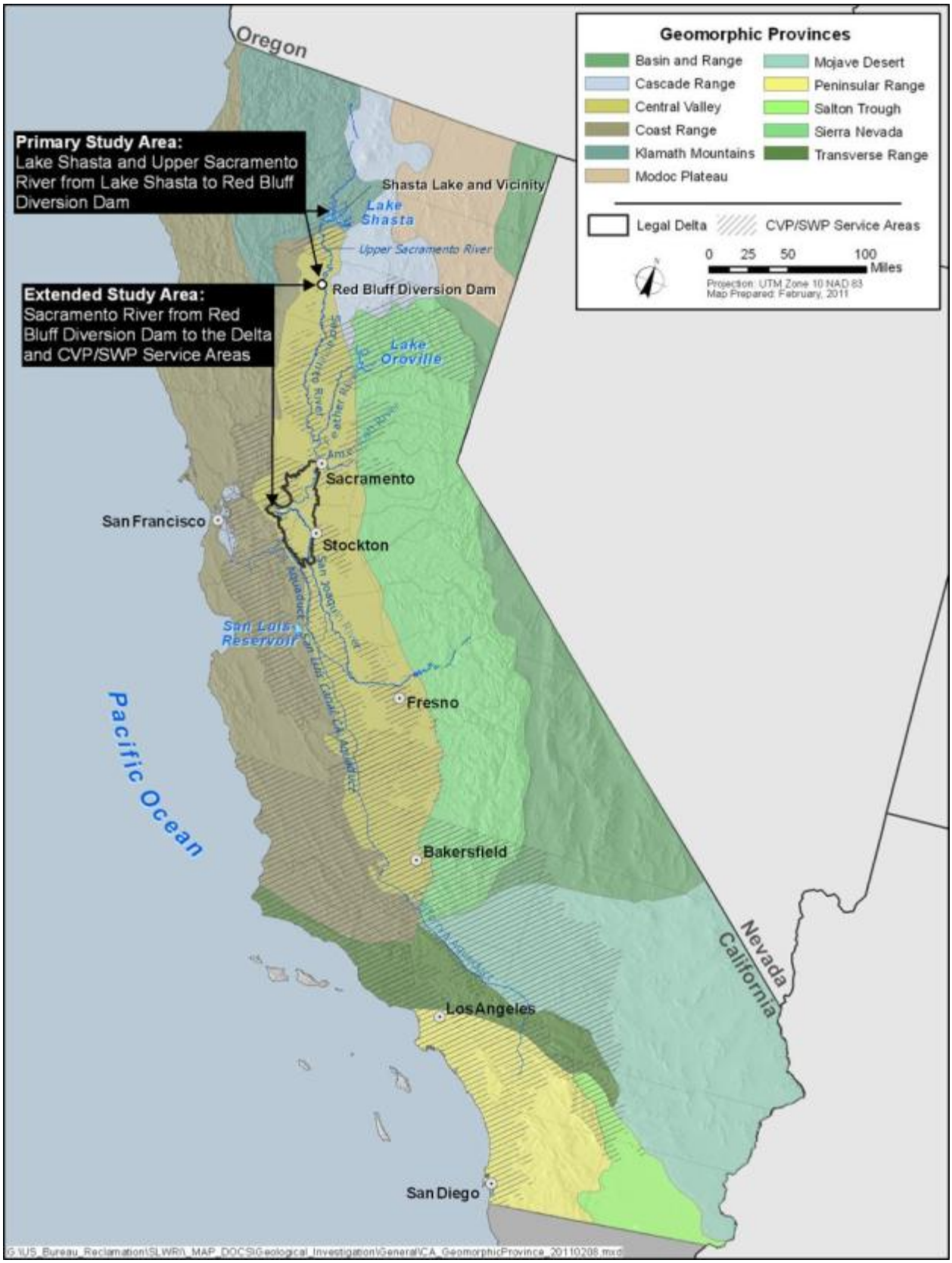


Figure 4-1. Geomorphic Provinces of California

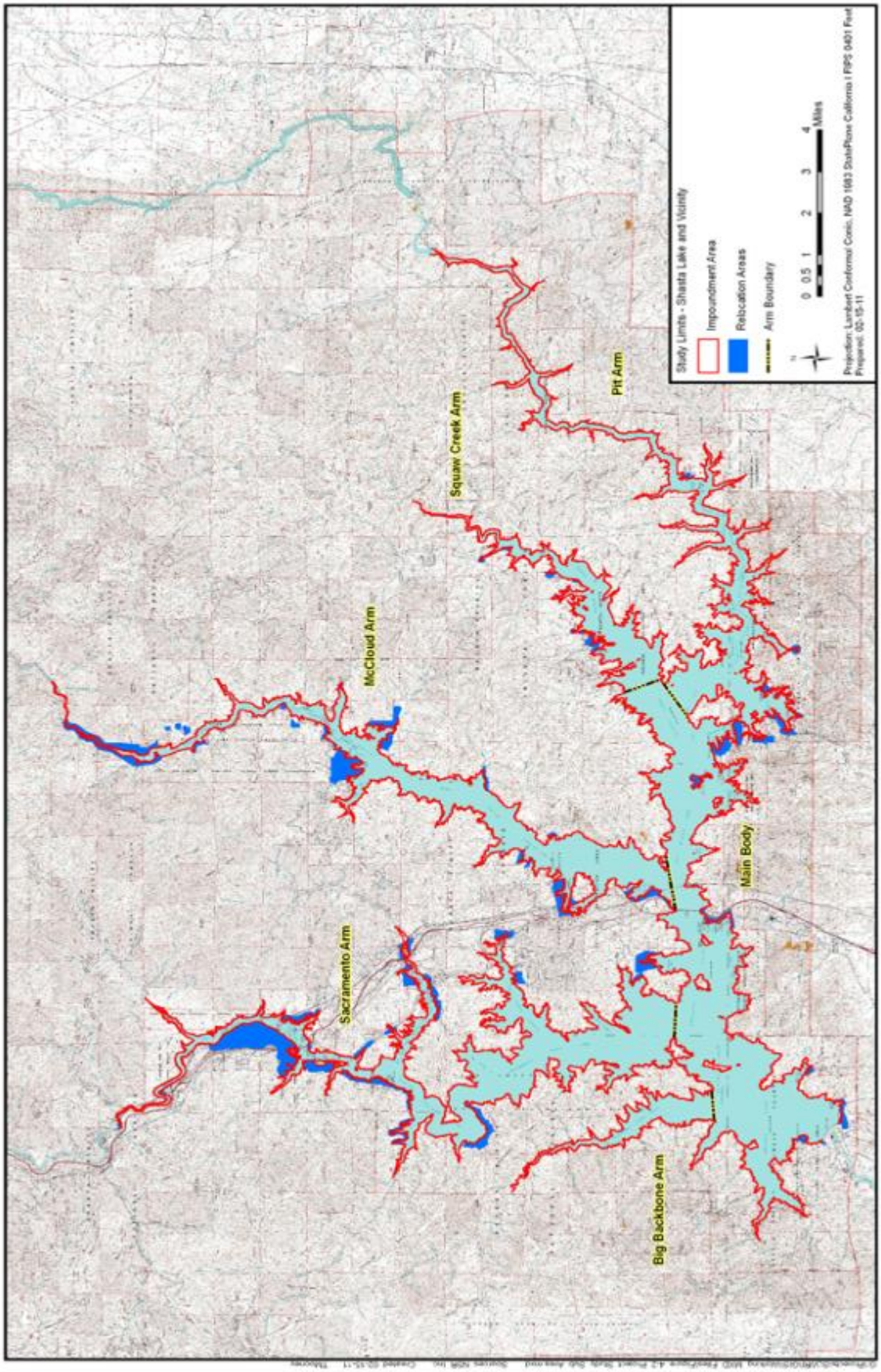


Figure 4-2. Shasta Lake and Vicinity Portion of the Primary Study Area

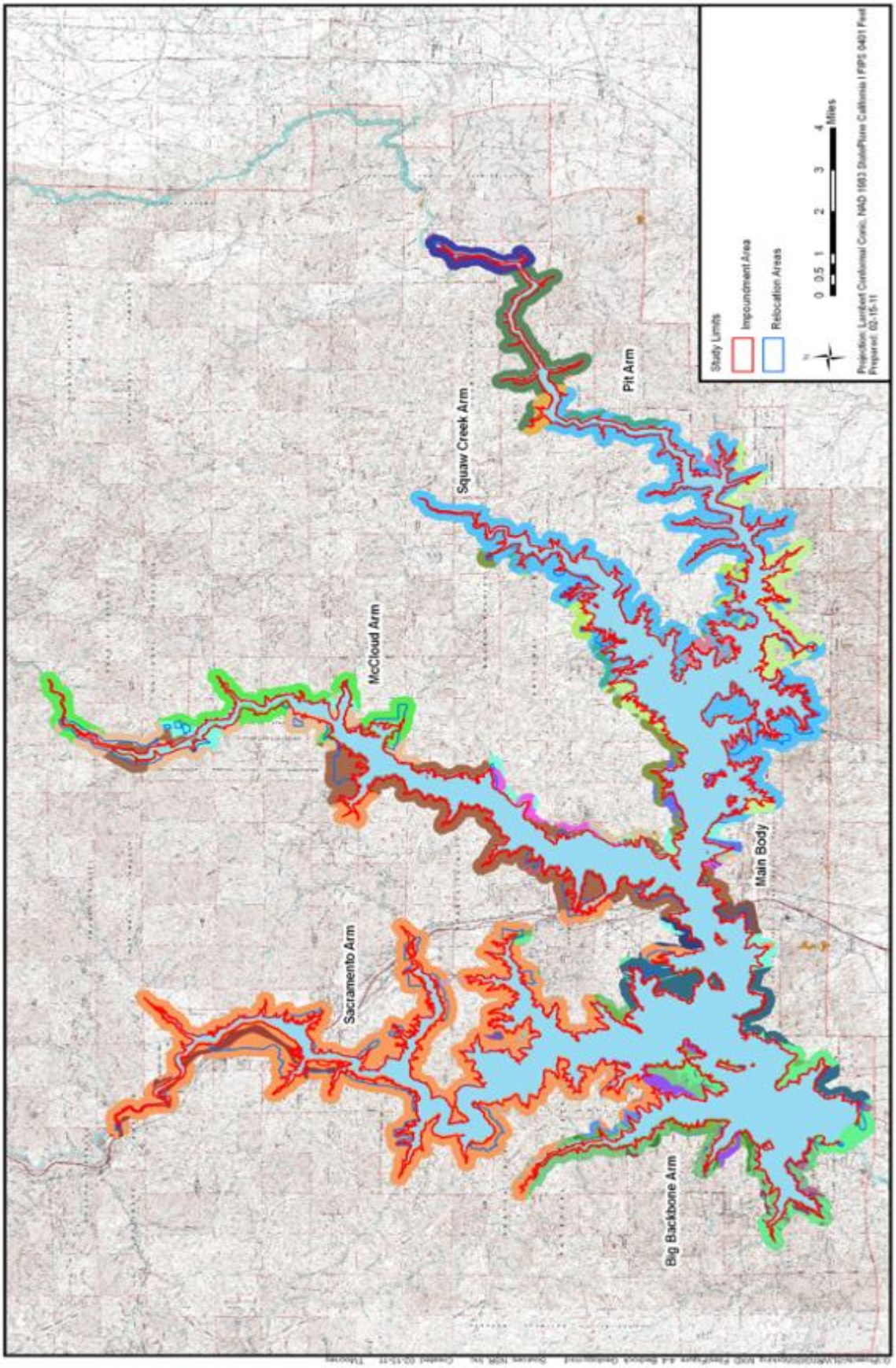


Figure 4-3. Bedrock Geology – Shasta Lake and Vicinity

Table 4-1. Key to Bedrock Geology Map Units – Shasta Lake and Vicinity



A large portion of the Shasta Lake and vicinity area is underlain by rocks of the eastern Klamath Mountain belt. The strata of the eastern belt constitute a column 40,000 to 50,000 feet thick, and represent the time from Ordovician (about 490 years before present) to Jurassic (about 145 million years before present). The stratigraphic column of formations that comprise the eastern Klamath Mountain belt, including a scale of geologic time, is shown in Table 4-2 (Hackel 1966). Important eastern belt rocks that underlay Shasta Lake and vicinity include metavolcanics of Devonian age (i.e., Copley Greenstone and Balaklala Rhyolite formations), metasedimentary rocks of Mississippian age (i.e., Bragdon Formation), thin-bedded to massive sedimentary rocks of Permian age (i.e., McCloud Limestone Formation), and metasedimentary and metavolcanic rocks of Triassic age (i.e., Pit, Modin, and Bully Hill Rhyolite formations) (Reclamation 2009). Intrusive igneous rocks (e.g., localized granitic bodies) make up less than 5 percent of the rocks in the sub-area, but are well represented on the Shasta Lake shoreline, particularly in the south-central area of the lake. Mesozoic intrusive dikes are scattered in the western portion of the map area.

The McCloud Limestone is prominently exposed within the McCloud, Pit, Main Body, and Big Backbone arms of Shasta Lake. Within the lake footprint, the McCloud River Arm has the largest exposure of this limestone, followed by the Pit, Main Body, and Big Backbone arms. Along the McCloud River Arm, this limestone crops out on the eastern shore from the mouth at the main body of the lake to Hirz Bay. Above Hirz Bay, it is intermittently exposed on both sides of the McCloud Arm. Along the Pit Arm near the mouth of Brock Creek, the McCloud Limestone is exposed along the north and southern banks. The McCloud Limestone is exposed near the southern shore of Allie Cove in the eastern portion of the Main Body Arm. Along the Big Backbone Arm, the McCloud Limestone is exposed near the eastern shore between the outlets of Shoemaker and Limerock creeks. Outside the Shasta Lake footprint, an outcrop of the McCloud Limestone is exposed along the McCloud River approximately 10 miles upstream from the mouth into the McCloud River Arm. The McCloud Limestone is also exposed on the north side of Bohemotash Mountain, which is approximately 2 miles from the mouth of Big Backbone Creek at the Big Backbone Arm.

“Skarn” is a geologic term that refers to metamorphic rocks formed in the contact zone of magmatic intrusions (e.g., granite) with carbonate-rich rocks (e.g., limestone) Skarn deposits are rich in lime-silicate minerals, and locally contain magnetite. Permian-aged skarn deposits are present within the McCloud River Arm. The deposits are located near the mouths of Marble and Potter creeks and on the peninsula at the eastern margin of the inlet of the McCloud River Arm. The skarn deposits occur adjacent to the McCloud Limestone at the mouths of Marble and Potter creeks, but the McCloud Limestone is absent near skarn deposits on the peninsula.

Table 4-2. Stratigraphic Column of Formations of the Eastern Klamath Mountain Belt

Period/Age Before Present (million years)	Formation	Thickness (feet)	General Features
Jurassic (145-200)	Potem Formation	1,000	Argillite and tuffaceous sandstones, with minor beds of conglomerate, pyroclastics, and limestone.
	Bagley Andesite	700	Andesitic flows and pyroclastics.
	Arvison Formation of Sanborn (1953)	5,090	Interbedded volcanic breccia, conglomerate, tuff, and minor andesitic lava flows.
Triassic (200-250)	Modin Formation	5,500	Basal member of volcanic conglomerate, breccia, tuff, and porphyry, with limestone fragments from the Hosselkus formation.
	Brock Shale	400	Dark massive argillite interlayered with tuff or tuffaceous sandstone.
	Hosselkus Limestone	0-250	Thin-bedded to massive light-gray limestone.
	Pit Formation	2,000-4,400	Predominantly dark shale and siltstone, with abundant lenses of metadacite and quartz-keratophyre tuffs.
	Bully Hill Rhyolite	100-2,500	Lava flows and pyroclastic rocks, with subordinate hypabyssal intrusive bodies.
Permian (250-300)	Dekkas Andesite	1,000-3,500	Chiefly fragmental lava and pyroclastic rocks, but includes mudstone and tuffaceous sandstone.
	Nosoni Formation	0-2,000	Mudstone and fine-grained tuff, with minor coarse mafic pyroclastic rocks and lava.
	McCloud Limestone	0-2,500	Thin-bedded to massive light-gray limestone, with local beds and nodules of chert.
Carboniferous (300-360)	Baird Formation	3,000-5,000	Pyroclastic rocks, mudstone, and keratophyre flows in lower part; siliceous mudstone, with minor limestone, chert, and tuff in middle part; and greenstone, quartz, keratophyre, and mafic pyroclastic rocks and flow breccia in upper part.
	Bragdon Formation	6,000±	Interbedded shale and sandstone, with grit and chert-pebble conglomerate abundant in upper part.
Devonian (360-420)	Kennett Formation	0-400	Dark, thin-bedded, siliceous mudstone and tuff.
	Balaklala Rhyolite	0-3,500	Light-colored quartz-keratophyre flows and pyroclastics.
	Copley Greenstone	3,700+	Keratophyric and spilitic pillow lavas and pyroclastic rocks.
Silurian (420-450 my	Gazelle Formation	2,400+	Siliceous graywackes, mudstone, chert-pebble conglomerate, tuff, and limestone.
Ordovician (450-490)	Duzel Formation	1,250+	Thinly layered phyllitic greywacke, locally with radiolarian chert and limestone.

A small area of the fossiliferous Cretaceous Chico Formation, consisting of Great Valley marine sedimentary rocks, occurs near Jones Valley Creek, a tributary to the Pit River Arm. Although this rock unit occurs in the immediate vicinity, it is not exposed along the shoreline of the lake and falls outside the Shasta Lake and vicinity area. Some outcrops of McCloud Limestone, especially in the vicinity of McCloud River Bridge, are also fossiliferous.

Modoc Plateau and Cascades Geomorphic Provinces The Cascade Range and Modoc Plateau together cover approximately 13,000 square miles in the northeast corner of California. The Cascade Range and Modoc Plateau (collectively the Modoc Plateau and Cascades Geomorphic Province) are very similar geologically and consist of young volcanic rocks that are Miocene to Pleistocene age. Included in this province are two composite volcanoes, Mt. Shasta and Mt. Lassen, and the Medicine Lake Highlands, a broad shield volcano.

The Cascade volcanics have been divided into the Western Cascade series and the High Cascade series. The Western Cascade series rocks consists of Miocene-aged basalts, andesites, and dacite flows interlayered with rocks of explosive origin, including rhyolite tuff, volcanic breccia, and agglomerate. This series is exposed at the surface in a belt 15 miles wide and 50 miles long from the Oregon border to the town of Mt. Shasta. After a short period of uplift and erosion that extended into the Pliocene, volcanism resumed creating the High Cascade volcanic series. The High Cascade series forms a belt 40 miles wide and 150 miles long just east of the Western Cascade series rocks. Early High Cascade rocks formed from very fluid basalt and andesite that extruded from fissures to form low shield volcanoes. Later eruptions during the Pleistocene contained more silica, causing more violent eruptions. Large composite cones like Mt. Shasta and Mt. Lassen had their origins during the Pleistocene (Norris and Webb 1990).

The Modoc Plateau consists of a high plain of irregular volcanic rocks of basaltic origin. The numerous shield volcanoes and extensive faulting on the plateau give the area more relief than otherwise may be expected for a plateau. The Modoc Plateau averages 4,500 feet in elevation and is considered a small part of the Columbia Plateau, which covers extensive areas of Oregon, Washington, and Idaho.

Volcanic rocks of the Modoc Plateau and Cascades Geomorphic Province are present adjacent to the eastern and northeastern boundaries of the Shasta Lake and vicinity area. In the vicinity of Shasta Lake they occur near the Pit River Arm and along the upper Sacramento River Arm. These rocks are generally younger than 4 million years old. Volcaniclastic rocks, mudflows, and tuffs of the Tuscan Formation occur in the Pit River area, and localized volcanic deposits occur in isolated locations.

The areal extent of bedrock types within the Shasta Lake and vicinity area is presented in Table 4-3 for the portion of the subarea between 1,070 feet and 1,090 feet above msl (i.e., Impoundment Area); and in Table 4-4 for the portion of the subarea potentially disturbed by construction activities (i.e., Relocation Areas).

Table 4-3. Areal Extent of Bedrock Types – Shasta Lake and Vicinity (Impoundment Area)

Map Unit	Formation	Bedrock Types	Study Area (acres)	Study Area (% Total Impoundment Area)
Cb	Baird	Meta-pyroclastic and keratophyre	145.3	5.82%
Cbg	Bragdon	Shale; graywacke; minor conglomerate	468.9	18.77%
Cbgcp	Bragdon	Chert-pebble and quartz conglomerate	3.3	0.13%
Cbgs	Bragdon	Black siliceous shale	0.0	0.00%
Cblss	Baird	Skarn; lime silicate minerals	1.2	0.05%
Cbmv	Baird	Greenstone and greenstone breccia	6.7	0.27%
Cbp	Baird	Mafic pyroclastic rocks	4.8	0.19%
Db	Balaklala rhyolite	Non-porphyritic and with small quartz phenocrysts	52.8	2.11%
Dbc	Balaklala rhyolite	Porphyritic with large quartz phenocrysts	3.3	0.13%
Dbp	Balaklala rhyolite	Volcanic breccia; tuff breccia; volcanic conglomer	12.9	0.52%
Dbt	Balaklala rhyolite	Tuff & tuffaceous shale	5.9	0.24%
Dc	Copley	Greenstone and undiff.	48.9	1.96%
Dct	Copley	Greenstone tuff & breccia	33.4	1.34%
di		Intermediate dikes	0.6	0.02%
dia		Diabase dikes	0.2	0.01%
Dk	Kennett	Siliceous shale and rhyolitic tuff	20.0	0.80%
Dkls	Kennett	Limestone	1.9	0.07%
Dkt	Kennett	Tuff; tuffaceous shale; shale	11.2	0.45%
dpp		Plagioclase	0.7	0.03%
Ehaev		Andesite	17.9	0.72%
Ja	Arvison	Volcaniclastic and pyroclastic	9.6	0.38%
lake	Shasta Lake		924.0	36.99%
Pmbh	Bully Hill rhyolite	Meta-andesite	84.6	3.39%
Pmbhp	Bully Hill rhyolite	Pyroclastic; tuff & tuff breccia	11.0	0.44%
Pmd		Quartz diorite	47.5	1.90%

Table 4-3. Areal Extent of Bedrock Types – Shasta Lake and Vicinity (Impoundment Area) (contd.)

Map Unit	Formation	Bedrock Types	Study Area (acres)	Study Area (% Total Impoundment Area)
Pmdk	Dekkas	Mafic flows and tuff	18.9	0.76%
Pmdkp	Dekkas	Breccia; tuff; tuff breccia	16.7	0.67%
Pmml	McCloud	Limestone	26.7	1.07%
Pmmls	McCloud	Skarn; lime silicate minerals; magnetite	2.2	0.09%
Pmn	Nosoni	Tuffaceous mudstone	66.4	2.66%
Pmpr	Pit River Stock	Quartz diorite; granodiorite	11.2	0.45%
Trh	Hosselkus Limestone	Limestone; thin-bedded to massive; gray; fossilife	7.5	0.30%
Trm	Modin	Andesitic volcaniclastic and pyroclastic rocks	27.9	1.12%
Trp	Pit	Shale; siltstone; metavolcanic; wi limestone	374.8	15.00%
Trpmv	Pit	Meta-andesite; meta-dacite	12.0	0.48%
Trpp	Pit	Pyroclastic; tuff and tuff breccia	16.6	0.66%
Tva	Western Cascades	Andesite	0.5	0.02%

Table 4-4. Areal Extent of Bedrock Types – Shasta Lake and Vicinity (Relocation Areas)

Map Unit	Formation	Bedrock Types	Study Area (acres)	Study Area (% Total Relocation Area)
Cb	Baird	Meta-pyroclastic and keratophyre	530.8	15.90%
Cbg	Bragdon	Shale; graywacke; minor conglomerate	1,088.4	32.59%
Cbgcp	Bragdon	Chert-pebble and quartz conglomerate	0.6	0.02%
Cbmv	Baird	Greenstone & greenstone breccia	25.6	0.77%
Db	Balaklala rhyolite	Non-porphyritic and with small quartz phenocrysts	9.8	0.29%
Dbc	Balaklala rhyolite	Porphyritic with large quartz phenocrysts	7.8	0.23%
Dbp	Balaklala rhyolite	Volcanic breccia; tuff breccia; volcanic conglomer	3.9	0.12%
Dbt	Balaklala rhyolite	Tuff and tuffaceous shale	1.1	0.03%
Dc	Copley	Greenstone and undiff.	61.5	1.84%
Dct	Copley	Greenstone tuff and breccia	84.9	2.54%

Table 4-4. Areal Extent of Bedrock Types – Shasta Lake and Vicinity (Relocation Areas) (contd.)

Map Unit	Formation	Bedrock Types	Study Area (acres)	Study Area (% Total Relocation Area)
Dk	Kennett	Siliceous shale and rhyolitic tuff	10.3	0.31%
Dkls	Kennett	Limestone	0.4	0.01%
Dkt	Kennett	Tuff; tuffaceous shale; shale	0.0	0.00%
Ehaev		Andesite	261.4	7.83%
Ja	Arvison	Volcaniclastic and pyroclastic	0.7	0.02%
lake	Shasta Lake		242.0	7.25%
Pmbh	Bully Hill rhyolite	Meta-andesite	53.0	1.59%
Pmbhp	Bully Hill rhyolite	Pyroclastic; tuff and tuff breccia	7.5	0.22%
Pmd		Quartz diorite	100.5	3.01%
Pmdk	Dekkas	Mafic flows and tuff	8.8	0.26%
Pmdkp	Dekkas	Breccia; tuff; tuff breccia	18.5	0.55%
Pmml	McCloud	Limestone	174.9	5.24%
Pmn	Nosoni	Tuffaceous mudstone	182.5	5.46%
Pmpr	Pit River Stock	Quartz diorite; granodiorite	42.8	1.28%
Trp	Pit	Shale; siltstone; metavolcanic; wi limestone	408.5	12.23%
Trpp	Pit	Pyroclastic; tuff and tuff breccia	11.5	0.34%
Tva	Western Cascades	Andesite	2.0	0.06%

Upper Sacramento River (Shasta Dam to Red Bluff)

The portion of the study area along the Sacramento River downstream to the Red Bluff Diversion Dam encompasses portions of the Cascade Range, Klamath Mountains, and Central Valley Geomorphic Provinces.

Central Valley Geomorphic Province The Central Valley Geomorphic Province is a large, asymmetrical, northwest-trending, structural trough formed between the uplands of the California Coast Ranges to the west and the Sierra Nevada to the east, and is approximately 400 miles long and 50 miles wide (Page 1985). The Coast Ranges to the west are made up of pre-Tertiary and Tertiary semiconsolidated to consolidated marine sedimentary rocks. The Coast Range sediments are folded and faulted and extend eastward beneath most of the Central Valley. The Sierra Nevada to the east side of the valley is composed of pre-Tertiary igneous and metamorphic rocks.

Along the western side of the Sacramento Valley, rocks of the Central Valley Geomorphic Province include Upper Jurassic to Cretaceous marine sedimentary rocks of the Great Valley Sequence; fluvial deposits of the Tertiary Tehama Formation; Quaternary Red Bluff, Riverbank, and Modesto Formations; and Recent alluvium.

The Great Valley Sequence was formed from sediments deposited within a submarine fan along the continental edge. The sediment sources were the Klamath Mountains and Sierra Nevada to the north and east, and include mudstones, sandstones, and conglomerates.

Tertiary and Quaternary fluvial sedimentary deposits unconformably overlie the Great Valley Sequence. The Pliocene Tehama Formation is the oldest, derived from erosion of the Coast Ranges and Klamath Mountains, and consists of pale green to tan semiconsolidated silt, clay, sand, and gravel. Along the western margin of the valley, the Tehama Formation is generally thin, discontinuous, and deeply weathered.

The Red Bluff Formation is a broad erosional surface, or pediment, of low relief formed on the Tehama Formation between 0.45 and 1.0 million years ago. Thickness varies to about 30 feet.

Recent alluvium consists of loose sedimentary deposits of clay, silt, sand, gravel, and boulders. The deposits may originate from landslides, colluvium, stream channel deposits, and floodplain deposits. Landslides occur along the project area but are generally small, shallow debris slides or debris flows.

Stream channel deposits generally consist of unconsolidated sand and gravel, with minor amounts of silt and clay. Floodplain deposits are finer grained and consist almost entirely of silt and clay (DWR 2003).

Lower Sacramento River and Delta

The study area along the lower Sacramento River and the Delta encompasses the Central Valley Geomorphic Province, as described above for the upper Sacramento River portion of the primary study area.

The Delta is a broad depression in the Franciscan bedrock that resulted from an east-west expansion of the San Andreas and Hayward fault systems, filled by sediments deposited over many millions of years via the Sacramento and San Joaquin Rivers and other tributary rivers and streams.

CVP/SWP Service Areas

The CVP/SWP service areas encompass portions of the Central Valley, Sierra Nevada, Coast Ranges, Cascade Range, Peninsular Ranges, Transverse Ranges, Mojave Desert, Modoc Plateau, and Klamath Mountains Geomorphic Provinces.

The south-of-Delta CVP/SWP service areas include two distinct, noncontiguous areas: in the north are the San Felipe Division's CVP service area and the South Bay SWP service area; to the south are the SWP service areas. The northern section of this region encompasses the Coast Ranges Geomorphic Province and the southern portion of this section includes portions of the Peninsular Ranges, Tranverse Ranges, and Mojave Desert Geomorphic Provinces. Additional information on the geomorphic provinces is available in the *Geology, Geomorphology, Minerals, and Soils Technical Report*.

4.1.2 Geologic Hazards

Geologic hazards are described below for both the primary and extended study areas.

Shasta Lake and Vicinity

Six types of geologic hazards have potential to occur within and near the Shasta Lake and vicinity project area: seismic hazards, volcanic eruptions and associated hazards, mudflows, snow avalanches, slope instability, and seiches.

Seismic Hazards Seismic hazards consist of the effects of ground shaking and surface rupture along and around the trace of an active fault. Ground shaking is the most hazardous effect of earthquakes because it is the most widespread and accompanies all earthquakes. Ground shaking can range from high to low intensity and is often responsible for structure failure leading to the largest loss of life and property damage during an earthquake. The Modified Mercalli intensity ratings reflect the relationship between earthquake magnitudes and shaking intensity. Higher magnitude earthquakes typically produce higher shaking intensities over wider areas, which may result in greater damage.

Surface rupture occurs when an earthquake results in ground rupture, causing horizontal and/or vertical displacement. Surface rupture typically is narrow in rock and wider in saturated soils, and also typically tends to occur along previous fault lines.

An active fault is defined by the Alquist-Priolo Earthquake Fault Zoning Act as a fault that has caused surface rupture within the last 11,000 years. The nearest active fault to the southern portion of the Shasta Lake and vicinity project area is the Battle Creek Fault Zone located approximately 27 miles south of the dam (CDC 2006a). The maximum credible earthquake for the southern portion of the Shasta Lake and vicinity area has a moment magnitude of 7.3. A maximum peak ground acceleration of 0.101 g[1] was calculated for the southern portion of the Shasta Lake and vicinity area based on an earthquake moment magnitude of 6.5 from the Battle Creek Fault Zone. The Northeastern California Fault system, located approximately 28 miles south of Shasta Dam, may be capable of causing the highest ground shaking at the site. A maximum peak ground acceleration of 0.126 g was calculated for the Shasta Dam location.

[1] Peak ground acceleration is expressed in units of "g", the acceleration due to Earth's gravity. Thus, 1g = 9.81m/s^2

According to the California Geological Survey Alquist-Priolo Act Active Fault Maps, the nearest active fault north of the Shasta Lake and vicinity area is the Hat Creek-Mayfield-McArthur Fault Zone, located about 50 miles to the northeast of Shasta Dam (Jennings 1975). This fault zone is composed of numerous parallel north-northwest trending normal faults. According to the Alquist-Priolo Act maps, the Hat Creek-Mayfield-McArthur Fault is capable of generating magnitude 7.0 earthquakes with a relatively long return period of 750 years (Petersen et al. 1996).

Other earthquake fault zones within or near the Shasta Lake and vicinity area include the following:

- Pittville Fault located in portions of the Day Bench
- Rocky Ledge Fault located north of Burney in Long Valley and east of Johnson Park

Northeast of the Shasta Lake and vicinity area, portions of Shasta and Siskiyou counties include the area between Lassen Peak and Medicine Lake Highlands. This area is cut by a series of active normal faults that are part of the Sierra Nevada-Great Basin dextral shear zone (Shasta County 2004). These faults are capable of affecting the upper watersheds northeast of the Sacramento Valley. These faults include the previously mentioned Hat Creek-Mayfield-McArthur Fault Zone, the Gillem-Big Crack faults near the California-Oregon border southeast of Lower Klamath Lake, and the Cedar Mountain Fault southwest of Lower Klamath Lake. The faults in this zone are capable of earthquakes up to magnitude 7.0. Farther northeast, the Likely Fault is judged capable of a magnitude 6.9 earthquake. In the northeast corner of the state, the Surprise Fault is capable of a magnitude 7.0 earthquake.

Seismic activity has been reported in the area of Shasta Dam and Shasta Lake, and has typically been in the 5.0 magnitude or lower range. The nearest seismic activity to Shasta Dam and Shasta Lake was a magnitude 5.2 earthquake that occurred 3 miles northwest of Redding, near Keswick Dam, in 1998 (Petersen 1999).

Volcanic Eruptions and Associated Hazards Volcanic hazards include potential eruptions, and their products and associated hazards. In the Shasta Lake and vicinity subarea these include lava flows, pyroclastic flows, domes, tephra, and mudflows and floods triggered by eruptions. Three active centers of volcanic activity, all associated with the Modoc Plateau and Cascades Geomorphic Province, occur near enough to this Shasta Lake and vicinity area to merit discussion: the Medicine Lake Highlands, Lassen Peak, and Mount Shasta.

Medicine Lake Highlands is located approximately 65 air miles northeast of Shasta Lake and includes a broad shield volcano that has a large caldera at its

summit and more than 100 smaller lava cones and cinder cones on its flanks. The volcano developed over a period of 1,000,000 years, mainly through lava flows. The most recent activity was approximately 500 years ago, when a large tephra eruption was followed by an extrusion of obsidian. Volcanic activity is likely to persist in the future (USFS 1994), specifically local lava flows and tephra eruptions.

Lassen Peak lies 50 miles southeast of Shasta Lake. Lassen Peak is a cluster of dacitic domes and vents that have formed over the past 250,000 years. The most recent eruption occurred in 1914. That eruption began as a tephra eruption with steam blasts, and climaxed with a lateral blast, hot avalanches, and mudflows. Most ash from the 1914 eruption was carried to the east of the volcano.

The most prominent, active volcanic feature in the vicinity of Shasta Lake is Mount Shasta, which is located approximately 45 miles north of Shasta Lake. Mount Shasta has erupted at least once per 800 years during the last 10,000 years, and about once per 600 years during the last 4,500 years. Mount Shasta last erupted in 1786. Eruptions during the last 10,000 years produced lava flows and domes on and around the flanks of Mount Shasta. Pyroclastic flows extended up to 12 miles from the summit. Most of these eruptions also produced mudflows, many of which reached tens of miles from Mount Shasta.

Eruptions of Mount Shasta could endanger the communities of Weed, Mount Shasta, McCloud, and Dunsmuir. Such eruptions will most likely produce deposits of lithic ash, lava flows, domes, and pyroclastic flows that may affect low- and flat-lying ground almost anywhere within 12 miles of the summit. However, on the basis of its past behavior, Mount Shasta is not likely to erupt large volumes of pumiceous ash (tephra) in the future. Areas subject to the greatest risk from air-fall tephra are located mainly east and within about 30 miles of the summit (Miller 1980).

Floods commonly are produced by melting of snow and ice during eruptions of ice-clad volcanoes like Mount Shasta, or by heavy rains that may accompany eruptions. By incorporating river water as they move down valleys, mudflows may grade into slurry floods carrying unusually large amounts of rock debris. Eruption-caused floods can occur suddenly and can be of large volume. If floods caused by an eruption occur when rivers are already high, floods far larger than normal can result. Streams and valley floors around Mount Shasta could be affected by such floods as far downstream as Shasta Lake. The danger from floods caused by eruptions is similar to that from floods having other origins, but floods caused by eruptions may be more damaging because of a higher content of sediment that would increase the bulk specific gravity of the fluid (Miller 1980).

Mudflows Small mudflows, not caused by eruptions, are common at Mount Shasta. Relatively small but frequent mudflows have been produced historically (1924, 1926, 1931, and 1977) by melting of glaciers on Mount Shasta during

warm summer months. Mudflows that occurred during the summer of 1924 entered the McCloud River and subsequently flowed into the Sacramento River (Miller 1980).

Snow Avalanches Avalanche hazards near the Shasta Lake and vicinity subarea typically occur in steep, high-elevation terrane. These areas are generally above the treeline or in sparsely vegetated areas. Significant avalanche areas are limited to locations on the upper slopes outside of the Shasta Lake and vicinity area.

Slope Instability (Mass Wasting) Slope instability hazards occur in areas of active and relict mass wasting features (e.g., active and relict landslides, debris flows, inner gorge landscape positions, and complexes of these features). Slope instability hazards occur throughout the Shasta Lake and vicinity area, and are most common in areas of steep topography. Locations in the Shasta Lake and vicinity area of mapped slope instability hazards are shown in Figure 4-4.

The terrane underlying the subarea and surrounding region has been influenced by a combination of tectonic uplift, mass wasting, and fluvial and surface erosion processes. The influence of these processes is ongoing, with evidence of ancient and more recent mass wasting features over the entire area, consisting of debris slides, torrents, and flows, with lesser amounts of rotational/translational landslides. The extent or distribution of mass wasting features across the region is believed not to have changed appreciably as a result of land use activities following Anglo-American settlement (USFS 1998).

Much of the topography in the general vicinity of Shasta Lake is steep, with concave swales; therefore, landslides are relatively common, ranging from small mudflows and slumps to large debris slides, debris flows, and inner gorge landslides. Small shallow debris slides associated with localized alluvial/colluvial rock units occur along the shoreline of Shasta Lake. Rock slides caused by mining activities have also occurred on the slopes surrounding Shasta Lake.

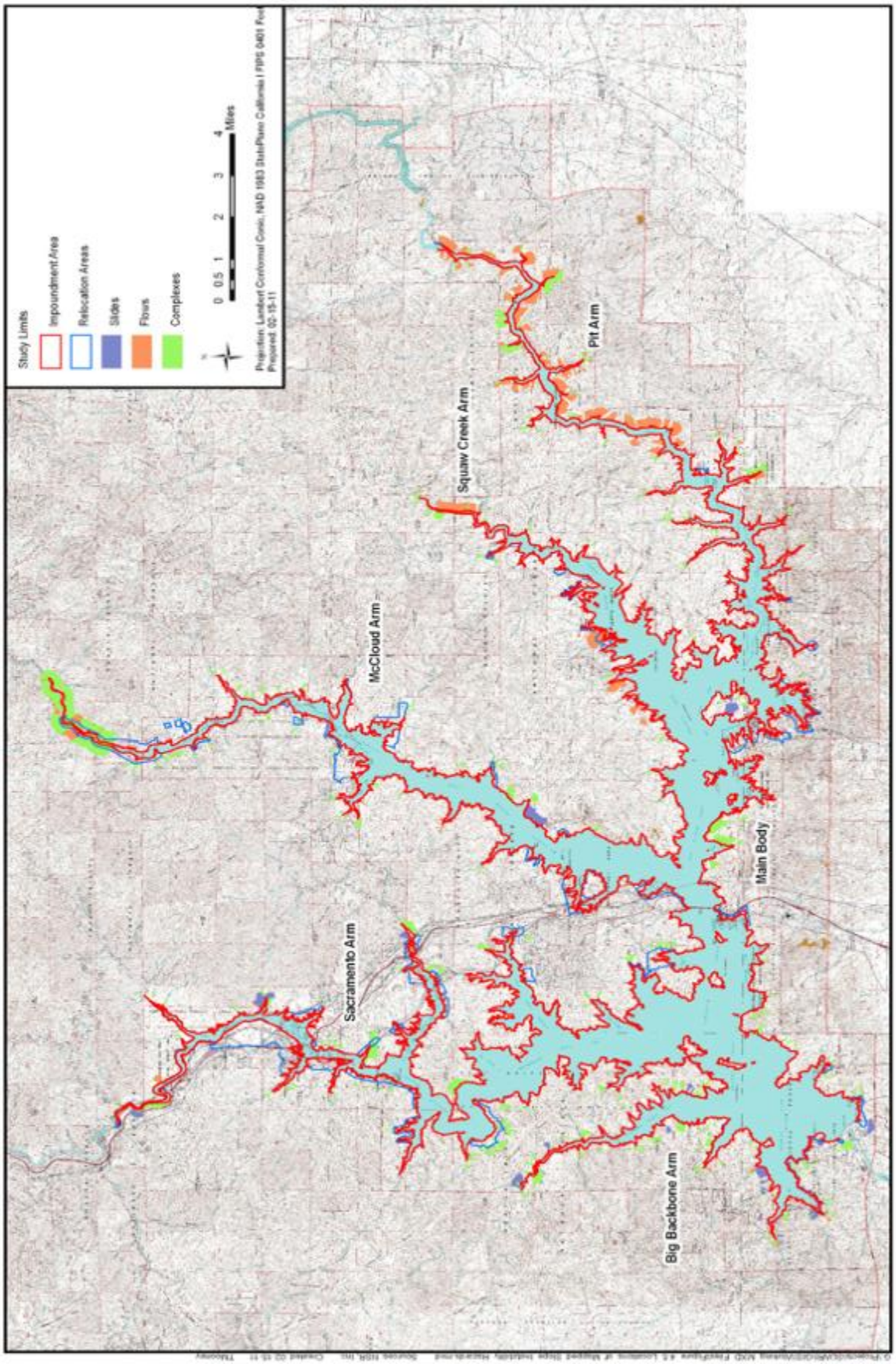


Figure 4-4. Locations of Mapped Slope Instability Hazards – Shasta Lake and Vicinity

The areal extent of mapped slope instability hazards within the Shasta Lake and vicinity area is presented in Table 4-5 for the portion of the subarea between 1,070 feet and 1,090 feet above msl (Impoundment Area); and in Table 4-6 for the portion of the subarea potentially disturbed by construction activities under the action alternatives (Relocation Areas). About 173 acres (7 percent) of the Impoundment Area is occupied by features that are potentially unstable. Potentially unstable features occupy about 232 acres (7 percent) of the Relocation Area. Most of the mapped slope instability hazards are debris flows.

Table 4-5. Areal Extent of Mapped Slope Instability Hazards – Shasta Lake and Vicinity (Impoundment Area)

Map Unit	Formation	Study Area (acres)	Study Area (% Total Sub-Area)
1050	Slides	9.5375	0.38%
1100	Flows	66.6091	2.67%
1200	Complexes	97.1695	3.89%

Table 4-6. Areal Extent of Mapped Slope Instability Hazards – Shasta Lake and Vicinity (Relocation Areas)

Map Unit	Formation	Study Area (acres)	Study Area (% Total Sub-Area)
1050	Slides	2.9947	0.09%
1100	Flows	52.9767	1.59%
1200	Complexes	175.8020	5.26%

Seiches A seiche is an oscillation of a body of water in an enclosed or semi enclosed basin that varies in period, depending on the physical dimensions of the basin, from a few minutes to several hours, and in height from a few millimeters to a few meters. Seiches arise chiefly as a result of sudden local changes in atmospheric pressure, aided by wind and occasionally tidal currents. Seiches can also be triggered by strong earthquake ground motion or large landslides entering a body of water.

If Mount Shasta were to erupt again, volcanic ash could fall in the study area, though as previously described, Mount Shasta is not likely to erupt large volumes of pumiceous ash (tephra) in the future. Minor seiches in Shasta Lake also could be generated by debris flows in the arms of the lake where its tributaries enter (City of Redding 2000). A large megathrust on the Cascadia subduction zone off the Pacific coast could generate enough ground shaking to generate a seiche in Shasta Lake.

Regardless of its cause, the effects of a seiche would depend on the local conditions at the time. If the reservoir were filled to capacity, there may be some overspill by way of the dam spillways. Substantial overtopping of the dam itself is extremely unlikely, as such an event would require a seiche more than 6 meters high, even if the reservoir were filled to capacity. Excess flows into the Sacramento River triggered by a seiche in Shasta Lake would be attenuated by Keswick Reservoir (City of Redding 2000).

Upper Sacramento River (Shasta Dam to Red Bluff)

The upper Sacramento River portion of the primary study area could potentially be affected by geologic hazards in the region attributed to seismic hazards and volcanic eruptions and associated hazards. Mudflows, snow avalanches, slope instability, and seiches are not considered to be geologic hazards in this portion of the primary study area.

Seismic Hazards The northeastern area of Shasta County is part of an area between Lassen Peak and the Medicine Lake Volcano (in Siskiyou County), which is cut by a series of active normal faults that are part of the Sierra Nevada-Great Basin dextral shear zone (Shasta County 2004). These faults are likely to affect the upper watersheds northeast of the Sacramento Valley. These faults include the Mayfield-MacArthur-Hat Creek faults, 25 to 85 miles north of Lake Almanor; the Gillem-Big Crack Faults near the California-Oregon border southeast of Lower Klamath Lake; and the Cedar Mountain Fault southwest of Lower Klamath Lake. The faults in this zone are capable of earthquakes up to magnitude 7.0.

Shasta County, is a seismically active region, but has not experienced significant property damage or loss of life from earthquakes in the past 120 years. The City of Redding (2005) reported that maximum recorded intensities have reached Modified Mercalli VII. The majority of intense seismic activity in Shasta County has occurred in the eastern half of the county, around Lassen Peak (City of Redding 2005).

The Shasta County General Plan states that the maximum intensity event expected to occur in eastern Shasta County is Modified Mercalli VIII (Shasta County 2004). In the western half of Shasta County, the maximum intensity event is expected to be Modified Mercalli VII (City of Redding 2005). Shasta County is entirely within Seismic Zone 3 of the Uniform Building Code. Redding is an area of “moderate seismicity” and the Hat Creek and McArthur areas are of “moderate-to-high seismicity” (Shasta County 2004).

South of Shasta County along the upper Sacramento River, potential surface faulting could be associated with the Great Valley thrust fault system, which is capable of earthquakes up to magnitude 6.8 along the west side of the Sacramento Valley. This fault system forms the boundary between the Coast Ranges and the Sacramento and San Joaquin Valleys.

The San Andreas Fault system is located west of the Sacramento and San Joaquin Valleys and is made up of a series of faults that lie along a 150-mile-long northwest trending zone of seismicity. This zone is 10 to 45 miles west of the Sacramento Valley and extends from Suisan Bay past Lake Berryessa and Lake Pillsbury to near the latitude of Red Bluff. The Green Valley, Hunting Creek, Bartlett Springs, Round Valley, and Lake Mountain Faults are the mapped active faults of the San Andreas Fault system most likely to affect the

upper watersheds west of the Sacramento Valley. The faults within this system are capable of earthquakes up to 7.1 in magnitude.

The Indian Valley Fault southeast of Lake Almanor and the Honey Lake Fault zone east of Lake Almanor are likely to affect the upper watersheds east of the Sacramento Valley, and are capable of a magnitude 6.9 earthquake. Surface rupture occurred in 1975 along the Cleveland Hill Fault south of Lake Oroville. The Foothills Fault system, which borders the east side of the Sacramento and San Joaquin Valleys, is judged to be capable of a magnitude 6.5 earthquake.

Volcanic Eruptions and Associated Hazards Shasta County is at the southern end of the Cascade Range (as described above for geology of the upper Sacramento River). The most recent volcanic activity in Shasta County occurred between 1914 and 1917, when Lassen Peak erupted, producing lava flows, numerous ash falls, and a large mudflow. The mudflow, a result of melting snow and ash, flowed down Lost Creek and Hat Creek (Shasta County 2004).

It is unlikely that a large mudflow from Mt. Shasta would endanger Shasta County (Shasta County 2004).

Lower Sacramento River and Delta

The lower Sacramento River and Delta portion of the extended study area could potentially be affected by geologic hazards in the region attributed to seismic hazards. Volcanic eruptions and associated hazards, mudflows, snow avalanches, slope instability, and seiches are not considered to be geologic hazards in this portion of the extended study area.

The nearest active fault to the lower Sacramento River below Red Bluff is the Dunnigan Hills Fault, which has experienced fault displacement within the last 10,000 years (Jennings 1994). The Dunnigan Hills Fault runs along the Sacramento River and is located between 6 and 10 miles west of the river near the Town of Dunnigan. The Cleveland Fault is located approximately 30 miles east of the Sacramento River near the Town of Oroville. In addition, the Great Valley thrust fault system and San Andreas fault system extend along the Sacramento River to the west, as described above for the upper Sacramento River portion of the primary study area.

Failure of Delta levees is the primary threat to the region as a result of seismic activity. The Delta levees are located in a region of relatively low seismic activity compared to the San Francisco Bay Area (Bay Area). The major strike-slip faults in the Bay Area (San Andreas, Hayward, and Calaveras faults) are located over 16 miles from the Delta region. The less active Green Valley and Marsh Creek–Clayton faults are over 9 miles from the Delta region. Small but significant local faults are situated in the Delta region, and there is a possibility that blind thrust faults occur along the west Delta.

CVP/SWP Service Areas

The CVP/SWP service areas portion of the extended study area could potentially be affected by geologic hazards in the region attributed to seismic hazards. Volcanic eruptions and associated hazards, mudflows, snow avalanches, slope instability, and seiches are not considered to be geologic hazards in this portion of the extended study area. A number of active faults exist along the Sacramento and San Joaquin rivers in the CVP/SWP service areas.

Major earthquake activity has centered along the San Andreas Fault zone, including the great San Francisco earthquake of 1906 in the Bay Area. Since that earthquake, four events of magnitude 5.0 on the Richter scale or greater have occurred in the Bay Area. The San Andreas and Hayward Faults remain active, with evidence of recent slippage along both faults.

In the San Joaquin River region, the Great Valley thrust fault system forms the boundary between the Coast Ranges and the west boundary of the San Joaquin Valley. This fault system is capable of earthquakes up to magnitude 6.7 along the west side of the San Joaquin Valley.

Active faults likely to affect the upper watersheds at the end of the San Joaquin Valley include the White Wolf Fault, which ruptured in 1952 with a magnitude 7.2 earthquake; the Garlock Fault, capable of a magnitude 7.3 earthquake; and several smaller faults l0 to 30 miles north of the White Wolf Fault.

A list of all of the reported faults, fault zones, and systems, according to the California Geological Survey, that are located south-of-Delta within the CVP/SWP service areas is presented in the California Public Resources Code, Division 2 Geology, Mines and Mining, Chapter 7.5 Earthquake Fault Zoning (CDC 2006a).

4.1.3 Geomorphology

Geomorphology in the study area is described below for both the primary and extended study areas.

Shasta Lake and Vicinity

As previously described, most of Shasta Lake and vicinity area is within the Klamath Geomorphic Province. The topography of the study area ranges from moderate to steep, and elevation ranges from approximately 1,070 to more than 6,000 feet above msl. The orientation and slopes of the ridges are controlled by the bedrock geology and structure. Generally speaking, the eastern slopes of the ridges are steeper than the western slopes. Hillslope gradient ranges from 0 percent to more than 100 percent within the Shasta Lake and vicinity area.

The regional stream network and boundaries of watersheds adjacent to Shasta Lake are shown in Figure 4-5. The boundaries of watersheds adjacent to Shasta Lake (shown in Figure 4-5) are the same as the boundaries of 6th Field

Hydrologic Unit Code watersheds defined in the subarea by the USFS. Regional-scale characteristics of the streams that are tributary to Shasta Lake are presented in Figure 4-6, where they are organized by arm. The total area of watersheds draining to the lake on a regional scale is 6,665 square miles. Of this total, watersheds that are immediately adjacent and contribute directly to Shasta Lake (i.e., 6th Field Hydrologic Unit Code watersheds) comprise about 512 square miles (see Table 4-7). These immediately adjacent watersheds include small portions of the five major tributaries to the lake (i.e., Big Backbone Creek, Sacramento River, McCloud River, Squaw Creek, and Pit River), and small watersheds that are adjacent and directly contributory to the Main Body Arm of the lake.

In general, the stream networks adjacent and directly tributary to Shasta Lake are irregular and dendritic. The drainages are steep, and the drainage density ranges from 3.0 to 6.4 miles of stream per square mile of drainage area (Table 4-7). The drainage density is the lowest in the Main Body Arm because this area has several small catchments. The density is the highest in the more well-defined arms, a function of their larger catchment areas of the tributary watersheds.

The lengths of streams within watersheds that are adjacent to Shasta Lake are also reported in Figure 4-6, where they again are aggregated by arm and further subdivided by flow regime (i.e., intermittent or perennial) and stream gradient. There are about 2,903 miles of ephemeral, intermittent, and perennial stream channels within these adjacent watersheds. Most (64 percent) of the stream channels are intermittent and have a stream slope greater than 10 percent. About 14 percent of the stream channels are perennial, with slopes less than 7 percent. Generally speaking, channels with gradients of less than 7 percent are known to support fish and other aquatic organisms. About 79 percent of these potential fish-bearing tributaries occur within the Sacramento River, Squaw Creek, and Pit River arms.

Again, the values reported in Table 4-7 do not include large parts of the Sacramento River, Squaw Creek, Pit, McCloud, and Big Backbone watersheds; only the “face drainages” within the arms themselves are included in the reported values.

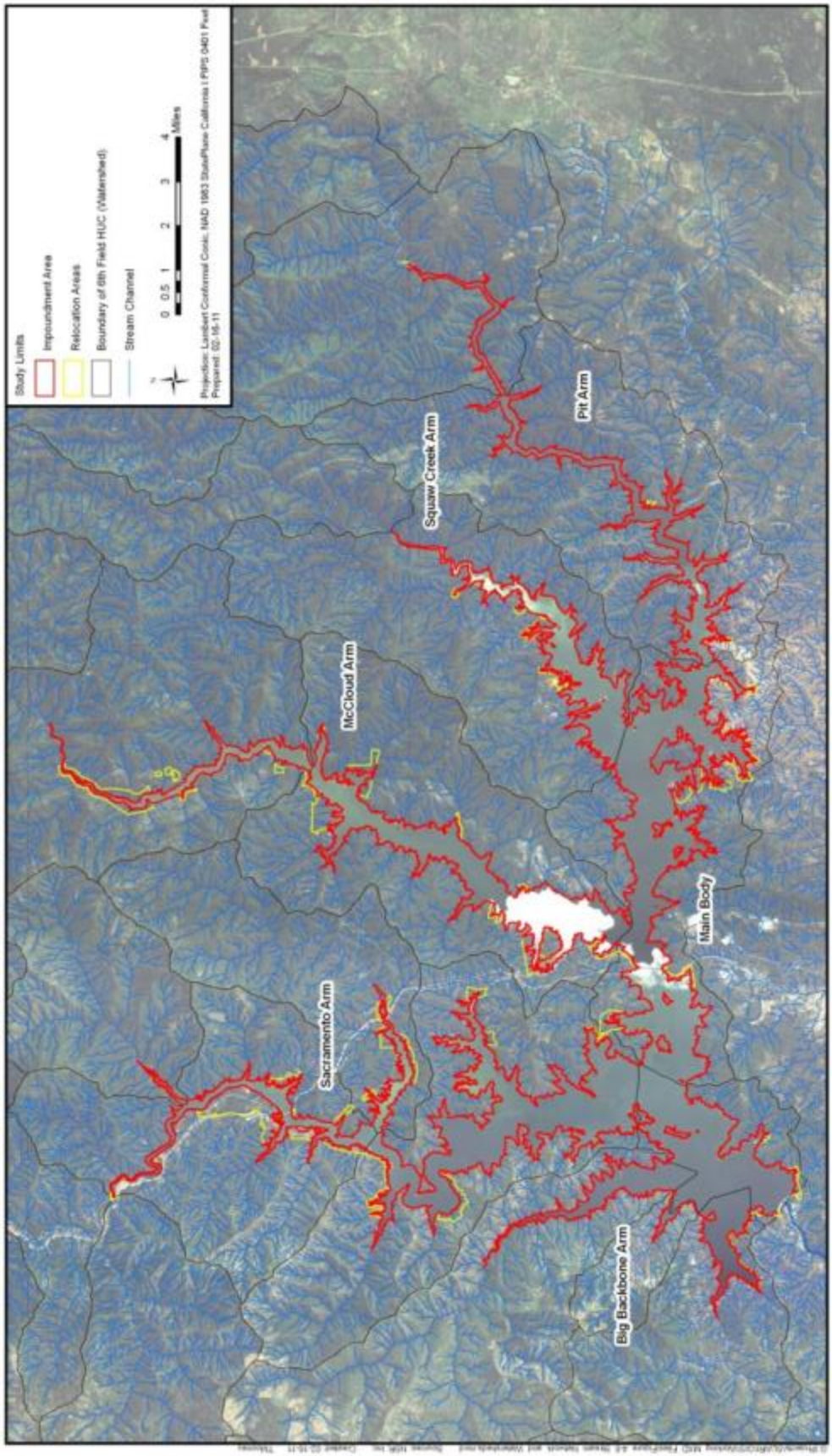


Figure 4-5. Regional Stream Network and Boundaries of Watersheds Adjacent to Shasta Lake and Vicinity

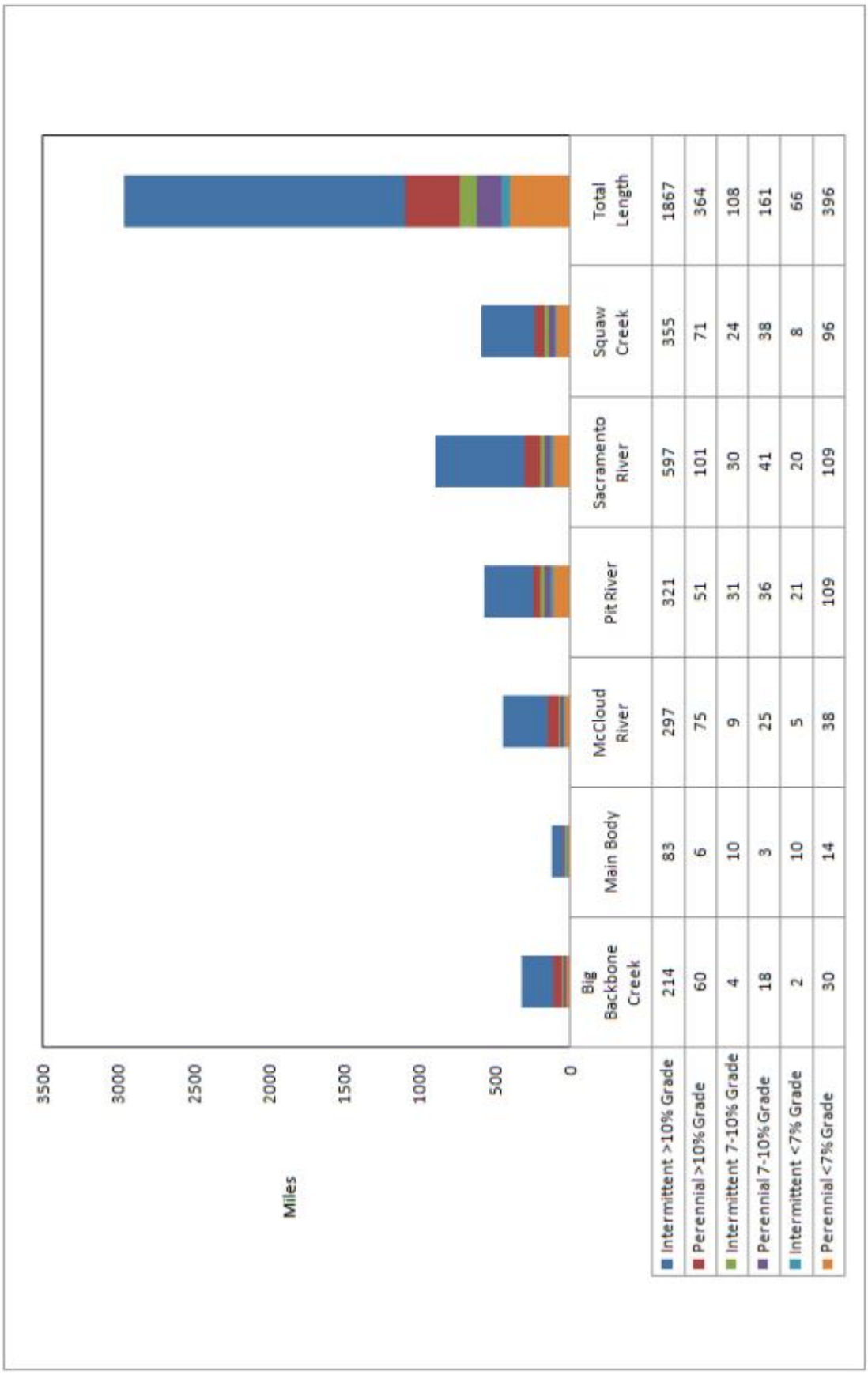


Figure 4-6. Regional-Scale Characteristics of Streams Tributary to Shasta Lake

Table 4-7. Characteristics of Watersheds Adjacent and Directly Tributary to Shasta Lake

Lake Arm	Drainage Area (square miles)	Stream Length (miles)	Drainage Density (miles/square miles)	Average Elevation (feet)	Max Elevation (feet)	Mean Annual Precipitation (inches)
Big Backbone Creek	60	325	5.4	2,185	4,633	74
Main Body	37	112	3.0	1,260	2,723	67
McCloud River	77	444	5.7	1,911	4,669	79
Pit River	100	551	5.5	1,700	3,246	73
Sacramento River	137	880	6.4	1,825	4,589	76
Squaw Creek	100	583	5.8	2,100	5,046	83
Total	512	2,903	5.7	1,885	5,046	77

Using existing data and information (NSR 2003), the following observations were made concerning the relative stability of the riverine reaches. Of the five main tributaries influencing Shasta Lake, all except Big Backbone Creek and the Sacramento River are underlain by shallow bedrock that limits channel incision. For this reason, Squaw Creek, and the Pit and McCloud rivers are relatively stable streams that are unlikely to be changed significantly in response to average floods. Although they occur infrequently, debris flows have the potential to substantially affect particularly shallow bedrock reaches of these tributaries, as is evident in Dekkas Creek. The Sacramento River and Big Backbone Creek are relatively dynamic because the channel bed has the potential to undergo physical changes in response to a moderate flood. Although Big Backbone Creek and Squaw Creek have similar watershed areas, Squaw Creek has more bedrock reaches than Big Backbone Creek and is therefore inherently more stable.

Upper Sacramento River (Shasta Dam to Red Bluff)

The geomorphology of the Sacramento River is a product of several factors: the geology of the Sacramento Valley, hydrology, climate, vegetation, and human activity. Large flood events drive lateral channel migration and remove large flow impediments. Riparian vegetation stabilizes riverbanks and reduces water velocities, inducing deposition of eroded sediment. In the past, a balance existed between erosion and deposition along the Sacramento River. However, construction of dams, levees, and water projects has altered streamflow and other hydraulic characteristics of the Sacramento River. In some areas, human-induced changes have stabilized and contained the river, while in other reaches, the loss of riparian vegetation has reduced sediment deposition and led to increased erosion.

Lower Sacramento River and Delta

Downstream from Red Bluff, the lower Sacramento River is relatively active and sinuous, meandering across alluvial deposits within a wide meander belt. The active channel consists of point bars composed of sand on the inside of meander bends, and is flanked by active floodplain and older terraces. While

most of these features consist of easily eroded, unconsolidated alluvium, there are also outcrops of resistant, cemented alluvial units such as the Modesto and Riverbank Formations. Geologic outcroppings and man-made structures, such as bridges and levees, act as local hydraulic controls and confine movement of much of the lower Sacramento River. Natural geomorphic processes in the Delta have been highly modified by changes to upstream hydrology (reservoirs and streamflow regulation) and construction of levees, channels, and other physical features.

Since construction of Shasta Dam in the early 1940s, flood volumes on the river have been reduced, which has reduced the energy available for sediment transport. Straightening and a reduced rate of meander migration of the river may be associated with flow regulation because of Shasta Dam. The reduction in active channel dynamics is compounded by the physical effects of riprap bank protection structures, which typically eliminate shaded bank habitat and associated deep pools, and halt the natural processes of channel migration.

CVP/SWP Service Areas

Geomorphology in the CVP/SWP service areas is a product of the same factors mentioned above, which include geology, hydrology and climate, vegetation, and human activity. Geomorphology in the CVP service areas is summarized in the descriptions of the primary study area and the lower Sacramento River and Delta portions of the extended study area.

Geomorphology in the SWP service areas extends into the southern geomorphic provinces of California and along part of the coast. The southern geomorphic provinces and coastal province include the Transverse Ranges, Peninsular Ranges, Mojave Desert, and Coast Ranges. The Transverse Ranges, composed of overlapping mountain blocks, consist of parallel and subparallel ranges and valleys. The Peninsular Ranges Geomorphic Province is composed of northwest to southeast trending fault blocks, extending from the Transverse Ranges into Mexico. The Peninsular Ranges are similar to the Sierra Nevada in that they have a gentle westerly slope and generally consist of steep eastern faces. Mojave Desert Geomorphic Province topography is controlled by two faults: the San Andreas Fault, trending northwest to southeast, and the Garlock Fault, trending east to west (Jennings 1938). Before development of the Garlock Fault, sometime during the Miocene, the Mojave Desert was part of the Basin and Range Geomorphic Province. The Mojave Desert is now dominated by alluvial basins, which are aggrading surfaces from adjacent upland continental deposits (Norris and Webb 1990). The Coast Ranges have been greatly affected by plate tectonics. The Coast Ranges Geomorphic Province consists of elongate ranges and narrow valleys that run subparallel to the coast. Some of the mountain ranges along the Coast Range terminate abruptly at the sea (Norris and Webb 1990).

4.1.4 Mineral Resources

This section describes the known mineral resources of commercial or otherwise documented economic value in both the primary and extended study areas. The mineral resources of concern include metals and industrial minerals (e.g., aggregate, sand, and gravel, oil and gas, and geothermal resources that would be of value to the region).

Shasta Lake and Vicinity

The following section describes mineral resources in the Shasta Lake and vicinity portion of the primary study area.

Metals The lands within the Shasta Lake and Vicinity area are highly mineralized, with a history of significant mineral production. The Shasta Lake and vicinity area encompasses portions of two historic base metal mining districts, the west Shasta and east Shasta copper-zinc districts. The two districts focused on development of massive sulfide (Kuroko-Type) deposits of submarine volcanogenic origin that formed contemporaneously with, and by the same process as, the host volcanic rocks. Similar to other areas in the Klamath Mountains, copper was by far the predominant commodity produced. Zinc, sulfur, iron, limestone, gold, and silver were produced as byproducts of copper production.

The Golinsky mine complex is located in the west Shasta district, approximately 7 miles west of Shasta Dam in the headwaters of Dry Creek and Little Backbone Creek. This inactive, abandoned mine complex is the only large historic producing mine within the Shasta Unit of the National Recreation Area (NRA). Other mines within the Shasta NRA occur in the east Shasta district, concentrated between the McCloud and Squaw arms of Shasta Lake. The east Shasta district includes the Bully Hill, Copper City, and Rising Star mines, all of which are located in the Bully Hill area. These mines ceased operation before Shasta Dam was built.

These types of mineral deposits, in conjunction with the historic lode mining methods, have resulted in the discharge of toxic mine waste and acidic waters to Shasta Lake and some tributaries on a recurring basis (USFS 2000). The Golinsky mine complex has been subject to extensive remediation to reduce the discharge of toxic mine waste and acidic waters to Shasta Lake.

Industrial Minerals Industrial minerals occurring in the vicinity of the Shasta Lake include alluvial sand and gravel, crushed stone, volcanic cinders, limestone and diatomite. In 2002, Shasta County produced 462,000 tons of sand and gravel, 852,000 tons of crushed stone (including limestone), and 51,000 tons of volcanic cinders. Limestone used to produce portland cement and diatomite are not included in these figures.

The supply of portland cement concrete (PCC) grade alluvial sand and gravel within the region is more limited than non-PCC grade material. The primary

sources for alluvial sand and gravel near the Shasta Lake and vicinity area are the Sacramento River (downstream from Keswick Dam), Clear Creek, Cottonwood Creek, and Hat Creek. Crushed stone has been produced at a limestone quarry in Mountain Gate, a granite quarry in Keswick, an andesite quarry in Mountain Gate, a shale quarry in Oak Run, and at two basalt quarries in the Lake Britton area near Burney. Volcanic cinders are produced at sites east of the Shasta Lake and vicinity area.

Limestone is used in a variety of industrial applications, but the bulk of limestone is used for the production of portland cement concrete. Most of the limestone resources within and near the Shasta Lake and vicinity area are located in fairly remote mountainous areas where extraction is uneconomical. However, significant mining of limestone for PCC production occurs immediately south of Shasta Lake, in Mountain Gate. Diatomite is produced from sources near Lake Britton, east of the Shasta Lake and vicinity area.

Geothermal Resources Significant geothermal resources occur in the Medicine Lake Highlands, approximately 65 air miles northeast of Shasta Lake. The potential capacity at Medicine Lake overall has been estimated at 480 megawatts (PacifiCorp 2010). Development of the Medicine Lake geothermal resources has been the subject of extensive litigation of environmental issues and Native American concerns.

Upper Sacramento River (Shasta Dam to Red Bluff)

Economically viable minerals found within the upper Sacramento River portion of the primary study area consist of alluvial sand and gravel, crushed stone, volcanic cinders, limestone, and diatomite. Additional mineral resources are found in the surrounding regions within Shasta and Tehama Counties. These mineral resources include asbestos, barium, calcium, chromium, copper, gold, iron, lead, manganese, molybdenum, silver, and zinc (USGS 2005).

Lower Sacramento River and Delta

Economically viable minerals found within the lower Sacramento River and Delta portion of the extended study area consist of alluvial sand and gravel, crushed stone, calcium, and clay. Additional mineral resources are found in the surrounding regions, including chromium, gold, granite, lithium, manganese, mercury, pumice, and silver (USGS 2005).

CVP/SWP Service Areas

The U.S. Geologic Survey mineral resources database indicates that numerous minerals resources are currently mined or have been mined within the CVP/SWP service areas. These minerals include antimony, asbestos, barium, bismuth, boron, calcium, chromium, clay, copper, diatomite, feldspar, fluorite, gold, gypsum-anhydrite, halite, iron, lead, limestone, magnetite, manganese, marble, mercury, molybdenum, pumice, quartz, sand and gravel, silica, silver, slate, stone (crushed/broken), talc, tin, titanium, tungsten, uranium, and vanadium (USGS 2005).

4.1.5 Soils

Soils and erosion area are described below for both the primary and extended study areas. Soils in the project study area are described in the following sections in terms of their biomass productivity, susceptibilities to erosion, subsidence, liquefaction and expansion, and suitability for onsite application of waste material.

Soil biomass productivity is a measure of the capability of a site to produce biomass. The purpose of this management interpretation is to measure site productive capability when vegetative indicators (e.g., crop yields, site trees, and other vegetative biomass data) are not directly available (Miles 1999). Factors that influence soil biomass productivity include soil depth, parent material, available water-holding capacity, precipitation, soil temperature regime, aspect, and reaction (i.e., pH). Soil biomass productivity is characterized using four relative rankings: high, moderate, low, and nonproductive.

Susceptibility to erosion is characterized in terms of erosion hazard rating. The ratings indicate the hazards of topsoil loss in an unvegetated condition as might occur following disturbance by construction. Ratings are based on soil erosion factor K (a measure of the susceptibility of soil particles to detachment and transport by rainfall and runoff, based primarily on soil texture but also considering structure, organic matter, and permeability), slope, and content of rock fragments. Three ratings are recognized: slight, moderate, and severe. A rating of slight indicates that no post-disturbance acceleration of naturally occurring erosion is likely; moderate indicates that some acceleration of erosion is likely, and that simple erosion-control measures are needed; and severe indicates that significant erosion is expected, and that extensive erosion-control measures are needed.

Land subsidence is broadly defined to mean the sudden sinking or gradual downward settling of the land surface with little or no horizontal motion. Land subsidence can arise from a number of causes, including the weathering characteristics of the underlying bedrock (e.g., as occurs for certain limestone formations), decomposition of the organic matter fraction of soils that are derived from peaty or mucky parent materials, aquifer-system compaction, underground mining, and natural compaction. Three processes account for most instances of water-related subsidence: compaction of aquifer systems, drainage and subsequent oxidation of organic soils, and dissolution and collapse of susceptible rocks.

Soil liquefaction is a phenomenon in which the strength and stiffness of a soil is reduced by earthquake shaking or other rapid loading. Liquefaction occurs in saturated soils when the pore spaces between individual soil particles are completely filled with water. This water exerts a pressure on the soil particles that influences how tightly the particles themselves are pressed together. Before an earthquake, the water pressure is relatively low. However, earthquake

shaking can cause the water pressure to increase to the point where the soil particles can readily move with respect to each other. When liquefaction occurs, the strength of soils decrease, and the ability of soils to support foundations for buildings and bridges are reduced.

Expansive soils are soils that contain water absorbing minerals, mainly "active" clays (e.g., montmorillonite). Such soils may expand by 10 percent or more when wetted. The cycle of shrinking and expanding exerts continual pressure on structures, and over time can reduce structural integrity. Soil susceptibility to expansion (i.e., shrinking and swelling) is tested using Uniform Building Code Test Standard 18-1.

Soil suitability for onsite application of waste material focuses on the suitability of the soil to support the use of septic tanks or alternative wastewater disposal systems. Suitability interpretations are based on consideration of soil depth, permeability, rock content, depth to groundwater (including seasonally perched water), and slope.

Shasta Lake and Vicinity

Soils in the Shasta Lake and vicinity area derive from materials weathered from metavolcanic and metasedimentary rocks and from intrusions of granitic rocks, serpentine, and basalt. Soils derived from the metavolcanic sources, such as greenstone, include the Goulding and Neuns families. Soils derived from metasedimentary materials include the Marpa family. Holland family soils are derived from metasedimentary and granitic rocks.

In general, metamorphosed rocks do not weather rapidly, and shallow soils are common in the subarea, especially on steep landscape positions. Soils from metamorphosed rocks generally contain large percentages of coarse fragments (e.g., gravels, cobbles, stones), which reduce their available water holding capacity and topsoil productivity. Granitic rocks may weather deeply, but soils derived from them may be droughty due to high amounts of coarse quartz grains and low content of "active" clay. Soils derived from granitic rocks commonly are highly susceptible to erosion.

Soil map units in the Shasta Lake and vicinity area are shown in Figure 4-7. The mapping legend that accompanies Figure 4-7 is presented in Table 4-8. The areal extent of soil map units within the Shasta Lake and vicinity area is presented in Table 4-9 for the portion of the subarea between 1,070 feet and 1,090 feet above msl (Impoundment Area); and in Table 4-10 for the portion of the subarea potentially disturbed by construction activities (Relocation Areas). Sixty soil map units, comprised of soil families and miscellaneous land types (e.g., rock outcrop, limestone) are recognized to occur in the subarea. Common soil families are Marpa, Neuns, Goulding, and Holland. These are well-drained soils with fine loamy or loamy-skeletal (i.e., gravelly or cobbly) profiles.

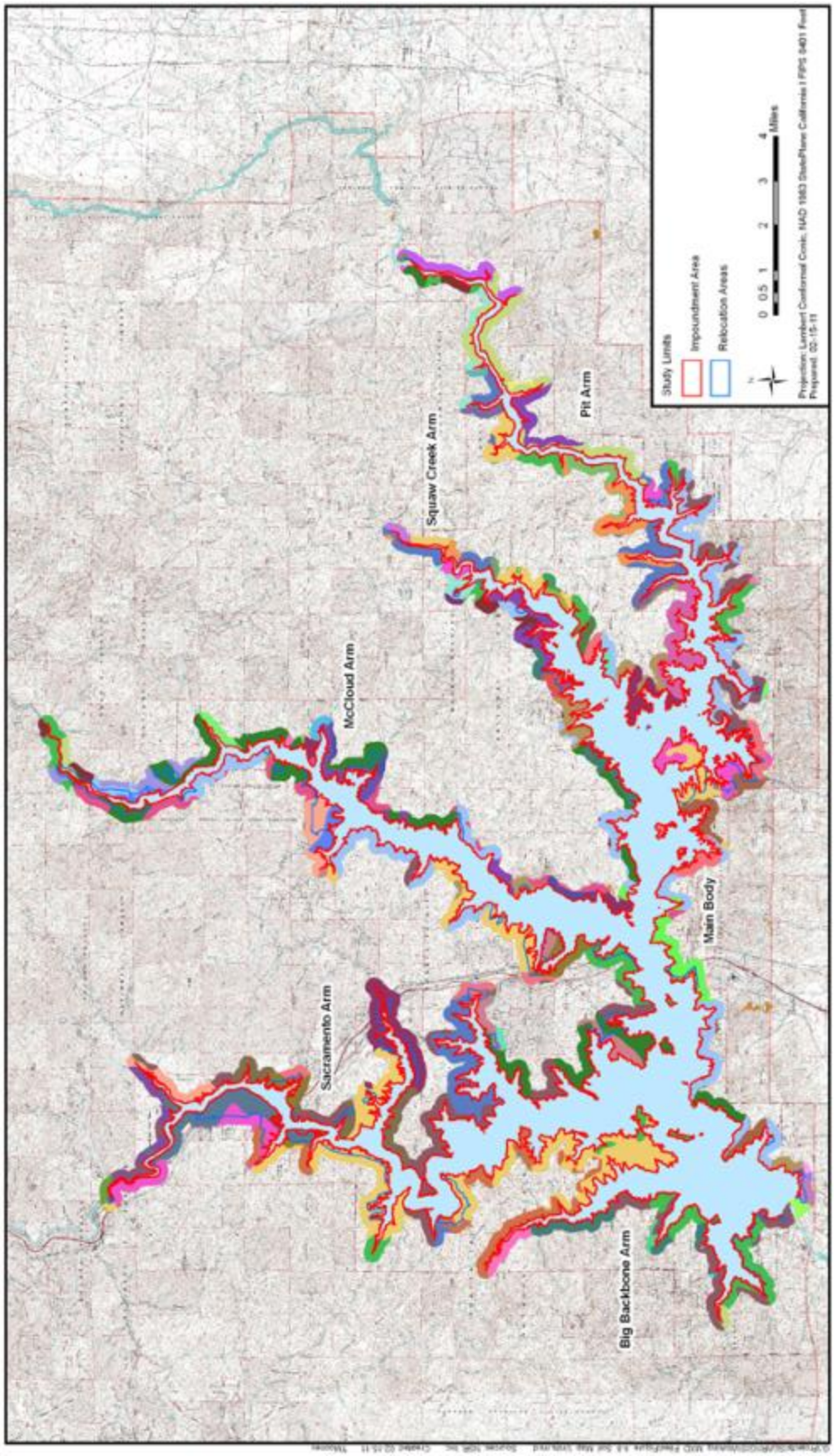


Figure 4-7. Soil Map Units – Shasta Lake and Vicinity

Table 4-8. Key to Soil Map Units – Shasta Lake and Vicinity



Table 4-8. Key to Soil Map Units – Shasta Lake and Vicinity (contd.)

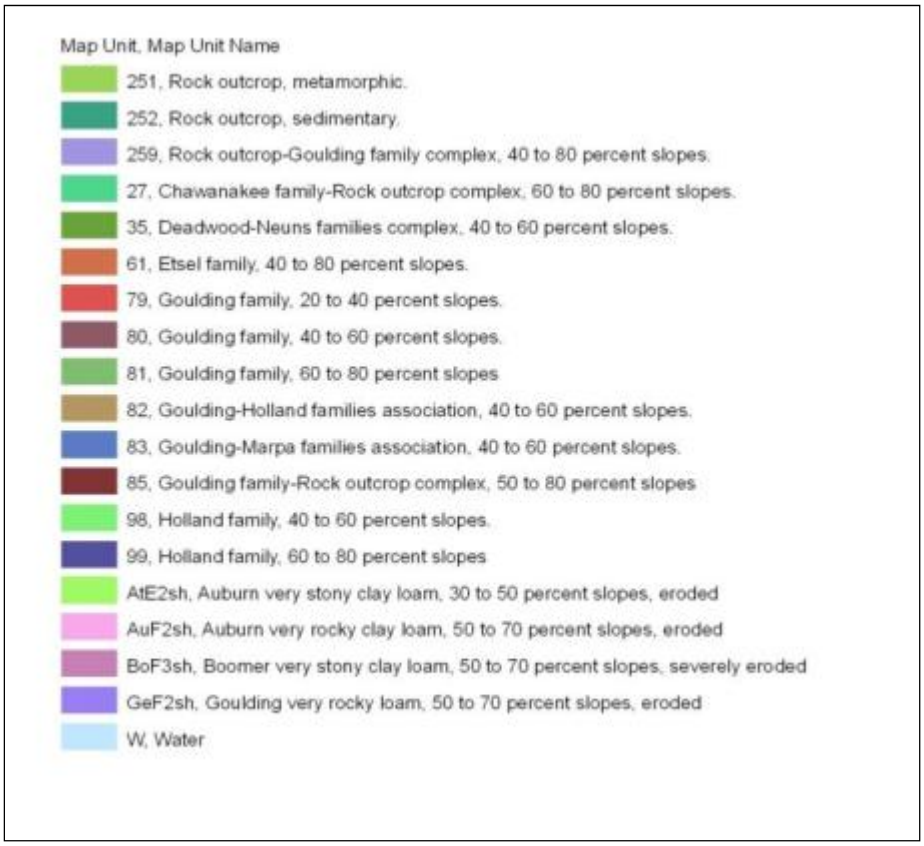


Table 4-9. Areal Extent of Soil Map Units – Shasta Lake and Vicinity (Impoundment Area)

Map Unit	Map Unit Name	Study Area (acres)	Study Area (% Total Sub-Area)
18	Chaix family, 40-60% slopes	43.6	1.75%
27	Chawanakee family-Rock outcrop complex, 60-80% slopes	0.8	0.03%
35	Deadwood-Neuns families complex, 40-60% slopes	2.5	0.10%
61	Etsel family, 40-80% slopes	39.4	1.58%
79	Goulding family, 20-40% slopes	32.0	1.28%
80	Goulding family, 40-60% slopes	153.1	6.13%
81	Goudling family, 60-80% slopes	7.3	0.29%
82	Goulding-Holland families association, 40-60% slopes	45.3	1.81%
83	Goulding-Marpa families association, 40-60% slopes	118.5	4.74%
85	Goulding family-Rock outrcrop complex, 50-80% slopes	10.8	0.43%
98	Holland family, 40-60% slopes	3.6	0.14%
99	Holland family, 60-80% slopes	8.4	0.34%
101	Holland-Goulding families association, 20-40% slopes	66.5	2.66%

Table 4-9. Areal Extent of Soil Map Units – Shasta Lake and Vicinity (Impoundment Area) (contd.)

Map Unit	Map Unit Name	Study Area (acres)	Study Area (% Total Sub-Area)
102	Holland-Goulding families association, 40-60% slopes	145.0	5.80%
103	Holland-Goulding families association, 60-80% slopes	4.6	0.18%
104	Holland family-Holland family, deep complex, 20-40% slopes	60.6	2.43%
105	Holland family-Holland family, deep complex, 40-60 % slopes	215.3	8.62%
109	Holland family, ashy, 0-22% slopes	0.1	0.00%
111	Holland, ashy-Leadmount families association, 0-20% slopes	93.4	3.74%
114	Holland, ashy-Washougal families complex, 25-65% slopes	6.2	0.25%
115	Holland family, deep, 0-20% slopes	38.6	1.54%
116	Holland family, deep, 20-40% slopes	8.5	0.34%
117	Holland family, deep, 40-60% slopes	32.1	1.29%
119	Holland family, deep-Holland families complex 20-40% slopes	111.5	4.46%
120	Holland family, deep-Holland family complex, 40-60% slopes	70.4	2.82%
123	Holland, deep-Marpa families complex, 20-40% slopes	66.7	2.67%
127	Holland, deep Neuns families complex, 40-60% slopes	4.1	0.16%
133	Hugo family, 60-80% slopes	5.2	0.21%
139	Hugo-Neuns families complex, 60-80% slopes	4.3	0.17%
174	Marpa family, 20-40% slopes	28.2	1.13%
175	Marpa family, 40-60% slopes	28.4	1.14%
177	Marpa-Chawanakee families complex, 40-60% slopes	47.1	1.89%
178	Marpa-Goulding families association, 20-40% slopes	74.7	2.99%
179	Marpa-Goulding families association, 40-60% slopes	309.8	12.40%
180	Marpa-Goulding families association, 60-80% slopes	10.2	0.41%
182	Marpa-Holland, deep families complex, 20-40% slopes	89.1	3.57%
183	Marpa-Holland, deep families complex, 40-60% slopes	162.4	6.50%
187	Marpa-Neuns families complex, 40-60% slopes	5.6	0.22%
188	Marpa-Neuns families complex, 60-80% slopes	0.2	0.01%
195	Millsholm family, 20-60% slopes	39.7	1.59%
203	Neuns family, 40-60% slopes	7.6	0.30%
204	Neuns family, 60-80% slopes	43.5	1.74%
209	Neuns-Goulding families association, 60-80% slopes	1.7	0.07%
214	Neuns-Holland, deep families complex, 40-80% slopes	8.5	0.34%
218	Neuns-Marpa families complex, 40-60% slopes	1.1	0.04%
219	Neuns-Marpa families complex, 60-80% slopes	23.9	0.96%
250	Rock outcrop, limestone	9.3	0.37%
251	Rock outcrop, metamorphic	0.0	0.00%
259	Rock outcrop-Goulding family complex, 40-80% slopes	0.5	0.02%
AtE2sh	Auburn very stony clay loam, 30-50% slopes, eroded	0.1	0.01%
BoF3sh	Boomer very stony clay loam, 50-70% slopes, severely eroded	7.4	0.30%
W	Water	200.7	8.03%

Table 4-10. Areal Extent of Soil Map Units – Shasta Lake and Vicinity (Relocation Areas)

Map Unit	Map Unit Name	Study Area (acres)	Study Area (% Total Sub-Area)
18	Chaix family, 40-60% slopes	48.6	1.46%
35	Deadwood-Neuns families complex, 40-60% slopes	1.5	0.04%
61	Etsel family, 40-80% slopes	42.2	1.26%
79	Goulding family, 20-40% slopes	50.4	1.51%
80	Goulding family, 40-60% slopes	179.3	5.37%
82	Goulding-Holland families association, 40-60% slopes	13.9	0.42%
83	Goulding-Marpa families association, 40-60% slopes	6.6	0.20%
85	Goulding family-Rock outrcrop complex, 50-80% slopes	14.6	44.00%
102	Holland-Goulding families association, 40-60% slopes	280.0	8.38%
103	Holland-Goulding families association, 60-80% slopes	2.0	0.06%
104	Holland family-Holland family, deep complex, 20-40% slopes	79.1	2.37%
105	Holland family-Holland family, deep complex, 40-60 % slopes	170.9	5.12%
109	Holland family, ashy, 0-22% slopes	1.1	0.03%
111	Holland, ashy-Leadmount families association, 0-20% slopes	533.6	15.98%
114	Holland, ashy-Washougal families complex, 25-65% slopes	1.5	0.05%
115	Holland family, deep, 0-20% slopes	120.0	3.59%
117	Holland family, deep, 40-60% slopes	71.2	2.13%
119	Holland family, deep-Holland families complex 20-40% slopes	163.5	4.90%
120	Holland family, deep-Holland family complex, 40-60% slopes	28.6	0.86%
123	Holland, deep-Marpa families complex, 20-40% slopes	86.8	2.60%
174	Marpa family, 20-40% slopes	150.5	4.51%
175	Marpa family, 40-60% slopes	17.0	0.51%
177	Marpa-Chawanakee families complex, 40-60% slopes	3.1	0.09%
178	Marpa-Goulding families association, 20-40% slopes	107.6	3.22%
179	Marpa-Goulding families association, 40-60% slopes	545.8	16.34%
180	Marpa-Goulding families association, 60-80% slopes	11.7	0.35%
182	Marpa-Holland, deep families complex, 20-40% slopes	247.0	7.40%
183	Marpa-Holland, deep families complex, 40-60% slopes	167.2	5.01%
195	Millsholm family, 20-60% slopes	36.7	1.10%
204	Neuns family, 60-80% slopes	19.4	0.58%
250	Rock outcrop, limestone	43.3	1.30%
259	Rock outcrop-Goulding family complex, 40-80% slopes	20.1	0.60%
AtE2sh	Auburn very stony clay loam, 30-50% slopes, eroded	2.7	0.08%
BoF3sh	Boomer very stony clay loam, 50-70% slopes, severely eroded	43.6	1.30%
W	Water	28.6	0.86%

Soil Biomass Productivity Soil biomass productivity in the Shasta-Trinity National Forest (STNF) ranges from nonproductive to high (USFS 1994). Using Forest Service Site Class (FSSC) as a surrogate metric for soil biomass productivity, approximately 36 percent of the study area is occupied by soils of low biomass productivity, about 39 percent of the area is occupied by soils of moderate productivity, and about 13 percent is occupied by "nonproductive" soils and miscellaneous land types (e.g., rock outcrop). Soils of high biomass productivity are unlikely to occur in the Shasta Lake and vicinity area.

Soil Susceptibility to Erosion (Uplands) Interpretations of soil susceptibility to erosion are presented in Table 4-11 for the portion of the subarea between 1,070 feet and 1,090 feet above msl (Impoundment Area); and in Table 4-12 for the portion of the subarea potentially disturbed by construction activities. Of the approximately 5,837 acres in the Shasta Lake and vicinity area, 5,377 acres (92 percent of total area) are assigned a hazard rating of severe.

Table 4-11. Summary of Soil Erosion Hazard – Shasta Lake and Vicinity (Impoundment Area)

Soil Erosion Hazard	Study Area (acres)	Study Area (% Total Sub-Area)
Moderate	38.55	1.54%
Severe	2248.81	90.03%
Not Rated	210.00	8.41%

Table 4-12. Summary of Soil Erosion Hazard – Shasta Lake and Vicinity (Relocation Areas)

Soil Erosion Hazard	Study Area (acres)	Study Area (% Total Sub-Area)
Moderate	119.97	3.59%
Severe	3127.62	93.65%
Not Rated	92.01	2.76%

Soil Susceptibility to Erosion (Shoreline) There are more than 420 miles of shoreline around Shasta Lake. As described below under Methods and Assumptions, a conceptual model was developed to quantify current erosion rates and predict future erosion rates (see Attachment 1, Shoreline Erosion Technical Memorandum).

Based on the model output, about 50 percent of the shoreline has a low erosion severity. The remaining shoreline has moderate (35 percent) to high (15 percent) erosion severity. Most of the shoreline that is exposed during routine drawdown periods (i.e., drawdown zone) has been subject to substantial erosion, and very little soil remains after more than 60 years of reservoir operations.

Soil Susceptibility to Subsidence Published interpretations of soil susceptibility to subsidence are generally not available for the Shasta Lake and vicinity area. The likelihood that subsidence would occur due to decomposition of soil organic matter is low due to the absence of soils derived from peaty or mucky parent materials. Similarly, the likelihood of subsidence due to aquifer-system compaction is low due to the absence of significant, widespread groundwater withdrawal in the Shasta Lake and vicinity area. Land subsidence has potential to occur in areas underlain by highly-weatherable, carbonate-rich rocks (e.g., certain limestones), and in areas affected by underground construction.

Soil Susceptibility to Liquefaction Published interpretations of soil susceptibility to liquefaction are generally not available for the Shasta Lake and vicinity area. The likelihood that soil liquefaction would occur is low because of the absence of the necessary high groundwater conditions in the Shasta Lake and vicinity area.

Soil Susceptibility to Expansion Published interpretations of soil susceptibility to expansion (i.e., shrinking and swelling) are generally not available for most of the Shasta Lake and vicinity area. The likelihood that expansive soils occur is low because the weathering products derived from the local bedrock typically contain low concentrations of "active" clays (e.g., montmorillonite).

Soil Suitability for Onsite Application of Waste Material Published interpretations of soil suitability for onsite application of waste material (i.e., capability to support use of septic tanks or alternative wastewater disposal systems) are generally not available for the Shasta Lake and vicinity area. In general, soils in the Shasta Lake and vicinity area are poorly suited to these uses due to shallow soil depth, high rock content, and excessive slope.

Upper Sacramento River (Shasta Dam to Red Bluff)

The following section describes soil susceptibility to erosion (channel shoreline), soil susceptibility to erosion (wind), soil susceptibility to subsidence, soil susceptibility to liquefaction, and soil susceptibility to expansion in the upper Sacramento River portion of the primary study area.

Soils in the Sacramento River Basin are divided into four physiographic groups: upland soils, terrace soils, valley land soils, and valley basin soils. Upland soils are prevalent in the hills and mountains of the region and are composed mainly of sedimentary sandstones, shales, and conglomerates originating from igneous rocks. Terrace and upland soils are predominant between Redding and Red Bluff; however, valley land soils border the Sacramento River through this area. Valley land and valley basin soils occupy most of the Sacramento Valley floor south of Red Bluff. Valley land soils consist of deep alluvial and aeolian soils that make up some of the best agricultural land in the State. The valley floor was once covered by an inland sea, and sediments were formed by deposits of

marine silt followed by mild uplifting earth movements. After the main body of water disappeared, the Sacramento River began eroding and redepositing silt and sand in new alluvial fans.

Soil Susceptibility to Erosion (Channel Shoreline) Shasta and Keswick Dams have a significant influence on sediment transport in the Sacramento River because they block sediment that would normally be transported downstream. The result has been a net loss of coarse sediment, including salmon spawning gravels, in the Sacramento River below Keswick Dam. In alluvial river sections, bank erosion and sediment deposition cause river channel migrations that are vital to maintaining instream and riparian habitats, but which can cause loss of agricultural lands and damage to roads and other structures.

Soil Susceptibility to Erosion (Wind) Soil erodibility, climatic factors, soil surface roughness, width of field, and quantity of vegetative coverage affect the susceptibility of soils to wind erosion. Wind erosion leaves the soils shallower and can remove organic matter and needed plant nutrients. In addition, blowing soil particles can damage plants, particularly young plants. Blowing soils also can cause off-site problems such as reduced visibility and increased allergic reaction to dust.

Soil Susceptibility to Subsidence Land subsidence in the Sacramento Valley is localized and concentrated in areas of overdraft from groundwater pumping. Land subsidence had exceeded 1 foot by 1973 in two main areas in the southwestern part of the valley near Davis and Zamora; however, additional subsidence since then has not been reported.

Soil Susceptibility to Expansion Most of Shasta County is characterized by moderately expansive soils with areas of low expansiveness in the South Central Region and southeastern corner of the county. Small scattered areas of highly expansive soils exist in the mountains of the Western Upland, French Gulch, and North East Shasta County planning areas. The hazard associated with expansive soils is that areas of varying moisture or soil conditions can differentially expand or shrink, causing stresses on structures that lead to cracking or settling. Effects of expansive soils on structures can be mitigated through requiring proper engineering design and standard corrective measures.

Lower Sacramento River and Delta

The following section describes soil susceptibility to erosion (channel shoreline), soil susceptibility to erosion (wind), soil susceptibility to subsidence, soil susceptibility to liquefaction, and soil susceptibility to expansion in the lower Sacramento River and Delta portion of the extended study area.

The soils of the Sacramento River basin are divided into four physiographic groups, as described above for the upper Sacramento River portion of the study area.

The soils of the Delta region vary primarily as a result of differences in geomorphological processes, climate, parent material, biological activity, topography, and time. The soils are divided into the following four general soil types:

- Delta organic soils and highly organic mineral soils
- Sacramento River and San Joaquin River deltaic soils
- Basin and basin rim soils
- Moderately well to well-drained valley, terrace, and upland soils

The Delta region contains soils primarily with the required physical and chemical soil characteristics, growing season, drainage, and moisture supply necessary to qualify as Prime Farmland. This includes 80 to 90 percent of the area of organic and highly organic mineral soils, Sacramento River and San Joaquin River deltaic soils, and basin and basin rim soils. Most of the remaining soils of the Delta region qualify as farmland of statewide importance.

Soil Susceptibility to Erosion (Channel Shoreline) The extended study area downstream from the Red Bluff Diversion Dam along the Sacramento River is a major alluvial river section that is active and sinuous, meandering across alluvial deposits within a wide meander belt. In alluvial river sections, bank erosion and sediment deposition cause migrations of the river channel that are extremely important in maintaining instream and riparian habitats, but also can cause loss of agricultural lands and damage to roads and other structures. Geologic outcroppings and man-made structures, such as bridges and levees, act as local hydraulic controls along the river. Bank protection, consisting primarily of rock riprap, has been placed along various sections of the Sacramento River to reduce erosion and river meandering.

The great quantities of sediment transported by the rivers into the Delta move primarily as suspended load. Of the estimated 5 million tons per year of sediment inflow into the Delta, about 80 percent originates from the Sacramento River and San Joaquin River drainages; the remainder is contributed by local streams. Approximately 15 percent to 30 percent of the sediment is deposited in the Delta; the balance moves into the San Francisco Bay system or out through CVP and SWP facilities.

Soil Susceptibility to Erosion (Wind) The Delta organic soils and highly organic mineral soils have wind erodibility ratings of 2 to 4 on a scale where 1 is most erodible and 8 is least erodible. The high wind erodibility of Delta soils is caused by the organic matter content of the soil. The rate of wind erosion is estimated at 0.1 inches per year.

Soil Susceptibility to Subsidence Subsidence of the Delta's organic soils and highly organic mineral soils is attributable primarily to biochemical oxidation of organic soil material as a result of long-term drainage and flood protection. The highest rates of subsidence occur in the central Delta islands, where organic matter content in the soils is highest.

Development of the islands resulted in subsidence of the island interiors and greater susceptibility of the topsoil to wind erosion. Subsidence, as it relates to Delta islands, refers generally to the falling level of the land surface from primarily the oxidation of peat soil. Levee settlement may be partially caused by peat oxidation if land adjacent to levees is not protected from subsidence.

Soil Susceptibility to Expansion Soils within the lower Sacramento River and Delta portion of the extended study area vary from having low to high shrink-swell potential. In general, soils in the narrow corridor upstream along the Sacramento River have low shrink-swell potential according the United States Department of Agriculture's State Soil Geographic (STATSGO) Database Soil Surveys, with the exception of some soils with moderate shrink-swell potential near the Red Bluff Diversion Dam (USDA 1995). Downstream, the shrink-swell potential of soils near the Delta is generally classified by the STATSGO Soil Surveys as "high." The hazard associated with expansive soils is that areas of varying moisture or soil conditions can differentially expand or shrink, causing stresses on structures that lead to cracking or settling. This hazard is identifiable through standard soil tests. Its effects on structures can be mitigated through the requirements of proper engineering design and standard corrective measures.

CVP/SWP Service Areas

As described above for the upper Sacramento River portion of the primary study area, soils in the CVP/SWP service areas are divided into four physiographic groups: valley land, valley basin, terrace land, and upland soils. According to the U.S. Department of Agriculture's STATSGO Database, soils within the CVP/SWP service areas consist of clay, loam, silt, and sand, some of which is gravelly. The CVP/SWP service areas also consist of unweathered and weathered bedrock that is evident through outcrops at the ground surface (USDA 1995).

4.2 Regulatory Framework

The following section describes the Federal, State, and local regulatory setting for geological resources.

4.2.1 Federal

This section discusses the Federal regulatory setting for water quality, runoff, air quality, earthquakes, paleontological resources, and natural resources.

Clean Water Act

The Clean Water Act (CWA) includes provisions for reducing soil erosion for the protection of water quality. The CWA made it unlawful for any person to discharge pollutants from a point source (including construction sites), into navigable waters, unless a permit was obtained under its provisions. This pertains to construction sites where soil erosion and storm runoff and other pollutant discharges could affect downstream water quality.

National Pollutant Discharge Elimination System

The National Pollutant Discharge Elimination System process, established by the CWA, is intended to meet the goal of preventing or reducing pollutant runoff. Projects involving construction activities (e.g., clearing, grading, or excavation) with land disturbance greater than 1 acre must file a Notice of Intent with the applicable Regional Water Quality Control Board (RWQCB) to indicate the intent to comply with the State General Permit for Storm Water Discharges Associated with Construction Activity (General Permit). This permit establishes conditions to minimize sediment and pollutant loading and requires preparation and implementation of a Storm Water Pollution Prevention Plan before construction.

Clean Air Act

The Clean Air Act also has provisions for reducing soil erosion relevant to air and water quality. On construction sites, exposed soil surfaces are vulnerable to wind erosion, and small soil particulates are carried into the atmosphere. Suspended particulate matter (PM10 and PM2.5) is one of the six criteria air pollutants of the Clean Air Act.

Earthquake Hazards Reduction Act

In October 1977, the U.S. Congress passed the Earthquake Hazards Reduction Act to "reduce the risks to life and property from future earthquakes in the United States through the establishment and maintenance of an effective earthquake hazards and reduction program." To accomplish this, the act established the National Earthquake Hazards Reduction Program. The National Earthquake Hazards Reduction Program Act (NEHRPA) significantly amended this program in November 1990 by refining the description of agency responsibilities, program goals, and objectives. The NEHRPA designates the Federal Emergency Management Agency as the lead agency of the program and assigns it several planning, coordinating, and reporting responsibilities. Other NEHRPA agencies include the National Institute of Standards and Technology, the National Science Foundation, and U.S. Geologic Survey.

Antiquities Act of 1906

Federal protection for significant paleontological resources would apply to the project if any construction or other related project impacts occurred on Federally owned or managed lands. Federal legislative protection for paleontological resources stems from the Antiquities Act of 1906 (Public Law 59-209; 16 United States Code 431 et seq.; 34 Stat. 225), which calls for

protection of historic landmarks, historic and prehistoric structures, and other objects of historic or scientific interest on federal land.

Shasta-Trinity National Forest Land and Resource Management Plan

The STNF Land and Resource Management Plan (LRMP) (USFS 1995) contains forest goals, standards, and guidelines designed to guide the management of the STNF. The following goals, standards, and guidelines related to geologic and seismic hazards and soils issues associated with the study area were excerpted from the STNF LRMP.

- Goals (LRMP, p. 4-5):
  - Maintain or improve soil productivity and prevent excessive surface erosion, mass wasting, and cumulative watershed impacts.
- Standard and Guidelines (LRMP, p. 4-25):
  - Determine the sensitivity of each 2nd or 3rd order watershed using soil, geologic, and streamflow characteristics.
  - Implement Forest Soil Quality Standards and Best Management Practices for areas identified as having highly erodible soils. Specifically, apply the special practices dealing with timber harvest, site preparation, and road construction in highly erodible soils.
  - Forest Soil Quality Standards in relation to ground cover, soil organic matter, and soil porosity will be used to protect soil productivity (as referenced in Appendix O of the LRMP).1/Environmental Consequences/Impacts and Mitigation Measures

Bureau of Land Management Resource Management Plan

The Bureau of Land Management's (BLM) Resource Management Plan, which is its plan for managing federal lands in Shasta County, was amended by the 1994 Record of Decision for the Northwest Forest Plan (Final Supplemental Environmental Impact Statement for Amendments to Forest Service and Bureau of Land Management Planning Documents within the Range of the Northern Spotted Owl). This amendment required preparation of watershed analyses prior to initiating BLM activities. As a party to the Northwest Forest Plan, BLM, like the USFS, is also required to ensure that projects are consistent with the Aquatic Conservation Strategy.

Federal Minerals Management

Mineral development is permitted on all public lands not withdrawn from mineral entry. The U.S. Mining Laws (30 United States Codee 21-54) confer statutory right to enter upon public lands in search of minerals. Regulations found in 36 Code of Federal Regulations 228, Subpart A, set forth rules and

procedures to minimize adverse environmental impacts on national forest resources. Access for mineral exploration and development is generally unrestricted, subject to the mitigation of adverse impacts to surface resources.

Access for mineral exploration on STNF land is restricted in wildernesses, the "wild" portions of Wild and Scenic Rivers, botanical areas, Research Natural Areas, NRAs, and areas that have been withdrawn from mineral entry. Minerals in the NRA are not locatable (minerals that may be acquired under the Mining Law of 1872, as amended) but they are leasable (USFS 1994).

Access for mineral-related activities to wilderness, the NRA, and other lands typically withdrawn from mineral entry is subject to valid existing rights. The type of access authorized must be consistent with the proposed use and of a type that would maintain the special character of the areas to the fullest extent possible.

The Federal lands within the Shasta Unit of the NRA were withdrawn from mineral entry under the 1872 Mining Law by the NRA legislation, subject to valid existing rights. Five claims in the Shasta NRA predate the withdrawal. Currently, there are no approved operating plans for these five mining claims.

4.2.2 State

This section discusses the State regulatory setting for soil erosion, water quality, earthquakes, mining, air quality (related to asbestos) paleontological resources, and building design.

Porter-Cologne Act

State regulations, including the Porter-Cologne Act and Fish and Game Code 1600, have provisions to reduce soil erosion. The Porter-Cologne Act established the State Water Resources Control Board and nine RWQCBs that regulate water quality. The RWQCBs carry out the National Pollutant Discharge Elimination System permitting process for point source discharges and the CWA Section 401 certification program.

Fish and Game Code 1600

Fish and Game Code 1600 requires notification for projects that are planned to occur in, or in close proximity to, a river, stream, or lake, or their tributaries. Applicants are to enter into a "streambed alteration agreement" with DFG when a construction activity would (1) divert, obstruct, or change the natural flow or the bed, channel, or bank of any river, stream, or lake, (2) use material from a streambed, or (3) result in the disposal of debris, waste, or other material containing crumbled, flaked, or ground pavement that could pass into a river, stream, or lake. The Federal Government is not required to submit a Fish and Game code 1600 permit; however, the same impacts will be addressed under CWA Section 401 and 404 permits.

Alquist-Priolo Earthquake Fault Zoning Act

The Alquist-Priolo Earthquake Fault Zoning Act (Public Resources Code Section 2621 et seq.) was passed by the California Legislature to mitigate the hazard of surface faulting to structures. The act's main purpose is to prevent the construction of buildings used for human occupancy on the surface trace of active faults. The act addresses only the hazard of surface fault rupture and is not directed toward other earthquake hazards. Local agencies must regulate most development in fault zones established by the State Geologist. Before a project can be permitted in a designated Alquist-Priolo Earthquake Fault Zone, cities and counties must require a geologic investigation to demonstrate that proposed buildings would not be constructed across active faults.

1990 Seismic Hazards Mapping Act

The 1990 Seismic Hazards Mapping Act (California Public Resources Code Sections 2690-2699.6) addresses strong ground shaking, liquefaction, landslides, or other ground failures as a result of earthquakes. This act requires statewide identification and mapping of seismic hazard zones, which would be used by cities and counties to adequately prepare the safety element of their general plans and protect public health and safety (California Geological Survey 2003). Local agencies are also required to regulate development in any seismic hazard zones, primarily through permitting. Permits for development projects are not issued until geologic investigations have been completed and mitigation measures have been developed to address identified issues.

Surface Mining and Reclamation Act of 1975

The Surface Mining and Reclamation Act of 1975 (California Public Resources Code Sections 2710 et seq.) addresses surface mining and requires mitigation to reduce adverse impacts to public health, property, and the environment. Surface Mining and Reclamation Act applies to anyone (including a government agency) that disturbs more than 1 acre or removes more than 1,000 cubic yards of material through surface mining activities, even if activities occur on Federally managed lands (CDC 2006b). Local city and county "lead agencies" develop ordinances for permitting that provide the regulatory framework for mining and reclamation activities. The permit generally includes a permit to mine, a reclamation plan to return the land to a useable condition, and financial reports to ensure reclamation would be feasible. The State Mining and Geology Board reviews lead agency ordinances to ensure they comply with Surface Mining and Reclamation Act (CDC 2006b).

Asbestos Airborne Toxic Control Measure for Construction, Grading, Quarrying, and Surface Mining Operations

The Asbestos Airborne Toxic Control Measure for Construction, Grading, Quarrying, and Surface Mining Operations (see Title 17 California Code of Regulations (CCR) Section 93105) (CCR 2001a) contains the requirements for construction operations that would disturb any portion of an area that is located in a geographic ultramafic rock unit or that has naturally occurring asbestos, serpentine, or ultramafic rock. Construction or grading operations on property

where the area to be disturbed is greater than 1 acre require an Asbestos Dust Mitigation Plan to be submitted and approved by the air quality management district before the start of construction. The Asbestos Dust Mitigation Plan must be implemented at the beginning and must be maintained throughout the operation. To receive an exemption from this Asbestos Airborne Toxic Control Measure, a State registered professional geologist must conduct a geologic evaluation of the property and determine that no serpentine or ultramafic rock is likely to be found in the area to be disturbed. This report must be presented to the executive officer or air pollution control officer of the air pollution control or air quality management district, who may then grant or deny the exemption.

Asbestos Airborne Toxic Control Measure for Surfacing Applications

The Asbestos Airborne Toxic Control Measure for Surfacing Applications (17 CCR Section 93106) applies to any person who produces, sells, supplies, offers for sale or supply, uses, applies, or transports any aggregate material extracted from property where any portion of the property is located in a geographic ultramafic rock unit or the material has been determined to be ultramafic rock, or serpentine, or material that has an asbestos content of 0.25 percent or greater. Unless exempt, the use, sale, application, or transport of material for surfacing is restricted, unless it has been tested using an approved asbestos bulk test method and determined to have an asbestos content that is less than 0.25 percent. Any recipient of such materials may need to be provided a receipt with the quantity of materials, the date of the sale, verification that the asbestos content is less than 0.25 percent, and a warning label. Anyone involved in the transportation of the material must keep copies of all receipts with the materials at all times.

California Public Resources Code Chapter 1.7

No State or local agency requires a paleontological collecting permit to allow for the recovery of fossil remains discovered as a result of construction-related earthmoving on State or private land in a project site. California Public Resources Code Chapter 1.7 (Archaeological, Paleontological, and Historical Sites), Section 5097.3, specifies that State agencies may undertake surveys, excavations, or other operations as necessary on State lands to preserve or record paleontological resources.

California Building Standards Code

The State of California provides minimum standards for building design through the California Building Standards Code (CBC) (CCR 2001b). Where no other building codes apply, Chapter 29 regulates excavation, foundations, and retaining walls. The CBC also applies to building design and construction in the State and is based on the Federal Uniform Building Code used widely throughout the country (generally adopted on a state-by-state or district-by-district basis). The CBC has been modified for California conditions with numerous more detailed and/or more stringent regulations.

The State's earthquake protection law (California Health and Safety Code Section 19100 et seq.) requires that structures be designed to resist stresses produced by lateral forces caused by wind and earthquakes. Specific minimum seismic safety and structural design requirements are set forth in Chapter 16 of the CBC. The CBC identifies seismic factors that must be considered in structural design.

Chapter 18 of the CBC regulates the excavation of foundations and retaining walls, and Appendix Chapter A33 regulates grading activities, including drainage and erosion control, and construction on unstable soils such as expansive soils and liquefaction areas.

4.2.3 Regional and Local

The following section describes the regional and local regulatory setting for geological resources.

County General Plans

Section 65302(g) of the California Government Code requires that county general plans include an element that identifies and appraises seismic and geologic hazards.

Seismic hazards that must be addressed in this section include the following:

- Surface faulting
- Ground shaking
- Ground failure

Non-seismic hazards addressed include the following:

- Volcanoes
- Erosion
- Expansive soils

Local Guiding Ordinances

In addition to identifying and appraising seismic and geologic hazards, counties and municipalities in the project study area also commonly set requirements for grading and erosion control, including prevention of sedimentation or damage to off-site property. Usually these requirements are established via a grading ordinance, which is administered through issuance of grading permits. Grading permits typically require a vested map and the following information:

- Detailed grading plan
- Geological studies if located within an area prone to slippage, having highly erodible soils, or of known geologic hazards

- Detailed drainage or flood control information as required by the department of public works
- Final plan for development if the project is located in a zone district that requires a final development plan
- Noise analysis if the project is located in the vicinity of a high noise generating use

4.3 Environmental Consequences and Mitigation Measures

This chapter is organized by the project alternatives described in Chapter 1, Affected Environment, and discusses environmental consequences to geology, geologic hazards, geomorphology, minerals, and soils associated with implementation of the project alternatives. It also describes potential mitigation measures associated with impacts to geology that are significant or potentially significant.

4.3.1 Methods and Assumptions

In general, the analysis presented in this section is qualitative and is based on general information on geology, geologic hazards, geomorphology, minerals, and soils, as reported in Section 4.1. Environmental consequences associated with geologic resources that could result from implementing alternatives were evaluated qualitatively based on expected construction methods; environmental commitments common to all action alternatives; and the locations, materials, and durations of project construction and related activities.

As described in following paragraphs, for the Shasta Lake and vicinity project area more quantitative analyses were undertaken to address geomorphology (i.e., stream characteristics in watersheds that are adjacent and directly tributary to Shasta Lake) (also see Section 4.1.3) and shoreline erosion (also see Section 4.1.5).

Geomorphology

The analysis of fluvial characteristics of watersheds that are adjacent and directly tributary to Shasta Lake evaluated the impact of raising Shasta Dam on stream channel equilibrium, focusing on the balance between sediment transport capacity and channel stability. The average gradient and flow regime of a watercourse are often the variables that control the sediment transport capacity of a given stream channel. The flow regime of a stream is determined by the measure of the average flow of surface water. The analysis assumed that any stream that has a predicted average annual flow above 0.1 cubic feet per second (cfs) functions as a perennial stream, and any stream with a predicted flow of less than 0.1 cfs functions as an intermittent stream.

Typically, over time, streams reach a natural state of equilibrium based on their gradient and sediment transport capacity. Raising the water level of Shasta Lake may affect the equilibrium of watercourses that are controlled by the present reservoir level. Raising the dam may destabilize these streams by altering the length of stream that will be incorporated into the drawdown. Raising the dam will affect the gradient of adjacent watercourses by altering the length of the watercourse and the change in elevation due to seasonal fluctuations in lake water levels. This is the rationale behind analyzing the gradient and flow regime of watercourses that are adjacent and directly tributary to Shasta Lake.

The stream networks in the Shasta Lake and vicinity area were characterized using the Net Trace model generated in a geographic information system (GIS) environment. Net Trace was used because existing California and USFS stream layers lack the level of detail and necessary variables needed to assess the impact of raising the water level of Shasta Lake on stream channel equilibrium. Initially, sub-10-meter digital elevation models covering the Shasta Lake and vicinity were imported into GIS. Using the methods described in Programs for digital elevation model Analysis (Miller 2003), a surface stream network with user-selected attributes was created using Net Trace. The following characteristics were then calculated for each stream segment: drainage area, riparian area, length, flow direction (degrees), stream order, elevation, gradient statistics, mean precipitation, and mean annual stream flow (cfs).

To verify the accuracy of the Net Trace stream model, the measured bed gradient along surveyed transects on Squaw Creek and Big Backbone Creek was compared to the modeled gradient values calculated by Net Trace along the same transect. The combined average difference between the measured and modeled bed gradient was approximately 4.5 percent, meaning that the measured stream bed gradient is steeper than the modeled gradient. A sampling bias is believed to be the cause of the disparity. For example, 22 segments were surveyed along the Squaw Creek transect and used to determine the measured bed gradient; however, only 5 segments were available from the Net Trace model to calculate the gradient. Simply, the surveyed transects were measured at greater level of detail than were calculated in the Net Trace model.

Although the surveyed gradient values are more accurate than the modeled values, it would be impractical to survey every watercourse within a study area as large as that of the SLWRI. Since this study seeks to characterize the stream channel, a more reasonable approach was to compare the surveyed water surface gradient to the modeled values. This approach eliminates the topographic details of the streambed surface and measures the surface gradient of the stream over the entire transect. The combined average difference between the measured surface gradient and modeled bed gradient was about 2 percent, meaning the measured stream bed gradient is 2 percent steeper than the modeled gradient. Although this disparity is noteworthy, the modeled stream network is considered an accurate representation of the hydrologic system of the study area, and the lower gradient values produce a more conservative estimate of

sediment transport within the system. These results suggest that the digital elevation model-generated stream network is accurate enough to be used as a measure of the potential impacts of raising Shasta Dam on stream channel equilibrium.

Using GIS, the Net Trace stream network was intersected with polygons representative of shoreline area affected through the inundation by each alternative. These intersections were completed for each arm of Shasta Lake. The total stream length and riparian area affected by the inundation were calculated for each arm and summarized to calculate the value for the entire shoreline of Shasta Lake. The affected stream length and riparian areas were also calculated in further detail for perennial and intermittent streams by stream-gradient categories of less than or greater than 10 percent.

Soil Erosion (Shoreline)

A conceptual model was developed to predict the rate and volume of shoreline erosion. The methods and assumptions used for the model are described in Attachment 1, Shoreline Erosion Technical Memorandum. The conceptual model represents the spatial and temporal components of shoreline erosion, and was developed as a framework for field investigations, quantifying present erosion rates, and predicting future erosion rates. The process-based model characterizes the primary causes of shoreline erosion and uses external erosion triggers to weight the relative erodibility of the shoreline. The model was developed using results from similar studies; available precipitation, wind, and lake level data; information concerning the engineering properties of the bedrock geology and soils; the shoreline and hillslope topography; measured erosion processes and rates from sequential historical aerial photographs; and field investigations. Because there were very few shoreline erosion studies for reservoirs as large as Shasta Lake to use as background and support for the analysis, readily available references were used to help characterize the process of shoreline erosion, verify the predicted shoreline erosion rates, and design mitigation measures.

The model divided the shoreline into two zones, which helped account for the episodic nature of erosional events. The nearshore zone is classified as the area above the 1,070-foot contour, and represents the “bathtub” ring around the reservoir. The drawdown zone is classified as the area between the 1,070-foot contour and the 1,020-foot contour. The latter contour was used to represent the drawdown level that typically occurs to meet USACE requirements for flood storage capacity. The nearshore zone is eroded by wave action when the reservoir is full. During drawdown periods, this zone erodes as a result of upland surface runoff, subsurface flow, and fluvial incision along stream channels and gullies.

To represent the temporal component of shoreline erosion, the model compartmentalizes shoreline development into three time steps. The first step lasts for about 15 years and is when most of the erosion occurs (Morris and Fan

1997). During this time, the inundated soils are fully saturated; as a result, they lose cohesion and are subject to rapid erosion, transport, and deposition. Shoreline exposed in the drawdown zone is typically eroded to bedrock or to resilient soil layers, leaving an exposed surface that supports little vegetation. Within this zone, stream channels and gullies rapidly incise the underlying soil and rock.

The second time step can last between about 0 and 150 years. During this time, stable shoreline topography is developing through a sequence of slope-forming events. For modeling purposes, the types of slope-forming events were classified by lithotopo unit because several common processes trigger and control erosion. The shoreline erosion survey data suggest that stable hillslopes are typically associated with shallow soils on coherent bedrock, forming steep topography (greater than 65 percent slope gradient). Unstable hillslopes are associated with deep soils on moderately steep areas (between 30 percent and 65 percent). Around Shasta Lake, stable shoreline formed rapidly during the first 15 years of lake management. Conversely, about 60 years later, unstable hillslopes are still responding to erosional forces and, in some locations, continue to erode at a very high rate (greater than 900 cubic yards/acre/year).

The third time step is used to represent a period when the shoreline slope is stable and soil shear strength remains greater than the shear stresses acting on the slope. During this time, the erosion rate continues to decrease and eventually equals the upslope erosion rates. The analysis assumes that most of the shoreline around Shasta Lake will become stable as the reservoir ages, and the data show that about half of the shoreline is presently stable.

4.3.2 Criteria for Determining Significance of Effects

An environmental document prepared to comply with NEPA must consider the context and intensity of the environmental consequences that would be caused by, or result from, the proposed action. Under NEPA, the significance of an environmental consequence is used solely to determine whether an Environmental Impact Statement must be prepared. An environmental document prepared to comply with CEQA must identify the potentially significant environmental effects of a proposed project. A "[s]ignificant effect on the environment" means a substantial, or potentially substantial, adverse change in any of the physical conditions within the area affected by the project (State CEQA Guidelines, Section 15382). CEQA also requires that the environmental document propose feasible measures to avoid or substantially reduce significant environmental effects (State CEQA Guidelines, Section 15126.4(a).

The following significance criteria were developed based on guidance provided by the State CEQA Guidelines, and consider the context and intensity of the environmental effects as required under NEPA. At a minimum, impacts of an alternative on geology, geologic hazards, geomorphology, mineral resources,

and soils would be significant under CEQA if project implementation would do the following:

- Expose people or structures to potential substantial adverse effects, including the risk of loss, or injury, or death involving the following:
  - Rupture of a known earthquake fault, as delineated on the most recent Alquist-Priolo Earthquake Fault Zoning Map issued by the State Geologist for the area or based on other substantial evidence of a known fault
  - Strong seismic ground shaking
  - Seismic-related ground failure, including liquefaction
  - Landslides
- Result in substantial soil erosion or loss of topsoil
- Be located on a geologic unit or soil that is unstable, or that would become unstable as a result of the project, and potentially result in on- or off-site landslide, lateral spreading, subsidence, liquefaction or collapse
- Be located on expansive soil, as defined in Table 18-1-B of the Uniform Building Code (CCR 2001b), creating substantial risks to life or property
- Have soils incapable of adequately supporting the use of septic tanks or alternative wastewater disposal systems where sewers are not available for disposal of wastewater
- Result in the loss or availability of known mineral resources that would be of future value to the region

Significance statements are relative to both existing conditions (2005) and future conditions (2030), unless stated otherwise.

4.3.3 Topics Eliminated from Further Discussion

The topics of snow avalanches, expansive soil, and soil liquefaction are eliminated from the discussion of environmental consequences owing to the low likelihood of their occurrence as previously discussed (see Sections 4.1.2 for snow avalanches and 4.15 for other eliminated topics).

Paleontological resources are not included in the discussion of environmental consequences. As described in Section 4.1.1, a small area of the fossiliferous Cretaceous Chico Formation occurs near Jones Valley Creek, a tributary to the

Pit River Arm, but this rock unit is not exposed along the shoreline of the lake, and falls outside the study sub-area. Some outcrops of McCloud Limestone, especially in the vicinity of McCloud River Bridge, also contain fossil corals and other microinvertebrates. Some areas underlain by limestone are likely to be disturbed regardless of the action alternative being considered. However, the fossils that comprise the McCloud Limestone are well documented in the scientific literature, and it is unlikely that paleontological resources of scientific or cultural significance occur in this formation.

Paleontological resources have been eliminated from further discussion in the upper Sacramento River (Shasta Dam to Red Bluff), lower Sacramento River and Delta, and CVP/SWP service areas because no impacts are anticipated to these resources as a result of reoperation of the dam.

4.3.4 Direct and Indirect Effects

The following section describes the potential environmental consequences of the project, and impacts and mitigation measures.

No-Action Alternative

This section describes potential impacts that would occur under the NEPA No-Action Alternative. Under the No-Action Alternative, no additional Federal action would be taken to address water reliability issues or increase anadromous fish survival. Shasta Dam would not be modified, and the CVP would continue operating similar to the existing condition. No new construction would occur under the No-Action Alternative and the full pool elevation of the reservoir would remain at approximately 1,070 feet above msl.

Shasta Lake and Vicinity This section describes impacts to the Shasta Lake and vicinity portion of the primary study area.

Impact Geo-1 (No-Action): Exposure of Structures and People to Geologic Hazards Resulting From Seismic Conditions, Slope Instability, and Volcanic Eruption Under the No-Action Alternative, no new construction would occur and the full pool level would not be increased. Therefore, there would be no increase in the risk of geologic hazards to people or structures. There would be no impact. Mitigation is not required for the No-Action Alternative.

Impact Geo-2 (No-Action): Alteration of Fluvial Geomorphology and Hydrology of Aquatic Habitats Under the No-Action Alternative, the full pool level would not be increased. Therefore, there would be no change to streams tributary to Shasta Lake. There would be no impact. Mitigation is not required for the No-Action Alternative.

Impact Geo-3 (No-Action): Loss or Diminished Availability of Known Mineral Resources That Would Be of Future Value to the Region Under the No-Action Alternative, no new construction would occur and the full pool level would not be increased. Therefore, there would be no loss or diminished availability of

known mineral resources that would be of future value to the region. There would be no impact. Mitigation is not required for the No-Action Alternative.

Impact Geo-4 (No-Action): Lost or Diminished Soil Biomass Productivity Under the No-Action Alternative, no new construction would occur and the full pool level would not be increased. Therefore, there would be no lost or diminished soil biomass productivity. There would be no impact. Mitigation is not required for the No-Action Alternative.

Impact Geo-5 (No-Action): Substantial Soil Erosion or Loss of Topsoil Due to Shoreline Processes Under the No-Action Alternative, the full pool level would not be increased. Therefore, there would be no increase in soil erosion or loss of topsoil due to shoreline processes. There would be no impact. Mitigation is not required for the No-Action Alternative.

Impact Geo-6 (No-Action): Substantial Soil Erosion or Loss of Topsoil Due to Upland Processes Under the No-Action Alternative, there would be no disturbance of upland landscape positions. Therefore, there would be no increase in soil erosion or loss of topsoil due to upland processes. There would be no impact. Mitigation is not required for the No-Action Alternative.

Impact Geo-7 (No-Action): Be Located on a Geologic Unit or Soil That Is Unstable, or That Would Become Unstable as a Result of the Project, and Potentially Result in Subsidence Under the No-Action Alternative, no new construction would occur and the full pool level would not be increased. Therefore, there would be no increase in the risk of land subsidence. There would be no impact. Mitigation is not required for the No-Action Alternative.

Impact Geo-8 (No-Action): Failure of Septic Tanks or Alternative Wastewater Disposal Systems Due to Soils That Are Unsuited to Land Application of Waste Under the No-Action Alternative, no new construction would occur and the full pool level would not be increased. Therefore, there would be no increase in the risk of failure of septic tanks or alternative wastewater disposal systems. There would be no impact. Mitigation is not required for the No-Action Alternative.

Upper Sacramento River (Shasta Dam to Red Bluff) This section describes impacts to the upper Sacramento River portion of the primary study area.

Impact Geo-9 (No-Action): Substantial Increase in Channel Erosion and Meander Migration No Shasta Dam enlargement activities would be implemented, and no new water releases from the dam would occur as a result of the No-Action Alternative. The water releases from the dam would continue to vary based on time of year, water year-types, and system conditions. There would be no impact. Mitigation is not required for the No-Action Alternative.

Impact Geo-10 (No-Action): Substantial Soil Erosion or Loss of Topsoil Due to Construction No Shasta Dam enlargement activities would be implemented, and no gravel augmentation activities would occur as a result of the No-Action

Alternative. Therefore, no soil additional soil erosion would be anticipated on the banks along the river channel. There would be no impact. Mitigation is not required for the No-Action Alternative.

Impact Geo-11 (No-Action): Alteration of Fluvial Geomorphology Under the No-Action Alternative, no activities to breach the levee to Reading Island would occur and therefore, no changes in fluvial geomorphology would be anticipated along Anderson Creek. There would be no impact. Mitigation is not required for the No-Action Alternative.

Lower Sacramento River and Delta This section describes impacts to the lower Sacramento River and Delta portions of the extended study area associated with the No-Action Alternative.

Impact Geo-12 (No-Action): Substantial Increase in Channel Erosion and Meander Migration No Shasta Dam enlargement activities would be implemented, and no new water releases from the dam would occur as a result of the No-Action Alternative. The water releases from the dam would continue to vary based on time of year, water year-types, and system conditions. Therefore, there would be no impact.

This impact would be similar to Impact Geo-9 (No-Action) for the primary study area.

For the same reasons described above for Impact Geo-9 (No-Action), there would be no impact. Mitigation is not required for the No-Action Alternative.

CVP/SWP Service Area This section describes the impacts associated with the No-Action Alternative to the CVP/SWP service areas within the extended study area.

Impact Geo-13 (No-Action): Substantial Increase in Channel Erosion and Meander Migration No Shasta Dam enlargement activities would be implemented, and no new water releases from the dam would occur as a result of the No-Action Alternative. No changes in operations would occur under the No-Action Alternative. The water releases from the from Shasta Dam, Folsom Dam, and Oroville Dam would continue to vary based on time of year, water year-types, and system conditions, but would not be anticipated to be outside of normal operating conditions. Therefore, there would be no impact.

This impact would be similar to Impact Geo-9 (No-Action) for the primary study area.

For the same reasons described above for Impact Geo-9 (No-Action), there would be no impact. Mitigation is not required for the No-Action Alternative.

CP1 – 6.5-Foot Dam Raise, Anadromous Fish Survival and Water Supply Reliability

This section describes impacts associated with CP1, which focuses on increasing water supply reliability while contributing to increased anadromous fish survival by raising Shasta Dam 6.5 feet. The dam raise would increase the reservoir's full pool by 8.5 feet, and enlarge total storage space in the reservoir by 256,000 acre-feet.

Shasta Lake and Vicinity This section describes impacts to the Shasta Lake and vicinity portion of the primary study area.

Impact Geo-1 (CP1): Exposure of Structures and People to Geologic Hazards Resulting from Seismic Conditions, Slope Instability, and Volcanic Eruption
Implementing CP1 has the potential to increase the exposure of structures and people to geologic hazards.

There are very few seismic hazard areas within the Shasta Lake and vicinity area. No active faults are known to be present within or immediately adjacent to the Shasta Lake and vicinity area, and there is a low risk of fault rupture (CDC 2006a) According to Jennings (1994) and CDC (1997), all known faults around the Shasta Lake and vicinity area are classified as inactive. (Inactive faults show no evidence of movement in the last 10,000 years (i.e., Holocene). Because there are few active faults in close proximity to the Shasta Lake and vicinity area the likelihood of strong seismic ground shaking also is low. Detailed, site-specific geologic and foundation investigations will be completed to develop design criteria to withstand reasonably probable seismic events. This impact would be less than significant.

Under CP1, the pool level increase would inundate 78 acres of mapped slope instability hazards (i.e., active and relict landslides, debris flows, inner gorge landscape positions, and complexes of these features). Relocation of infrastructure is proposed to occur in the vicinity of about 232 acres of mapped slope instability hazards. Inundation of bedrock and soils resulting from the increased pool elevation, and earthwork and vegetation removal associated with new construction, could reduce the stability of hillslopes prone to mass wasting. The existing relict and active mass wasting features may become less stable. The risks associated with increased slope instability due to the rise in pool elevation and relocation of infrastructure have been considered in formulating the description of CP1. Areas of known instability have been addressed via avoidance or through design measures intended to minimize the risk of increased instability. This impact would be less than significant.

Hazards associated with volcanic eruptions have a low probability of occurring within the Shasta Lake and vicinity area. Significant impacts resulting from eruptions in the Medicine Lake Highlands and at Lassen Peak are unlikely due to their distance from Shasta Lake and the lack of drainage connections. Eruptions of Mount Shasta are not likely to deposit lithic ash, lava flows,

domes, or pyroclastic flows within the reservoir, and Mount Shasta is not likely to erupt large volumes of pumiceous ash. The danger from floods caused by eruptions is similar to that from floods having other origins, and would be mitigated via the proposed dam modifications (e.g., increased spillway capacity) and operational procedures. This impact would be less than significant.

Similarly, the dangers from mudflows and seiche hazards are low, and would be mitigated via the proposed dam modifications (e.g., increased spillway capacity) and operational procedures. This impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact Geo-2 (CP1): Alteration of Fluvial Geomorphology and Hydrology of Aquatic Habitats Under CP1, stream channel equilibrium and geomorphology would be affected by an increase in full pool level. Lower gradient channels (less than 7 percent slope) with existing delta deposits would be affected more than higher gradient channels. It is likely that the delta deposits would expand both upstream and downstream as a result of this alternative. When the lake is full and regional flooding occurs, sediment transported from the uplands would be deposited as deltas at the confluence of the streams and lake. When the lake level is low during baseflow periods, stream channels within the inundation zone are likely to be channelized as they downcut into the Delta deposits. In the lower gradient channels, the stream type could shift to an unstable braided channel.

Inundation of lower gradient streams draining to Shasta Lake could result in long-term changes to channel equilibrium by changing the sediment transport capacity of the stream channels between 1,070 and 1,080 feet of elevation. CP1 could also destabilize the stream channels as a result of riparian vegetation loss on the lower and upper banks and a more mobile stream bed.

Based on a GIS-generated stream network, the total stream length inundated as a result of CP1 is estimated to be 18.5 miles (see Figure 4-8), which equates to about 0.7 percent of the total length of the streams in watersheds that are directly adjacent and contributory to Shasta Lake. Of the 18.5 miles inundated, about 6.2 miles are streams with a gradient of less than 7 percent. This impact would be significant. Mitigation for this impact is proposed in Section 4.3.5.

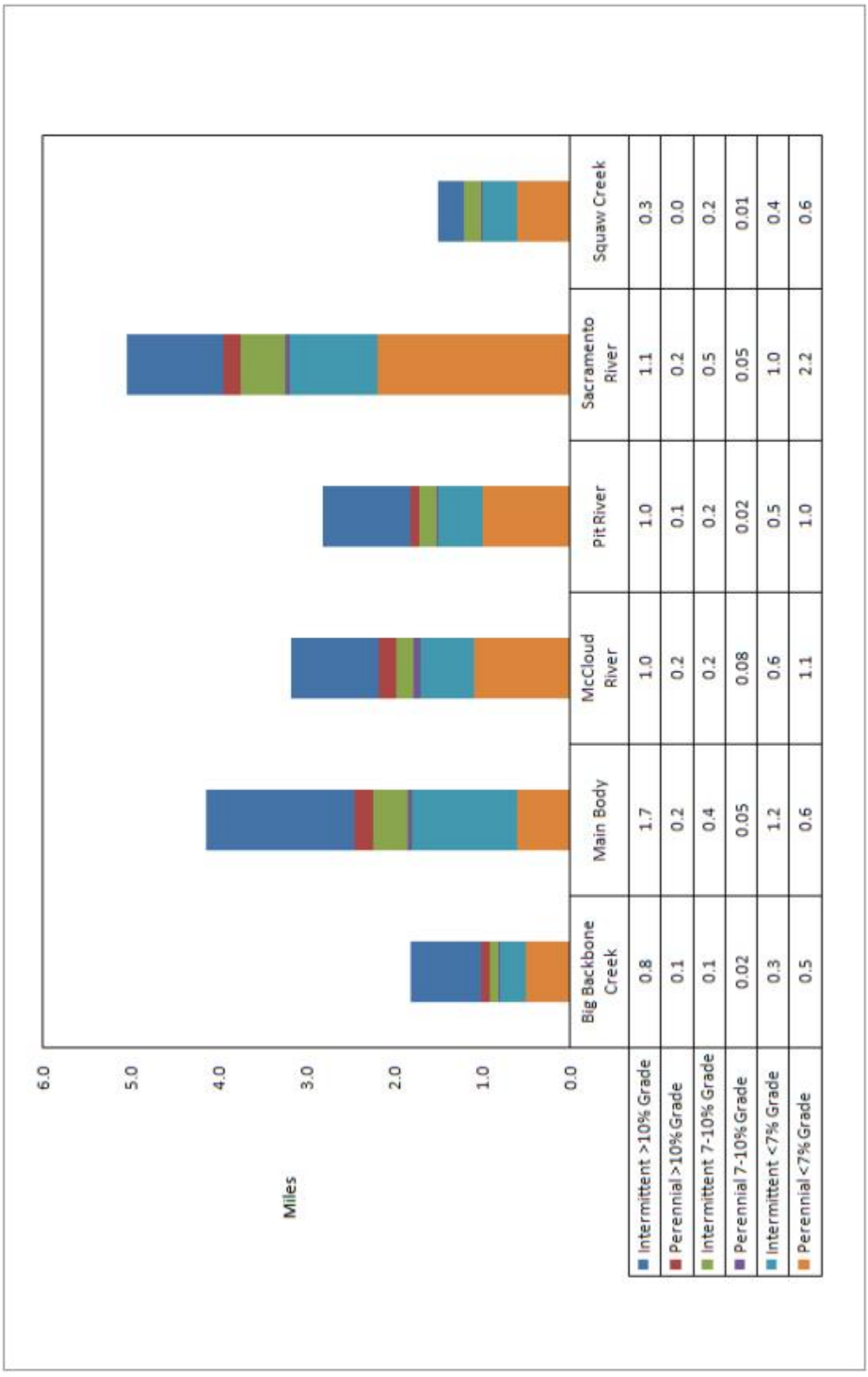


Figure 4-8. Stream Lengths in Watersheds Adjacent to Shasta Lake that Would Be Periodically Inundated Under Alternative CP1

Impact Geo-3 (CP1): Loss or Diminished Availability of Known Mineral Resources That Would Be of Future Value to the Region Significant quantities of cement, concrete sand and aggregate, and coarse aggregate would be needed under CP1. Cement Types I, II, III, and V are produced locally but supplies are limited. Required quantities of concrete sand and aggregate are available from local commercial suppliers. The tonnage of sand anticipated to be needed is roughly more than 150 percent of the annual Shasta County production of sand and gravel. Embankment material (i.e., coarse aggregate) could be obtained from local sources, including from within Shasta Lake itself. Implementation of CP1 has the potential to diminish the availability of cement, and of concrete sand and aggregate, in the region. This impact would be significant and unavoidable. Mitigation for this impact is not available.

Impact Geo-4 (CP1): Lost or Diminished Soil Biomass Productivity Under CP1, soil productivity would be lost due to periodic inundation caused by increasing the full pool elevation and by construction including relocation of infrastructure. Using Equivalent FSSC as a surrogate metric for soil biomass productivity, implementation of CP1 would result in loss of the following acreages by productivity rank: moderate productivity – 1,954.6 acres; low productivity – 1,604.5 acres; nonproductive - 565 acres.

This impact would be significant and unavoidable. Mitigation for this impact is not available.

Impact Geo-5 (CP1): Substantial Soil Erosion or Loss of Topsoil Due to Shoreline Processes Under CP1, the area of shoreline that would be periodically inundated would be about 1,229 acres. Substantial soil erosion and loss of topsoil would result.

The inundated area would be subjected to shoreline erosional processes. For the first 15 years after raising the dam, the average rate of shoreline erosion would increase substantially, from 90 cubic yards per acre per year to about 300 cubic yards per acre per year. For the first time step (i.e., 15 years), the total average annual volume of potential shoreline erosion from CP1 would be about 421,000 cubic yards per year. Within 60 years of raising the dam, the average annual volume is predicted to decrease to 107,000 cubic yards per year.

Sediment delivery from shoreline erosion would likely be greatest in the Sacramento River Arm, eastern portion of the Main Body Arm, and McCloud River Arm. These three arms are predicted to deliver more than 66,000 cubic yards per year for the first 15 years after raising the dam. Within 60 years of raising the dam, the average rate for these arms is predicted to decrease to 19,000 cubic yards per year. The western portion of the Main Body Arm and the Backbone Creek Arm are predicted to have the lowest shoreline erosion rates, resulting in a 15-year average annual potential erosion volume of less than 26,000 cubic yards per year. The Pit River Arm is predicted to produce about

50,000 cubic yards per year and the Squaw Creek Arm about 35,000 cubic yards per year.

Assuming the available vegetation removal prescriptions between the 1,070-foot and 1,080-foot contours, for the first time step (i.e., 15 years after raising Shasta Dam), there would be about 421,000 cubic yards per year of shoreline erosion. After about 15 to 20 years, depending on climatic variability, the new shoreline would form and would start to stabilize. Total reservoir erosion is predicted to decrease by 70 percent between 15 and 60 years after raising the dam. The wetter the climate cycle, the more rapidly the shoreline is predicted to form.

The analysis also calculated the 15-year erosion volume using the prescribed vegetation treatments and modeled higher erosion rates for shoreline with partial and complete vegetation removal. The Big Backbone, Squaw Creek, and Pit River arms would have very little vegetation removal, which would not affect the short-term rate of shoreline erosion. The Main Body, Sacramento River, and McCloud River arms would have substantial amounts of vegetation removal, which would result in higher short-term erosion rates. For these arms, areas treated by vegetation removal represent about half of the total predicted erosion.

This impact would be significant and unavoidable. Mitigation for this impact is not available.

Impact Geo-6 (CP1): Substantial Soil Erosion or Loss of Topsoil Due to Upland Processes Interpretations of soil susceptibility to erosion are presented in Table 4-12 for the portion of the subarea potentially disturbed by construction activities. Up to approximately 3,340 acres in the upland portion of the Shasta Lake and vicinity area could be disturbed, and up to 3,128 acres (94 percent of total area) are assigned a hazard rating of severe. A severe rating indicates that significant erosion is expected, and that extensive erosion-control measures are needed.

Construction-related erosion will be avoided and minimized via implementation of the stormwater pollution prevention plans (i.e., erosion and sediment control plans including site revegetation) that are a part of the environmental commitments common to all action alternatives. These plans will address the necessary local jurisdiction requirements regarding erosion control and site revegetation, and would implement best management practices for erosion and sediment control. This impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact Geo-7 (CP1): Be Located on a Geologic Unit or Soil That is Unstable, or That Would Become Unstable as a Result of the Project, and Potentially Result in Subsidence Of the approximately 3,340 acres in the upland portion of the Shasta Lake and vicinity area, 175.5 acres (5.3 percent of total area) occupy

landscape positions underlain by limestone. Land subsidence has potential to occur in areas underlain by certain limestones, and in areas affected by underground construction. Detailed, site-specific geologic and foundation investigations will be completed to inform project design as to how to avoid potential subsidence due to these potential causes. This impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact Geo-8 (CP1): Failure of Septic Tanks or Alternative Wastewater Disposal Systems Due to Soils that are Unsuited to Land Application of Waste In general, soils in the Shasta Lake and vicinity area are poorly suited to use as septic tank leach fields or alternative waste disposal systems due to shallow soil depth, high rock content, and excessive slope. Relocated wastewater facilities will be designed and constructed to satisfy the conditions of the Shasta County Environmental Health Division Sewage Disposal System Permit. This impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Upper Sacramento River (Shasta Dam to Red Bluff) This section describes impacts to the upper Sacramento River portion of the primary study area associated with CP1.

Impact Geo-9 (CP1): Substantial Increase in Channel Erosion and Meander Migration This impact would be similar to Impact Geo-9 for the No-Action Alternative. However, by altering storage and operations at Shasta Lake as compared to the No-Action Alternative and existing condition, this alternative would change the maximum pool elevation and seasonal pool elevations at Shasta Lake and the flow regime in the Sacramento River and potentially several other reservoirs and downstream waterways. Alterations to river flows could potentially change downstream stream erosion and change downstream geomorphologic characteristics. However, the frequency and duration of high flow events resulting from this action are expected to be reduced as compared to existing conditions with current operations. Therefore, downstream erosion would not be anticipated to increase. This impact would be less than significant.

Reductions of stream bedload contribution are greatest during high flow events. Bed and bank conditions in streams and rivers are created, maintained, and destroyed by natural geomorphic processes whose rates and patterns are regulated through complex interactions of flow, sediment transport, and properties of the channel and floodplain (including slope, erodibility, and morphology). Because large fluvial systems, such as the Sacramento River and its floodplain, are affected by the interaction of a wide variety of geomorphic processes, quantifying and understanding how they evolve can be complex. The legacy of land and water use in a region add to the complexity, modulating factors such as flow, sediment supply, and floodplain erodibility, thus affecting the dynamics of riverine and floodplain characteristics.

High flow events can mobilize and scour gravel stored in the channel bed, routing the sediment downstream. In the alluvial reaches of unregulated rivers, the sediment scoured from a local reach is generally replaced by sediment transported from upstream, supplied from tributaries, or recruited from storage in riverbanks. There may be short-term or local changes in the amount of gravel stored in a channel bed due to episodic sediment delivery (e.g., mass wasting events in the watershed) or extreme flow events, but over a broader time span, unregulated rivers generally achieve a balance between sediment supply and routing so that in-channel sediment storage is maintained.

The first significant natural source of sediment to the Sacramento River is nearly 30 miles (48 kilometers) downstream from Keswick Dam at Cottonwood Creek (River Mile 273.5). Tributaries between Keswick Dam and Cottonwood Creek contribute little sediment to the mainstem because they drain small basins of erosion-resistant material or, as is the case for Clear Creek, are themselves regulated by dams and are affected by aggregate mining. Much of the upper Sacramento River (i.e., from River Mile 302 to approximately River Mile 273.5) is bounded by erosion-resistant bedrock and terrace deposits, such that bank erosion is not fast enough, relative to in-channel transport, to provide a significant source of coarse sediment. In other words, the rate of supply from erosion of banks due to meander migration in the upper river is minimal.

Meander migration and bank erosion occur by two processes: progressive channel migration, in which flows erode banks incrementally, and episodic meander-bend cutoff, in which the channel avulses to a completely new course. Cutoffs may be partial or complete, depending on initial meander bend geometry and the resistance of bank and floodplain materials to erosion, among other factors. Complete cutoffs are often referred to as "chute cutoffs." Partial cutoffs are sometimes also referred to as "neck cutoffs" in geomorphology texts and literature. While progressive migration and episodic cutoff can generally be thought of as distinct (i.e., mutually exclusive) processes, they are nevertheless interrelated because they simultaneously regulate and are affected by sinuosity and other channel characteristics.

An Erosion and Sediment Control Plan would be implemented, as described in Chapter 2, *Environmental Commitments Common to All Action Alternatives,* to control any short-term and long-term erosion and sedimentation effects of construction activities. This impact would be less than significant. Mitigation for this impact is proposed in Section 4.3.5.

Impact Geo-10 (CP1): Substantial Soil Erosion or Loss of Topsoil Due to Construction Under implementation of CP1 no gravel augmentation activities or construction activities to breach the levee to Reading Island would occur and therefore, no soil additional soil erosion would be anticipated on the banks along the river channel. There would be no impact. Mitigation for this impact is not needed, and thus not proposed.

Impact Geo-11 (CP1): Alteration of Fluvial Geomorphology Under implementation of CP1, no activities to breach the levee to Reading Island would occur and therefore, no changes in fluvial geomorphology would be anticipated along Anderson Creek. There would be no impact. Mitigation for this impact is not needed, and thus not proposed.

Lower Sacramento River and Delta This section describes impacts to the lower Sacramento River and Delta portions of the extended study area associated with CP1.

Impact Geo-12 (CP1.): Substantial Increase in Channel Erosion and Meander Migration It is not anticipated that implementation of CP1 would lead to increased channel erosion and meander migration as compared to the No-Action Alternative and existing conditions. Under implementation of CP1, there would be a potential reduction in high flow events. Therefore, increases in Sacramento River flow would be limited and affects to reservoirs and rivers in the extended study area would be attenuated and dissipated by the large number of these water bodies, as well as flood bypasses in the extended study area. This impact would be less than significant.

This impact would be very similar to Impact Geo-9 (CP1), but would take place in the lower Sacramento River and Delta and would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

CVP/SWP Service Areas This section describes impacts to the CVP/SWP service areas within the extended study area associated with CP1.

Impact Geo-13 (CP1): Substantial Increase in Channel Erosion and Meander Migration It is not anticipated that implementation of CP1 would lead to increased channel erosion and meander migration as compared to the No-Action Alternative and existing conditions. Changes in water operations in the CVP/SWP service areas could potentially result in small changes in flow in the American and Feather rivers, as a result of operations at Folsom Dam and Oroville Dam. However, changes in flow affecting these reservoirs and rivers in the extended study area would be within the normal range of conditions and would not be expected to result in an increase in channel erosion or meander migration. This would be a less than significant impact.

This impact would be very similar to Impact Geo-9 (CP1), but would be associated with the CVP/SWP service areas that extend along the Sacramento River and would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

CP2 – 12.5-Foot Dam Raise, Anadromous Fish Survival and Water Supply Reliability

This section describes impacts associated with CP2, which focuses on enlarging Shasta Dam and Reservoir by raising Shasta Dam 12.5 feet. The dam raise

would increase the reservoir's full pool by 14.5 feet, and enlarge total storage space in the reservoir by 443,000 acre-feet.

Shasta Lake and Vicinity This section describes impacts to the Shasta Lake portion of the primary study area.

Impact Geo-1 (CP2): Exposure of Structures and People to Geologic Hazards Resulting From Seismic Conditions, Slope Instability, and Volcanic Eruption Implementing CP2 has the potential to increase the exposure of structures and people to geologic hazards similar to CP1. For the same reasons as apply to CP1, impacts resulting from seismic conditions would be less than significant for CP2.

Under CP2, the pool level increase would inundate 110 acres of mapped slope instability hazards. Relocation of infrastructure is proposed to occur in the vicinity of about 232 acres of mapped slope instability hazards. For the same reasons as apply to CP1, impacts resulting from slope instability hazards would be less than significant for CP2.

For the same reasons as apply to CP1, impacts resulting from hazards associated with volcanic eruptions would be less than significant for CP2. Mitigation for this impact is not needed, and thus not proposed.

Impact Geo-2 (CP2): Alteration of Fluvial Geomorphology and Hydrology of Aquatic Habitats Like CP1, under CP2 stream channel equilibrium and geomorphology would be affected by an increase in full pool level. Inundation of lower gradient streams draining to Shasta Lake could result in long-term changes to channel equilibrium by changing the sediment transport capacity of the stream channels between 1,070 and 1,084 feet of elevation.

Based on a GIS-generated stream network, the total stream length inundated as a result of CP2 would be 25.5 miles (see Figure 4-9), which equates to about 0.9 percent of the total length of the streams in watersheds that are directly adjacent and contributory to Shasta Lake. Of the 25.5 miles inundated, about 8.2 miles are streams with a gradient less than 7 percent. This impact would be significant. Mitigation for this impact is proposed in Section 4.3.5.

Impact Geo-3 (CP2): Loss or Diminished Availability of Known Mineral Resources That Would Be of Future Value to the Region Implementing CP2 has the same potential as CP1 to diminish the availability in the region of cement, and of concrete sand and aggregate. For the same reasons as apply to CP1, this impact would be significant and unavoidable for CP2. Mitigation for this impact is not available.

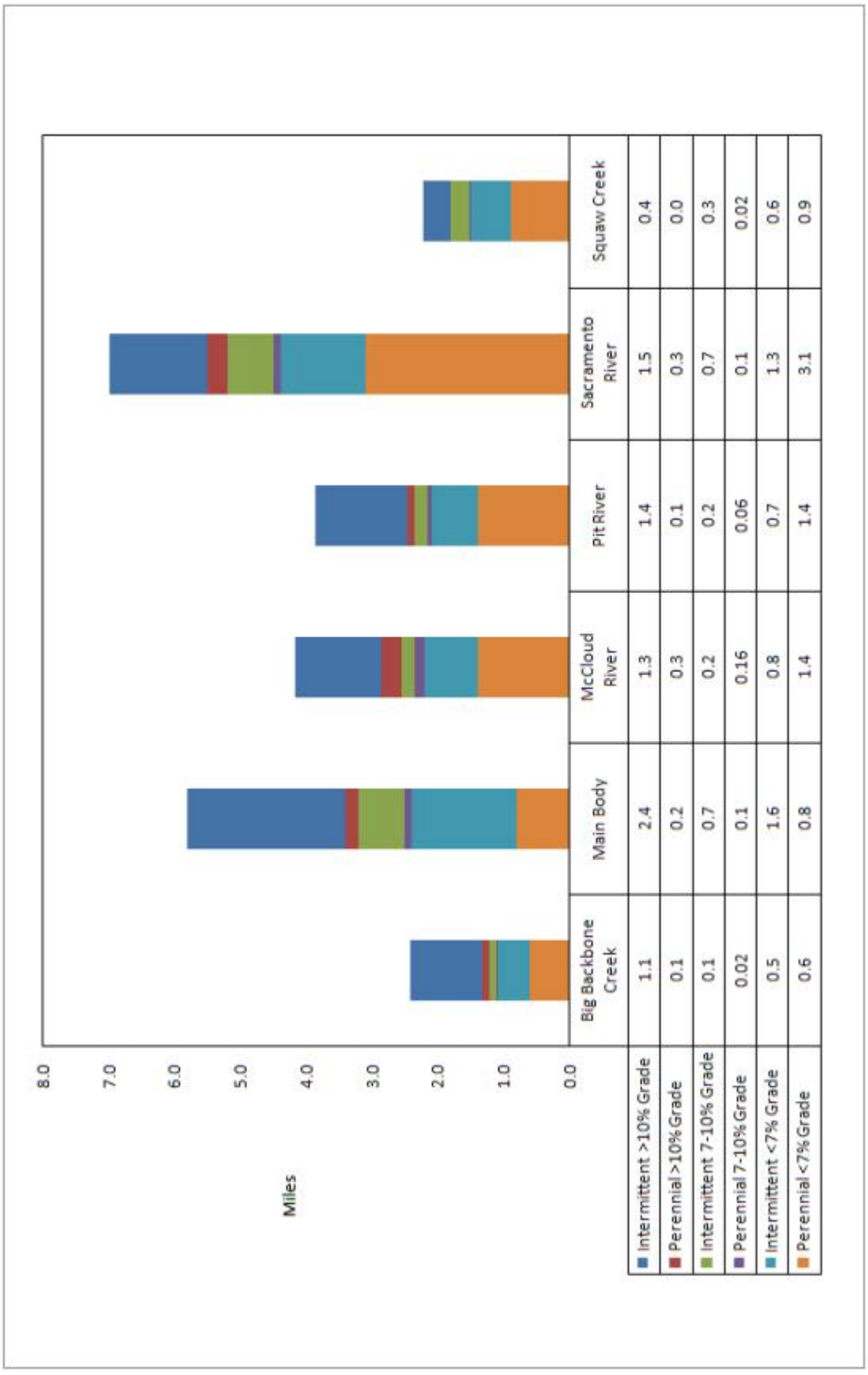


Figure 4-9. Stream Lengths in Watersheds Adjacent to Shasta Lake that Would Be Periodically Inundated Under Alternative CP2

Impact Geo-4 (CP2): Lost or Diminished Soil Biomass Productivity Like CP1, under CP2 soil productivity would be lost due to periodic inundation caused by increasing the full pool elevation and by construction including relocation of infrastructure. Using Equivalent FSSC as a surrogate metric for soil biomass productivity, implementation of CP2 would result in loss of the following acreages by productivity rank: moderate productivity, 2,128 acres; low productivity, 1,751 acres; nonproductive, 638 acres.

This impact would be significant and unavoidable. Mitigation for this impact is not available.

Impact Geo-5 (CP2): Substantial Soil Erosion or Loss of Topsoil Due to Shoreline Processes Under CP2, the area of shoreline that would be inundated would be about 1,734 acres. Substantial soil erosion and loss of topsoil would result.

For the first 15 years after raising the dam, the average rate of shoreline erosion would increase substantially, from 90 cubic yards per acre per year to about 300 cubic yards per acre per year. For the first time step (i.e., 15 years), the total average annual volume of potential shoreline erosion from CP2 would be about 549,000 cubic yards per year. Within 60 years of raising the dam, the average annual volume is predicted to decrease to 150,000 cubic yards per year.

Sediment delivery from shoreline erosion would likely be greatest in the Sacramento River Arm, eastern portion of the Main Body Arm, and McCloud River Arm. These three arms are predicted to deliver more than 90,000 cubic yards per year for the first 15 years after raising the dam. Within 60 years of raising the dam, the average rate for these arms is predicted to decrease to 27,000 cubic yards per year. The western portion of the Main Body Arm and the Backbone Creek Arm are predicted to have the lowest shoreline erosion rates, a 15-year average annual potential erosion volume of less than 43,000 cubic yards per year. The Pit River Arm is predicted to produce about 67,000 cubic yards per year and the Squaw Creek Arm about 63,000 cubic yards per year.

Assuming the available vegetation removal prescriptions between the 1,070-foot and 1,084-foot contours, for the first time step (i.e., 15 years after raising Shasta Dam), there would be about 549,000 cubic yards per year of shoreline erosion. After about 15 to 20 years, depending on climatic variability, the new shoreline would form and would start to stabilize. Total reservoir erosion is predicted to decrease by 70 percent between 15 and 60 years after raising the dam. The wetter the climate cycle, the more rapidly the shoreline is predicted to form.

The analysis also calculated the 15-year erosion volume using the prescribed vegetation treatments and modeled higher erosion rates for shoreline with partial and complete vegetation removal. The Big Backbone, Squaw Creek, and Pit River Arms would have very little vegetation removal, which would not

affect the short-term rate of shoreline erosion. The Main Body, Sacramento River, and McCloud River arms would have substantial amounts of vegetation removal, which would result in higher short-term erosion rates. For these arms, areas treated by vegetation removal represent about half of the total predicted erosion.

This impact would be significant and unavoidable. Mitigation for this impact is not available.

Impact Geo-6 (CP2): Substantial Soil Erosion or Loss of Topsoil Due to Upland Processes Alternative CP2 is similar to Alternative CP1 with respect to its potential to cause substantial soil erosion or loss of topsoil due to upland processes. The area disturbed by construction activities under CP2 is roughly the same as the area disturbed under CP1, up to approximately 3,340 acres. Of this area, up to approximately 3,128 acres are assigned a hazard rating of severe. For the same reasons as apply to CP1, this impact would be less than significant for CP2. Mitigation for this impact is not needed, and thus not proposed.

Impact Geo-7 (CP2): Be Located on a Geologic Unit or Soil That is Unstable, or That Would Become Unstable as a Result of the Project, and Potentially Result in Subsidence Alternative CP2 is similar to Alternative CP1 with respect to its potential to cause or be effected by subsidence. For the same reasons as apply to CP1, this impact would be less than significant for CP2 Mitigation for this impact is not needed, and thus not proposed.

Impact Geo-8 (CP2): Failure of Septic Tanks or Alternative Wastewater Disposal Systems Due to Soils that are Unsuited to Land Application of Waste Alternative CP2 is similar to Alternative CP1 with respect to its potential to cause or be effected by failure of septic tanks or alternative wastewater disposal systems due to soils that are unsuited to land application of waste. For the same reasons as apply to CP1, this impact would be less than significant for CP2. Mitigation for this impact is not needed, and thus not proposed.

Upper Sacramento River (Shasta Dam to Red Bluff) This section describes the impacts to the upper Sacramento River portion of the primary study area associated with CP2.

Impact Geo-9 (CP2): Substantial Increase in Channel Erosion and Meander Migration It is not anticipated that implementation of CP2 would lead to increased channel erosion and meander migration as compared to the No-Action Alternative and existing conditions. However, by altering storage and operations at Shasta Lake as compared to the No-Action Alternative and existing condition, this alternative would change the maximum pool elevation and seasonal pool elevations at Shasta Lake and the flow regime in the Sacramento River and potentially several other reservoirs and downstream waterways. Alterations to river flows could potentially change downstream stream erosion and change downstream geomorphologic characteristics.

However, the frequency and duration of high flow events resulting from this action are expected to be reduced as compared to existing conditions with current operations. Therefore, downstream erosion would not be anticipated to increase. An Erosion and Sediment Control Plan would be implemented, as described in Chapter 2, *Environmental Commitments Common to All Action Alternatives,* to control any short-term and long-term erosion and sedimentation effects of construction activities. This impact would be less than significant.

This impact would be very similar to Impact Geo-9 (CP1), except the modification of flow regimes would be slightly greater under CP2. This impact would be less than significant. Mitigation for this impact is proposed in Section 4.3.5.

Impact Geo-10 (CP2): Substantial Soil Erosion or Loss of Topsoil Due to Construction Under implementation of CP2 no gravel augmentation activities would occur and therefore, no soil additional soil erosion would be anticipated on the banks along the river channel. There would be no impact. Mitigation for this impact is not needed, and thus not proposed.

Impact Geo-11 (CP2): Alteration of Fluvial Geomorphology Under implementation of CP2, no activities to breach the levee to Reading Island would occur and therefore, no changes in fluvial geomorphology would be anticipated along Anderson Creek. There would be no impact. Mitigation for this impact is not needed, and thus not proposed.

Lower Sacramento River and Delta This section describes impacts to the lower Sacramento River and Delta portions of the extended study area associated with CP2.

Impact Geo-12 (CP2): Substantial Increase in Channel Erosion and Meander Migration It is not anticipated that implementation of CP2 would lead to increased channel erosion and meander migration as compared to the No-Action Alternative and existing conditions. Under implementation of CP1, there would be a potential reduction in high flow events. Therefore, increases in Sacramento River flow would be limited and affects to reservoirs and rivers in the extended study area would be attenuated and dissipated by the large number of these water bodies, as well as by flood bypasses in the extended study area. This impact would be less than significant.

This impact would be very similar to Impact Geo-9 (CP1), except the modification of flow regimes would be slightly greater under CP2. This impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

CVP/SWP Service Areas This section describes impacts to the CVP/SWP service areas within the extended study area associated with CP2.

Impact Geo-13 (CP2): Substantial Increase in Channel Erosion and Meander Migration It is not anticipated that implementation of CP2 would lead to increased channel erosion and meander migration as compared to the No-Action Alternative and existing conditions. Changes in water operations in the CVP/SWP service areas could potentially result in small changes in flow in the American and Feather rivers, as a result of operations at Folsom Dam and Oroville Dam. However, changes in flow affecting these reservoirs and rivers in the extended study area would be within the normal range of conditions and would not be expected to result in an increase in channel erosion or meander migration. This impact would be less than significant.

This impact would be very similar to Impact Geo-9 (CP1), except the modification of flow regimes would be slightly greater under CP2. This impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

CP3 – 18.5-Foot Dam Raise, Anadromous Fish Survival and Water Supply

This section describes impacts associated with CP3, which focuses on the greatest practical enlargement of Shasta Dam and Reservoir consistent with the goals of the 2000 CALFED Bay-Delta Program Record of Decision (CALFED 2000b). CP3 was formulated for the primary purposes of increased water supply reliability and increased anadromous fish survival by raising Shasta Dam 18.5 feet. The dam raise would raise the reservoir's full pool by 20.5 feet, and enlarge total storage space in the reservoir by 5.19 million acre-feet.

Shasta Lake and Vicinity This section describes impacts to the Shasta Lake portion of the primary study area for CP3.

Impact Geo-1 (CP3): Exposure of Structures and People to Geologic Hazards Resulting from Seismic Conditions, Slope Instability, and Volcanic Eruption
Implementing CP3 has the potential to increase the exposure of structures and people to geologic hazards similar to CP1. For the same reasons as apply to CP1, impacts resulting from seismic conditions would be less than significant for CP3.

Under CP3, the pool level increase would inundate 173 acres of mapped slope instability hazards (i.e., active and relict landslides, debris slides, and inner gorge landscape positions). Relocation of infrastructure is proposed to occur in the vicinity of about 232 acres of mapped slope instability hazards. For the same reasons as apply to CP1, impacts resulting from slope instability hazards would be less than significant for CP3

For the same reasons as apply to CP1, impacts resulting from hazards associated with volcanic eruptions would be less than significant for CP3. Mitigation for this impact is not needed, and thus not proposed.

Impact Geo-2 (CP3): Alteration of Fluvial Geomorphology and Hydrology of Aquatic Habitats Similar to CP1, under CP3 stream channel equilibrium and geomorphology would be affected by an increase in full pool level. Inundation of lower gradient streams draining to Shasta Lake could result in long-term changes to channel equilibrium by changing the sediment transport capacity of the stream channels between 1,070 and 1,090 feet of elevation.

Based on a GIS-generated stream network, the total stream length inundated as a result of CP3 would be 36.5 miles (see Figure 4-10), which equates to about 1.3 percent of the total length of the streams in watersheds that are directly adjacent and contributory to Shasta Lake. Of the 36.5 miles inundated, about 12.1 miles are streams with a gradient less than 7 percent. This impact would be significant. Mitigation for this impact is proposed in Section 4.3.5.

Impact Geo-3 (CP3): Loss or Diminished Availability of Known Mineral Resources That Would Be of Future Value to the Region Implementing CP3 has the same potential as CP1 to diminish the availability in the region of cement, and of concrete sand and aggregate. For the same reasons as apply to CP1, this impact would be significant and unavoidable for CP3. Mitigation for this impact is not available.

Impact Geo-4 (CP3): Loss or Diminished Soil Biomass Productivity Like CP1, under CP3 soil productivity would be lost due to periodic inundation caused by increasing the full pool elevation and by construction including relocation of infrastructure. Using Equivalent FSSC as a surrogate metric for soil biomass productivity, implementation of CP3 would result in loss of the following acreages by productivity rank: moderate productivity – 2,301 acres; low productivity – 2,092 acres; nonproductive – 760 acres.

This impact would be significant and unavoidable. Mitigation for this impact is not available.

Impact Geo-5 (CP3): Substantial Soil Erosion or Loss of Topsoil Due to Shoreline Processes Under CP3, the area of shoreline that would be inundated would be about 2,498 acres. Substantial soil erosion and loss of topsoil would result.

For the first 15 years after raising the dam, the average rate of shoreline erosion would increase substantially, from 90 cubic yards per acre per year to about 300 cubic yards per acre per year. For the first time step (i.e., 15 years), the total average annual volume of potential shoreline erosion from CP3 would be about 767,000 cubic yards per year. Within 60 years of raising the dam, the average annual volume is predicted to decrease to 216,000 cubic yards per year.

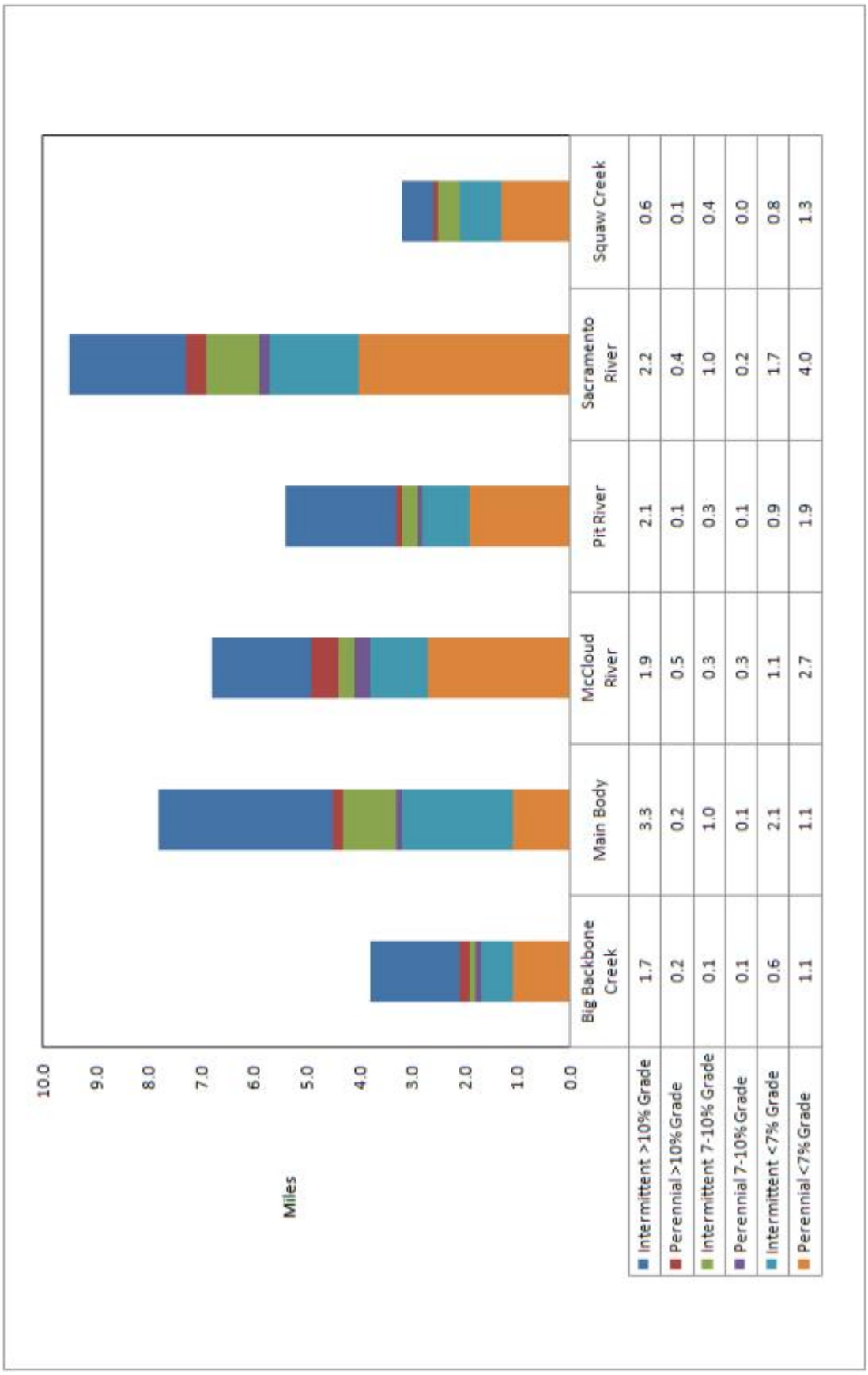


Figure 4-10. Stream Lengths in Watersheds Adjacent to Shasta Lake that Would Be Periodically Inundated Under Alternatives CP3, CP4, and CP5

Sediment delivery from shoreline erosion would likely be greatest in the Sacramento River Arm, eastern portion of the Main Body Arm, and McCloud River Arm. These three arms are predicted to deliver more than 140,000 cubic yards per year for the first 15 years after raising the dam. Within 60 years of raising the dam, the average rate for these arms is predicted to decrease to 39,000 cubic yards per year. The western portion of the Main Body Arm and Backbone Creek Arm are predicted to have the lowest shoreline erosion rates, a 15-year average annual potential erosion volume of less than 57,000 cubic yards per year. The Pit River Arm is predicted to produce about 99,000 cubic yards per year and the Squaw Creek Arm about 68,000 cubic yards per year.

Assuming the available vegetation removal prescriptions between the 1,070-foot and 1,090-foot contours, for the first time step (i.e., 15 years after raising Shasta Dam), there would be about 767,000 cubic yards per year of shoreline erosion. After about 15 to 20 years, depending on climatic variability, the new shoreline would form and would start to stabilize. Total reservoir erosion is predicted to decrease by 70 percent between 15 and 60 years after raising the dam. The wetter the climate cycle, the more rapidly the shoreline is predicted to form.

The analysis also calculated the 15-year erosion volume using the prescribed vegetation treatments and modeled higher erosion rates for shoreline with partial and complete vegetation removal. The Big Backbone, Squaw Creek, and Pit River Arms would have very little vegetation removal, which would not affect the short-term rate of shoreline erosion. The Main Body, Sacramento River, and McCloud River arms would have substantial amounts of vegetation removal, which would result in higher short-term erosion rates. For these arms, areas treated by vegetation removal represent about half of the total predicted erosion.

This impact would be significant and unavoidable. Mitigation for this impact is not available.

Impact Geo-6 (CP3): Substantial Soil Erosion or Loss of Topsoil Due to Upland Processes Alternative CP3 is similar to Alternative CP1 with respect to its potential to cause substantial soil erosion or loss of topsoil due to upland processes. The area disturbed by construction activities under CP3 is about 3,340 acres. Of this area, approximately 3,128 acres are assigned a hazard rating of severe. For the same reasons as apply to CP1, this impact would be less than significant for CP3. Mitigation for this impact is not needed, and thus not proposed.

Impact Geo-7 (CP3): Be Located on a Geologic Unit or Soil That is Unstable, or That Would Become Unstable as a Result of the Project, and Potentially Result in Subsidence Alternative CP3 is similar to Alternative CP1 with respect to its potential to cause or be effected by subsidence. For the same

reasons as apply to CP1, this would be less than significant for CP3. Mitigation for this impact is not needed, and thus not proposed.

Impact Geo-8 (CP3): Failure of Septic Tanks or Alternative Wastewater Disposal Systems Due to Soils that are Unsuited to Land Application of Waste Alternative CP3 is similar to Alternative CP1 with respect to its potential to cause or be effected by failure of septic tanks or alternative wastewater disposal systems due to soils that are unsuited to land application of waste. For the same reasons as apply to CP1, this would be less than significant for CP3. Mitigation for this impact is not needed, and thus not proposed.

Upper Sacramento River (Shasta Dam to Red Bluff) This section describes impacts to the upper Sacramento River portion of the primary study area associated with CP3.

Impact Geo-9 (CP3): Potential Increase in Channel Erosion and Meander Migration It is not anticipated that implementation of CP3 would lead to increased channel erosion and meander migration as compared to the No-Action Alternative and existing conditions. However, by altering storage and operations at Shasta Lake as compared to the No-Action Alternative and existing condition, this alternative would change the maximum pool elevation and seasonal pool elevations at Shasta Lake and the flow regime in the Sacramento River and potentially several other reservoirs and downstream waterways. Alterations to river flows could potentially change downstream stream erosion and change downstream geomorphologic characteristics. However, the frequency and duration of high flow events resulting from this action are expected to be reduced as compared to existing conditions with current operations. Therefore, downstream erosion would not be anticipated to increase. An Erosion and Sediment Control Plan would be implemented, as described in Chapter 2, *Environmental Commitments Common to All Action Alternatives*, to control any short-term and long-term erosion and sedimentation effects of construction activities. This impact would be less than significant.

This impact would be very similar to Impact Geo-9 (CP1), except the modification of flow regimes would be greater under CP3. This impact would be less than significant. Mitigation for this impact is proposed in Section 4.3.5.

Impact Geo-10 (CP3): Substantial Soil Erosion or Loss of Topsoil Due to Construction Under implementation of CP3 no gravel augmentation activities would occur and therefore, no soil additional soil erosion would be anticipated on the banks along the river channel. There would be no impact. Mitigation for this impact is not needed, and thus not proposed.

Impact Geo-11 (CP3): Alteration of Fluvial Geomorphology Under implementation of CP3, no activities to breach the levee to Reading Island would occur and therefore, no changes in fluvial geomorphology would be

anticipated along Anderson Creek. There would be no impact. Mitigation for this impact is not needed, and thus not proposed.

Lower Sacramento River and Delta This section describes impacts to the lower Sacramento River and Delta portions of the extended study area associated with CP3.

Impact Geo-12 (CP3): Substantial Increase in Channel Erosion and Meander Migration It is not anticipated that implementation of CP3 would lead to increased channel erosion and meander migration as compared to the No-Action Alternative and existing conditions. Under implementation of CP1, there would be a potential reduction in high flow events. Therefore, increases in Sacramento River flow would be limited and affects to reservoirs and rivers in the extended study area would be attenuated and dissipated by the large number of these water bodies, as well as by flood bypasses in the extended study area. This impact would be less than significant.

This impact would be very similar to Impact Geo-9 (CP1), except the modification of flow regimes would be greater under CP3. This impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

CVP/SWP Service Areas This section describes impacts to the CVP/SWP service areas within the extended study area associated with CP3.

Impact Geo-13 (CP3): Substantial Increase in Channel Erosion and Meander Migration It is not anticipated that implementation of CP3 would lead to increased channel erosion and meander migration as compared to the No-Action Alternative and existing conditions. Changes in water operations in the CVP/SWP service areas could potentially result in small changes in flow in the American and Feather rivers, as a result of operations at Folsom Dam and Oroville Dam. However, changes in flow affecting these reservoirs and rivers in the extended study area would be within the normal range of conditions and would not be expected to result in an increase in channel erosion or meander migration. This impact would be less than significant.

This impact would be very similar to Impact Geo-9 (CP1), except the modification of flow regimes would be slightly greater under CP3. This impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

CP4 – 18.5-Foot Dam Raise, Anadromous Fish Focus With Water Supply Reliability

This section describes impacts associated with CP4, which focuses on increasing the volume of cold water available to the Shasta Dam temperature control device through reservoir reoperations, and on raising Shasta Dam by raising Shasta Dam 18.5 feet. The dam raise would increase the reservoir's full

pool by 20.5 feet, and enlarge total storage space by 634,000 acre-feet. This additional storage space would expand the Shasta Lake cold-water supply available to the temperature control device by 378,000 acre-feet, a feature that would help regulate cooler water temperatures in the upper Sacramento River.

Shasta Lake and Vicinity This section describes impacts to the Shasta Lake portion of the primary study area for CP4.

Impact Geo-1 (CP4): Exposure of Structures and People to Geologic Hazards Resulting from Seismic Conditions, Slope Instability, and Volcanic Eruption Implementing CP4 has the potential to increase the exposure of structures and people to geologic hazards similar to CP1. For the same reasons as apply to CP1, impacts resulting from seismic conditions would be less than significant for CP4.

Like CP3, under CP4, the pool level increase would inundate 173 acres of mapped slope instability hazards. Relocation of infrastructure is proposed to occur in the vicinity of about 232 acres of mapped slope instability hazards. For the same reasons as apply to CP1, impacts resulting from slope instability hazards would be less than significant for CP4.

For the same reasons as apply to CP1, impacts resulting from hazards associated with volcanic eruptions would be less than significant for CP4. Mitigation for this impact is not needed, and thus not proposed.

Impact Geo-2 (CP4): Alteration of Fluvial Geomorphology and Hydrology of Aquatic Habitats Like CP3, under CP4 stream channel equilibrium and geomorphology would be affected by an increase in full pool level. Inundation of lower gradient streams draining to Shasta Lake could result in long-term changes to channel equilibrium by changing the sediment transport capacity of the stream channels between 1,070 and 1,090 feet of elevation.

Based on a GIS-generated stream network, the total stream length inundated as a result of CP4 would be the same as for CP3, about 36.5 miles (see Figure 4-10). This value equates to about 1.3 percent of the total length of the streams in watersheds that are directly adjacent and contributory to Shasta Lake. Of the 36.5 miles inundated, about 12.1 miles are streams with a gradient less than 7 percent. This impact would be significant. Mitigation for this impact is proposed in Section 4.3.5.

Impact Geo-3 (CP4): Loss or Diminished Availability of Known Mineral Resources That Would Be of Future Value to the Region Implementing CP4 has the same potential as CP1 to diminish the availability in the region of cement, and of concrete sand and aggregate. For the same reasons as apply to CP1, this impact would be significant and unavoidable for CP4. Mitigation for this impact is not available.

Impact Geo-4 (CP4): Lost or Diminished Soil Biomass Productivity Like CP3, under CP4 soil productivity would be lost due to periodic inundation caused by increasing the full pool elevation and by construction including relocation of infrastructure. The acreages of these losses would be the same as those reported for CP3.

This impact would be significant and unavoidable. Mitigation for this impact is not available.

Impact Geo-5 (CP4): Substantial Soil Erosion or Loss of Topsoil Due to Shoreline Processes Under CP4, the area of shoreline that would be inundated would be the same as the area reported under CP3, about 2,498 acres. Substantial soil erosion and loss of topsoil would result. The previous descriptions of the time steps and associated volumes of soil lost due to shoreline processes under CP3 also apply to CP4.

This impact would be significant and unavoidable. Mitigation for this impact is not available.

Impact Geo-6 (CP4): Substantial Soil Erosion or Loss of Topsoil Due to Upland Processes Alternative CP4 is similar to Alternative CP3 with respect to its potential to cause substantial soil erosion or loss of topsoil due to upland processes. The area disturbed by construction activities under CP4 is roughly the same as the area disturbed under CP3, about 3, 340 acres. Of this area, approximately 3,128 acres are assigned a hazard rating of severe. For the same reasons as apply to CP1, this impact would be less than significant for CP4. Mitigation for this impact is not needed, and thus not proposed.

Impact Geo-7 (CP4): Be Located on a Geologic Unit or Soil That is Unstable, or That Would Become Unstable as a Result of the Project, and Potentially Result in Subsidence Alternative CP4 is similar to Alternative CP1 with respect to its potential to cause or be effected by subsidence. For the same reasons as apply to CP1, this impact would be less than significant for CP4. Mitigation for this impact is not needed, and thus not proposed.

Impact Geo-8 (CP4): Failure of Septic Tanks or Alternative Wastewater Disposal Systems Due to Soils that are Unsuited to Land Application of Waste Alternative CP4 is similar to Alternative CP1 with respect to its potential to cause or be effected by failure of septic tanks or alternative wastewater disposal systems due to soils that are unsuited to land application of waste. For the same reasons as apply to CP1, this impact would be less than significant for CP4. Mitigation for this impact is not needed, and thus not proposed.

Upper Sacramento River (Shasta Dam to Red Bluff) This section describes impacts to the upper Sacramento River portion of the primary study area associated with CP4.

Impact Geo-9 (CP4): Potential Increase in Channel Erosion and Meander Migration It is not anticipated that implementation of CP4 would lead to increased channel erosion and meander migration as compared to the No-Action Alternative and existing conditions. However, by altering storage and operations at Shasta Lake as compared to the No-Action Alternative and existing condition, this alternative would change the maximum pool elevation and seasonal pool elevations at Shasta Lake and the flow regime in the Sacramento River and potentially several other reservoirs and downstream waterways. Alterations to river flows could potentially change downstream stream erosion and change downstream geomorphologic characteristics. However, the frequency and duration of high flow events resulting from this action are expected to be reduced as compared to existing conditions with current operations. Therefore, downstream erosion would not be anticipated to increase. An Erosion and Sediment Control Plan would be implemented, as described in Chapter 2, Environmental Commitments Common to All Action Alternatives, to control any short-term and long-term erosion and sedimentation effects of construction activities. This impact would be less than significant.

This impact would be the same as Impact Geo-9 (CP1) and would be less than significant. Mitigation for this impact is proposed in Section 4.3.5.

Impact Geo-10 (CP4): Substantial Soil Erosion or Loss of Topsoil Due to Construction CP4 involves replenishing spawning gravel in the Upper Sacramento River between Keswick Dam and Red Bluff diversion Dam. Implementation of these activities could potentially contribute to soil erosion or loss of topsoil from clearing, grading, and grubbing activities required while constructing roadways to access the new spawning gravel sites. In addition, soil erosion could also potentially occur at sites where clearing and grubbing of the river bank would be required to allow the gravel to be placed on the river bank for recruitment. An Erosion and Sediment Control Plan would be implemented, as described in Chapter 2, Environmental Commitments Common to All Action Alternatives, to control any short-term and long-term erosion and sedimentation effects of construction activities. This impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact Geo-11 (CP4): Alteration of Fluvial Geomorphology Under implementation of CP4, measures would be taken to restore riparian, floodplain, and side channel habitat at Reading Island, which lies along the Sacramento River just north of Cottonwood Creek in Shasta County. Implementation of CP4 would involve breaching the levee separating Anderson Creek Slough from the Sacramento River. Breaching of the levee would ideally allow Anderson Creek Slough, which previously captured a portion of the Sacramento River flow and functioned as a side channel habitat to reestablish connectivity at flows greater than 4,000 to 6,000 cfs. The reestablished side channel could potentially experience changes in fluvial geomorphology that could result in channelized or unstable braided streams depending on the gradient of the channel. However, restoration of habitat through planting of native vegetation would stabilize

channel banks. This impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Lower Sacramento River and Delta This section describes impacts to the lower Sacramento River and Delta portions of the extended study area associated with CP4.

Impact Geo-12 (CP4): Substantial Increase in Channel Erosion and Meander Migration It is not anticipated that implementation of CP4 would lead to increased channel erosion and meander migration as compared to the No-Action Alternative and existing conditions. Under implementation of CP1, there would be a potential reduction in high flow events. Therefore, increases in Sacramento River flow would be limited and affects to reservoirs and rivers in the extended study area would be attenuated and dissipated by the large number of these water bodies, as well as by flood bypasses in the extended study area. This impact would be less than significant.

This impact would be similar to Impact Geo-9 (CP1) and would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

CVP/SWP Service Areas This section describes impacts to the CVP/SWP service areas within the extended study area associated with CP4.

Impact Geo-13 (CP4): Substantial Increase in Channel Erosion and Meander Migration It is not anticipated that implementation of CP4 would lead to increased channel erosion and meander migration as compared to the No-Action Alternative and existing conditions. Changes in water operations in the CVP/SWP service areas could potentially result in small changes in flow in the American and Feather rivers, as a result of operations at Folsom Dam and Oroville Dam. However, changes in flow affecting these reservoirs and rivers in the extended study area would be within the normal range of conditions and would not be expected to result in an increase in channel erosion or meander migration. This impact would be less than significant.

This impact would be the same as Impact Geo-9 (CP1) and would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

CP5 – 18.5-Foot Dam Raise, Combination Plan

This section describes impacts associated with CP5, which includes raising Shasta Dam 18.5 feet. This alternative also includes (1) implementing environmental restoration features along the lower reaches of major tributaries to Shasta Lake, (2) constructing shoreline fish habitat around Shasta Lake, and (3) constructing additional and/or improved recreation features at various locations around Shasta Lake to increase the value of the recreational experience. The dam raise would increase the reservoir's full pool elevation by 20.5 feet to about 1,090 feet above msl, and enlarge total storage space by 634,000 acre-feet.

Shasta Lake and Vicinity This section describes impacts to the Shasta Lake portion of the primary study area for CP5.

Impact Geo-1 (CP5): Exposure of Structures and People to Geologic Hazards Resulting from Seismic Conditions, Slope Instability, and Volcanic Eruption Implementing CP5 has the potential to increase the exposure of structures and people to geologic hazards similar to CP1. For the same reasons as apply to CP1, impacts resulting from seismic conditions would be less than significant for CP5.

Like CP3, under CP5, the pool level increase would inundate 173 acres of mapped slope instability hazards. Relocation of infrastructure is proposed to occur in the vicinity of about 232 acres of mapped slope instability hazards. For the same reasons as apply to CP1, impacts resulting from slope instability hazards would be less than significant for CP5.

For the same reasons as apply to CP1, impacts resulting from hazards associated with volcanic eruptions would be less than significant for CP5. Mitigation for this impact is not needed, and thus not proposed.

Impact Geo-2 (CP5): Alteration of Fluvial Geomorphology and Hydrology of Aquatic Habitats Like CP3, under CP5 stream channel equilibrium and geomorphology would be affected by an increase in full pool level. Inundation of lower gradient streams draining to Shasta Lake could result in long-term changes to channel equilibrium by changing the sediment transport capacity of the stream channels between 1,070 and 1,090 feet of elevation.

Based on a GIS-generated stream network, the total stream length inundated as a result of CP5 would be the same as for CP3, about 36.5 miles (see Figure 4-10). This value equates to about 1.3 percent of the total length of the streams in watersheds that are directly adjacent and contributory to Shasta Lake. Of the 36.5 miles inundated, about 12.1 miles are streams with a gradient less than 7 percent. This impact would be significant. Mitigation for this impact is proposed in Section 4.3.5.

Impact Geo-3 (CP5): Lost or Diminished Availability of Known Mineral Resources That Would Be of Future Value to the Region Implementing CP5 has the same potential as CP1 to diminish the availability in the region of cement, concrete sand, and aggregate. For the same reasons that apply to CP1, this impact would be significant and unavoidable for CP5. Mitigation for this impact is not available.

Impact Geo-4 (CP5): Lost or Diminished Soil Biomass Productivity Like CP3, under CP5 soil productivity would be lost due to periodic inundation caused by increasing the full pool elevation and by construction including relocation of infrastructure. The acreages of these losses would be the same as those reported for CP3.

This impact would be significant and unavoidable. Mitigation for this impact is not available.

Impact Geo-5 (CP5): Substantial Soil Erosion or Loss of Topsoil Due to Shoreline Processes Under CP5, the area of shoreline that would be inundated would be the same as the area reported under CP3, about 2,498 acres. Substantial soil erosion and loss of topsoil would result. The previous descriptions of the time steps and associated volumes of soil lost due to shoreline processes under CP3 also apply to CP5.

This impact would be significant and unavoidable. Mitigation for this impact is not available.

Impact Geo-6 (CP5): Substantial Soil Erosion or Loss of Topsoil Due to Upland Processes Alternative CP5 is similar to Alternative CP3 with respect to its potential to cause substantial soil erosion or loss of topsoil due to upland processes. The area disturbed by construction activities under CP5 is roughly the same as the area disturbed under CP3, about 3,340 acres. Of this area, approximately 3,128 acres are assigned a hazard rating of severe. For the same reasons as apply to CP1, this impact would be less than significant for CP5. Mitigation for this impact is not needed, and thus not proposed.

Impact Geo-7 (CP5): Be Located on a Geologic Unit or Soil That is Unstable, or That Would Become Unstable as a Result of the Project, and Potentially Result in Subsidence Alternative CP5 is similar to Alternative CP1 with respect to its potential to cause or be effected by subsidence. For the same reasons as apply to CP1, this impact would be less than significant for CP5. Mitigation for this impact is not needed, and thus not proposed.

Impact Geo-8 (CP5): Failure of Septic Tanks or Alternative Wastewater Disposal Systems Due to Soils that are Unsuited to Land Application of Waste Alternative CP5 is similar to Alternative CP1 with respect to its potential to cause or be effected by failure of septic tanks or alternative wastewater disposal systems due to soils that are unsuited to land application of waste. For the same reasons as apply to CP1, this impact would be less than significant for CP5. Mitigation for this impact is not needed, and thus not proposed.

Upper Sacramento River (Shasta Dam to Red Bluff) This section describes impacts to the upper Sacramento River portion of the primary study area associated with CP5.

Impact Geo-9 (CP5): Potential Increase in Channel Erosion and Meander Migration It is not anticipated that implementation of CP5 would lead to increased channel erosion and meander migration as compared to the No-Action Alternative and existing conditions. However, by altering storage and operations at Shasta Lake as compared to the No-Action Alternative and existing condition, this alternative would change the maximum pool elevation

and seasonal pool elevations at Shasta Lake and the flow regime in the Sacramento River and potentially several other reservoirs and downstream waterways. Alterations to river flows could potentially change downstream stream erosion and change downstream geomorphologic characteristics. However, the frequency and duration of high flow events resulting from this action are expected to be reduced as compared to existing conditions with current operations. Therefore, downstream erosion would not be anticipated to increase. An Erosion and Sediment Control Plan would be implemented, as described in Chapter 2, Environmental Commitments Common to All Action Alternatives, to control any short-term and long-term erosion and sedimentation effects of construction activities. This impact would be less than significant.

Because Shasta Dam and Reservoir operations would be the same for CP3 and CP5, this impact would be the same as Impact Geo-9 (CP3) and would be less than significant. Mitigation for this impact is proposed in Section 4.3.5.

Impact Geo-10 (CP5): Substantial Soil Erosion or Loss of Topsoil Due to Construction CP5 involves replenishing spawning gravel in the Upper Sacramento River between Keswick Dam and Red Bluff Diversion Dam. Implementation of these activities could potentially contribute to soil erosion or loss of topsoil from clearing, grading, and grubbing activities required while constructing roadways to access the new spawning gravel sites. In addition, soil erosion could also potentially occur at sites where clearing and grubbing of the river bank would be required to allow the gravel to be placed on the river bank for recruitment. An Erosion and Sediment Control Plan would be implemented, as described in Chapter 2, Environmental Commitments Common to All Action Alternatives, to control any short-term and long-term erosion and sedimentation effects of construction activities. This impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact Geo-11 (CP5): Alteration of Fluvial Geomorphology Under implementation of CP5, measures would be taken to restore riparian, floodplain, and side channel habitat at Reading Island, which lies along the Sacramento River just north of Cottonwood Creek in Shasta County. Implementation of CP5 would involve breaching the levee separating Anderson Creek Slough from the Sacramento River. Breaching the levee would ideally allow Anderson Creek Slough, which previously captured a portion of the Sacramento River flow and functioned as a side channel habitat, to reestablish connectivity at flows greater than 4,000 to 6,000 cfs. The reestablished side channel could potentially experience changes in fluvial geomorphology that could result in channelized or unstable braided streams, depending on the gradient of the channel. However, restoration of habitat through planting of native vegetation would stabilize channel banks. This impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Lower Sacramento River and Delta This section describes impacts to the lower Sacramento River and Delta portions of the extended study area associated with CP5.

Impact Geo-12 (CP5): Substantial Increase in Channel Erosion and Meander Migration It is not anticipated that implementation of CP5 would lead to increased channel erosion and meander migration as compared to the No-Action Alternative and existing conditions. Under implementation of CP1, there would be a potential reduction in high flow events. Therefore, increases in Sacramento River flow would be limited and affects to reservoirs and rivers in the extended study area would be attenuated and dissipated by the large number of these water bodies, as well as by flood bypasses in the extended study area. This impact would be less than significant.

Because Shasta Dam and Reservoir operations would be the same for CP3 and CP5, this impact would be the same as Impact Geo-9 (CP3) and would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

CVP/SWP Service Areas This section describes impacts to the CVP/SWP service areas within the extended study area associated with CP5.

Impact Geo-13 (CP5): Substantial Increase in Channel Erosion and Meander Migration It is not anticipated that implementation of CP5 would lead to increased channel erosion and meander migration as compared to the No-Action Alternative and existing conditions. Changes in water operations in the CVP/SWP service areas could potentially result in small changes in flow in the American and Feather rivers, as a result of operations at Folsom Dam and Oroville Dam. However, changes in flow affecting these reservoirs and rivers in the extended study area would be within the normal range of conditions and would not be expected to result in an increase in channel erosion or meander migration. This impact would be less than significant.

Because Shasta Dam and Reservoir operations would be the same for CP3 and CP5, this impact would be the same as Impact Geo-9 (CP3) and would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

4.3.5 Mitigation Measures

This section discusses mitigation measures for each significant impact described in the environmental consequences section, as presented in Table 4-13.

Table 4-13. Summary of Mitigation Measures for Geology, Geomorphology, Minerals, and Soils

Impact		No-Action Alternative	CP1	CP2	CP3	CP4	CP5
Impact Geo-1: Exposure of Structures and People to Geologic Hazards Resulting from Seismic Conditions, Slope Instability, and Volcanic Eruptions	LOS before Mitigation	NI	LTS	LTS	LTS	LTS	LTS
	Mitigation Measure	None required.	None needed; thus, none proposed.				
	LOS after Mitigation	NI	LTS	LTS	LTS	LTS	LTS
Impact Geo-2: Alteration of Fluvial Geomorphology and Hydrology of Aquatic Habitats	LOS before Mitigation	NI	S	S	S	S	S
	Mitigation Measure	None required.	Mitigation Measure Geo-2: Replace Lost Ecological Functions of Aquatic Habitats By Restoring Existing Degraded Aquatic Habitats in the Vicinity of the Impact.				
	LOS after Mitigation	NI	LTS	LTS	LTS	LTS	LTS
Impact Geo-3: Loss or Diminished Availability of Known Mineral Resources That Would Be of Future Value to the Region	LOS before Mitigation	NI	SU	SU	SU	SU	SU
	Mitigation Measure	None required.	None available.				
	LOS after Mitigation	NI	SU	SU	SU	SU	SU
Impact Geo-4: Lost or Diminished Soil Biomass Productivity	LOS before Mitigation	NI	SU	SU	SU	SU	SU
	Mitigation Measure	None required	None available.				
	LOS after Mitigation	NI	SU	SU	SU	SU	SU
Impact Geo-5: Substantial Soil Erosion or Loss of Topsoil Due to Shoreline Processes	LOS before Mitigation	NI	SU	SU	SU	PS	SU
	Mitigation Measure	None required	None available				
	LOS after Mitigation	NI	SU	SU	SU	SU	SU

Table 4-13. Summary of Mitigation Measures for Geology, Geomorphology, Minerals, and Soils (contd.)

Impact		No-Action Alternative	CP1	CP2	CP3	CP4	CP5
Impact Geo-6: Substantial Soil Erosion or Loss of Topsoil Due to Upland Processes	LOS before Mitigation	NI	LTS	LTS	LTS	LTS	LTS
	Mitigation Measure	None required.	None needed; thus, none proposed.				
	LOS after Mitigation	NI	LTS	LTS	LTS	LTS	LTS
Impact Geo-7: Be Located on a Geologic Unit or Soil That is Unstable, or That Would Become Unstable as a Result of the Project, and Potentially Result in Subsidence	LOS before Mitigation	NI	LTS	LTS	LTS	LTS	LTS
	Mitigation Measure	None required.	None needed; thus, none proposed.				
	LOS after Mitigation	NI	LTS	LTS	LTS	LTS	LTS
Impact Geo-8: Failure of Septic Tanks or Alternative Wastewater Disposal Systems Due to Soils that are Unsuited to Land Application of Waste	LOS before Mitigation	NI	LTS	LTS	LTS	LTS	LTS
	Mitigation Measure	None required.	None needed; thus, none proposed.				
	LOS after Mitigation	NI	LTS	LTS	LTS	LTS	LTS
Impact Geo-9: Substantial Increase in Channel Erosion and Meander Migration	LOS before Mitigation	NI	LTS	LTS	LTS	LTS	LTS
	Mitigation Measure	None required.	Mitigation Measure Geo-9: Implement Channel Sensitive Water Release Schedules.				
	LOS after Mitigation	NI	LTS	LTS	LTS	LTS	LTS

Table 4-13. Summary of Mitigation Measures for Geology, Geomorphology, Minerals, and Soils (contd.)

Impact		No-Action Alternative	CP1	CP2	CP3	CP4	CP5
Impact Geo-10: Substantial Soil Erosion or Loss of Topsoil Due to Construction	LOS before Mitigation	NI	NI	NI	NI	LTS	LTS
	Mitigation Measure	None required.	None needed; thus, none proposed.				
	LOS after Mitigation	NI	NI	NI	NI	LTS	LTS
Impact Geo-11: Alteration of Fluvial Geomorphology	LOS before Mitigation	NI	NI	NI	NI	LTS	LTS
	Mitigation Measure	None required.	None needed; thus, none proposed.				
	LOS after Mitigation	NI	NI	NI	NI	LTS	LTS
Impact Geo-12: Substantial Increase in Channel Erosion and Meander Migration (Lower Sacramento River and Delta)	LOS before Mitigation	NI	LTS	LTS	LTS	LTS	LTS
	Mitigation Measure	None required.	None needed; thus, none proposed.				
	LOS after Mitigation	NI	LTS	LTS	LTS	LTS	LTS
Impact Geo-13: Substantial Increase in Channel Erosion and Meander Migration (CVP/SWP Service Areas)	LOS before Mitigation	NI	LTS	LTS	LTS	LTS	LTS
	Mitigation Measure	None required.	None needed; thus, none proposed.				
	LOS after Mitigation	NI	LTS	LTS	LTS	LTS	LTS

Key:
CVP = Central Valley Project
LOS = level of significance
LTS = less than significant
NI = No Impact
PS = potentially significant
S = significant
SU = significant and unavoidable
SWP = State Water Project

No-Action Alternative

No mitigation measures are required for this alternative.

CP1 – 6.5-Foot Dam Raise, Anadromous Fish Survival and Water Supply

The following section describes the mitigation measures associated with potential impacts of CP1.

Mitigation Measure Geo-2 (CP1): Replace Lost Ecological Functions of Aquatic Habitats By Restoring Existing Degraded Aquatic Habitats in the Vicinity of the Impact The loss of 18.5 miles of intermittent and perennial streams (including 6.2 miles of streams with a gradient less than 7 percent) will be mitigated by compensating for the impact by replacing or providing substitute resources or environments. Compensation will be accomplished by restoring and enhancing the aquatic functions of existing, degraded aquatic habitats in or near the Shasta Lake and vicinity area. Examples of techniques that may be used include channel and bank stabilization, channel redirection, channel reconstruction, culvert replacement and elimination of barriers to fish passage, and enhancement of habitat physical structure (e.g., placement of woody debris, rocks). The nature and extent of the restoration and enhancement activities will be based on an assessment of the ecological functions that are lost as a consequence of implementing this alternative. Implementation of this mitigation measure would render the impact less than significant.

Mitigation Measure Geo-9 (CP1): Implement Channel-Sensitive Water Release Schedules Dam operators will establish water release schedules that would maintain flow levels equal to or similar to current operating conditions. Under a sound water release regime, single event flows would remain at levels similar to the existing condition, although the frequency and duration of these flows could increase. This potential increase in frequency and duration would not be considered significant provided that single event flow levels do not exceed current operating conditions. Implementation of this mitigation measure would reduce the impact to a less than significant level.

Mitigation Measure Geo-9 (CP1) would reduce the impact of potential channel erosion and meander migration to a level of less than significant.

In wet years, CP1 would decrease potential channel erosion and meander migration compared to the existing condition, because of the dam's ability to store more water than is currently possible. Greater storage capacity would provide dam operators more flexibility in timing and amount of water that would be released during wet years, decreasing the need for large releases when the dam is at or near capacity. This impact would be less than significant after implementation of channel-sensitive water release schedules.

CP2 – 12.5-Foot Dam Raise, Anadromous Fish Survival and Water Supply

The following section describes the mitigation measures associated with potential impacts of CP2.

Mitigation Measure Geo-2 (CP2): Replace Lost Ecological Functions of Aquatic Habitats By Restoring Existing Degraded Aquatic Habitats in the Vicinity of the Impact The loss of 25.5 miles of intermittent and perennial streams (including 8.2 miles of streams with a gradient less than 7 percent) will be mitigated by compensating for the impact by replacing or providing substitute resources or environments. Compensation will be accomplished by restoring and enhancing the aquatic functions of existing, degraded aquatic habitats in or near the Shasta Lake and vicinity area. Examples of techniques that may be used include channel and bank stabilization, channel redirection, channel reconstruction, culvert replacement and elimination of barriers to fish passage, and enhancement of habitat physical structure (e.g., placement of woody debris, rocks). The nature and extent of the restoration and enhancement activities will be based on an assessment of the ecological functions that are lost as a consequence of implementing this alternative. Implementation of this mitigation measure would render the impact less than significant.

Mitigation Measure Geo-9 (CP2): Implement Channel-Sensitive Water Release Schedules This mitigation measure is identical to Mitigation Measure Geo-9 (CP1).

Implementation of Mitigation Measure Geo-9 (CP2) would reduce the stream channel erosion and meander migration impact associated with CP2 to a less than significant level.

In wet years, CP2 would decrease potential channel erosion and meander migration compared to the existing condition, because of the dam's ability to retain more water than is currently possible. Greater storage capacity would provide dam operators more flexibility in the timing and amount of water that would be released during wet years, decreasing the need for large releases when the dam is at or near capacity. This impact would be less than significant after implementation of channel-sensitive water release schedules.

CP3 – 18.5-Foot Dam Raise, Anadromous Fish Survival and Water Supply

The following section describes the mitigation measures associated with potential impacts of CP3.

Mitigation Measure Geo-2 (CP3): Replace Lost Ecological Functions of Aquatic Habitats By Restoring Existing Degraded Aquatic Habitats in the Vicinity of the Impact The loss of 36.5 miles of intermittent and perennial streams (including 12.1 miles of streams with a gradient less than 7 percent) will be mitigated by compensating for the impact by replacing or providing substitute resources or environments. Compensation will be accomplished by restoring and enhancing the aquatic functions of existing, degraded aquatic

habitats in or near the Shasta Lake and vicinity area. Examples of techniques that may be used include channel and bank stabilization, channel redirection, channel reconstruction, culvert replacement and elimination of barriers to fish passage, and enhancement of habitat physical structure (e.g., placement of woody debris, rocks). The nature and extent of the restoration and enhancement activities will be based on an assessment of the ecological functions that are lost as a consequence of implementing this alternative. Implementation of this mitigation measure would render the impact less than significant.

Mitigation Measure Geo-9 (CP3): Implement Channel-Sensitive Water Release Schedules This mitigation measure is identical to Mitigation Measure Geo-9 (CP1).

Implementation of Mitigation Measure Geo-9 (C3) would reduce the stream channel erosion and meander migration impact associated with CP3 to a less than significant level.

In wet years, CP3 would decrease potential channel erosion and meander migration compared to the existing condition, because of the dam's ability to retain more water than is currently possible. More retention capacity would provide dam operators more flexibility in the timing and amount of water that would be released during wet years, decreasing the need for large releases when the dam is at or near capacity. This impact would be less than significant after implementation of channel-sensitive water release schedules.

CP4 – 18.5-Foot Dam Raise, Anadromous Fish Focus With Water Supply Reliability

The following section describes the mitigation measures associated with potential impacts of CP4.

Mitigation Measure Geo-2 (CP4): Replace Lost Ecological Functions of Aquatic Habitats By Restoring Existing Degraded Aquatic Habitats in the Vicinity of the Impact This mitigation measure is identical to Mitigation Measure Geo-2 (CP3). Implementation of this mitigation measure would reduce the impact to a less than significant level.

Mitigation Measure Geo-9 (CP4): Implement Channel-Sensitive Water Release Schedules This mitigation measure is identical to Mitigation Measure Geo-9 (CP1).

Implementation of Mitigation Measure Geo-9 (CP4) would reduce the stream channel erosion and meander migration impact associated with CP4 to a less than significant level. Mitigation Measure Geo-9 (CP4) would also provide mitigation for the less than significant impacts Geo-10 (CP4), and Geo-11 (CP4).

In wet years, CP4 would decrease potential channel erosion and meander migration compared to the existing condition, because of the dam's ability to

retain more water than is currently possible. More retention capacity would provide dam operators more flexibility in the timing and amount of water that would be released during wet years, decreasing the need for large releases when the dam is at or near capacity. This impact would be less than significant after implementation of channel-sensitive water release schedules.

CP5 – 18.5-Foot Dam Raise, Combination Plan

The following section describes the mitigation measures associated with potential impacts of CP5.

Mitigation Measure Geo-2 (CP5): Replace Lost Ecological Functions of Aquatic Habitats By Restoring Existing Degraded Aquatic Habitats in the Vicinity of the Impact This mitigation measure is identical to Mitigation Measure Geo-2 (CP3). Implementation of this mitigation measure would reduce the impact to a less than significant level.

Mitigation Measure Geo-9 (CP5): Implement Channel-Sensitive Water Release Schedules This mitigation measure is identical to Mitigation Measure Geo-9 (CP1).

Implementation of Mitigation Measure Geo-9 (CP5) would reduce the stream channel erosion and meander migration impact associated with CP5 to a less than significant level. Mitigation Measure Geo-9 (CP5) would also provide mitigation for the less than significant impacts Geo-10 (CP5), and Geo-11 (CP5).

In wet years, CP5 would decrease potential channel erosion and meander migration compared to the existing condition, because of the dam's ability to retain more water than is currently possible. More retention capacity would provide dam operators more flexibility in the timing and amount of water that would be released during wet years, decreasing the need for large releases when the dam is at or near capacity. This impact would be less than significant after implementation of channel-sensitive water release schedules.

4.3.6 Cumulative Effects

Chapter 3, "Considerations for Describing the Affected Environment and environmental Consequences" discusses overall cumulative impacts of the project alternatives, including the relationship to CALFED Programmatic Cumulative Impacts Analysis, qualitative and quantitative assessment, past and future actions in the study area, and significance criteria.

This section provides an analysis of overall cumulative impacts of the project alternatives with other past, present, and reasonably foreseeable future projects producing related impacts. For both the primary and extended study areas, a number of factors could substantially affect geology, soils and erosion, mineral resources, and geomorphology as an outcome of present and future actions. These actions may result in either a beneficial or adverse impact for the study

areas. However, there is a high level of uncertainty regarding potential effects of the reasonably foreseeable future actions. Therefore, geology, soils and erosion, mineral resources, and geomorphology are expected to remain in similar conditions to existing conditions with the exception of potential effects associated with future climate change as described below.

The effects of climate change on operations at Shasta Lake could potentially result in changes to downstream geomorphology. As described in the Climate Change Projection Appendix, climate change could result in higher reservoir releases in the future due to an increase in winter and early spring inflow into the lake from high intensity storm events. The change in reservoir releases could be necessary to manage for flood events resulting from these potentially larger storms. The potential increase in releases from the reservoir could lead to long-term changes in downstream channel equilibrium.

The effects of increased monthly inflow into Shasta Lake in winter and early spring could also potentially result in changes to stream channel equilibrium and geomorphology upstream from the lake and at the point where the streams meet the lake.

CP1 – 6.5-Foot Dam Raise, Anadromous Fish Survival and Water Supply Reliability

As discussed in Section 4.3.4 above, CP1 could result in (1) several localized project-level impacts related to exposure of structures and people to geologic hazards (less than significant), (2) alteration of fluvial geomorphology and hydrology of aquatic habitats (significant but mitigable), (3) soil erosion from shoreline processes (significant and unavoidable), (4) soil erosion from upland processes (less than significant), (5) location of project features on unstable geologic or soil units (less than significant), and (6) the suitability of soils for wastewater disposal systems (less than significant). As with many types of geologic impacts, these project-level impacts are localized and would not contribute to any cumulative impacts.

Also discussed in Section 4.3.4 above, CP1 could result in regional impacts related to a diminished availability of cement, concrete sand, and aggregate and a loss of soil productivity. When taken together with reasonable foreseeable future projects in the region, CP1 could contribute to significant cumulative impacts related to these mineral and soil biomass resources. Mitigation is not available for either of these impacts; therefore, these cumulative impacts would be considered significant and unavoidable.

As stated previously, effects of climate change on operations at Shasta Lake could include a higher frequency of high flow events, potentially resulting in changes to geomorphology. While implementation of CP1 could potentially diminish these effects through additional storage capacity of the reservoir available after construction, it is not expected to result in long-term changes to channel equilibrium downstream from Shasta Dam. In addition, potential

impacts associated with channel meander and erosion under CP1 would be less than significant in the Shasta Lake and vicinity portion of the study area, the upper Sacramento River (Shasta Dam to Red Bluff) portion of the primary study area, and in the extended study area. When added to the anticipated effects of climate change, raising Shasta Dam would not have a significant cumulative effect.

CP2 – 12.5-Foot Dam Raise, Anadromous Fish Survival and Water Supply Reliability

As discussed in Section 4.3.4 above, CP2 could result in (1) several localized project-level impacts related to exposure of structures and people to geologic hazards (less than significant), (2) alteration of fluvial geomorphology and hydrology of aquatic habitats (significant but mitigable), (3) soil erosion from shoreline processes (significant and unavoidable), (4) soil erosion from upland processes (less than significant), (5) location of project features on unstable geologic or soil units (less than significant), and (6) the suitability of soils for wastewater disposal systems (less than significant). As with many types of geologic impacts, these project-level impacts are localized and would not contribute to any cumulative impacts.

Also discussed in Section 4.3.4 above, CP2 could result in regional impacts related to a diminished availability of cement, concrete sand, and aggregate and a loss of soil productivity. When taken together with reasonable foreseeable future projects in the region, therefore, CP2 could contribute to significant cumulative impacts related to these mineral and soil biomass resources. Mitigation is not available for either of these impacts; therefore, these cumulative impacts would be considered significant and unavoidable.

As stated previously, effects of climate change on operations at Shasta Lake could include a higher frequency of high flow events, potentially resulting in changes to geomorphology. While implementation of CP2 could potentially diminish these effects through additional storage capacity of the reservoir available after construction, it is not expected to result in long-term changes to channel equilibrium downstream from Shasta Dam. In addition, potential impacts associated with channel meander and erosion under CP2 would be less than significant in the Shasta Lake and vicinity portion of the study area, the upper Sacramento River (Shasta Dam to Red Bluff) portion of the primary study area, and in the extended study area. When added to the anticipated effects of climate change, raising Shasta Dam would not have a significant cumulative effect.

CP3 – 18.5-Foot Dam Raise, Anadromous Fish Survival and Water Supply

As discussed in Section 4.3.4 above, CP3 could result in (1) several localized project-level impacts related to exposure of structures and people to geologic hazards (less than significant), (2) alteration of fluvial geomorphology and hydrology of aquatic habitats (significant but mitigable), (3) soil erosion from shoreline processes (significant and unavoidable), (4) soil erosion from upland

processes (less than significant), (5) location of project features on unstable geologic or soil units (less than significant), and (6) the suitability of soils for wastewater disposal systems (less than significant). As with many types of geologic impacts, these project-level impacts are localized and would not contribute to any cumulative impacts.

Also discussed in Section 4.3.4 above, CP3 could result in regional impacts related to a diminished availability of cement, concrete sand, and aggregate and a loss of soil productivity. When taken together with reasonable foreseeable future projects in the region, therefore, CP3 could contribute to significant cumulative impacts related to these mineral and soil biomass resources. Mitigation is not available for either of these impacts; therefore, these cumulative impacts would be considered significant and unavoidable.

As stated previously, effects of climate change on operations at Shasta Lake could include a higher frequency of high flow events, potentially resulting in changes to geomorphology. While implementation of CP3 could potentially diminish these effects through additional storage capacity of the reservoir available after construction, it is not expected to result in long-term changes to channel equilibrium downstream from Shasta Dam. In addition, potential impacts associated with channel meander and erosion under CP3 would be less than significant in the Shasta Lake and vicinity portion of the study area, the upper Sacramento River (Shasta Dam to Red Bluff) portion of the primary study area, and in the extended study area. When added to the anticipated effects of climate change, raising Shasta Dam would not have a significant cumulative effect.

CP4 – 18.5-Foot Dam Raise, Anadromous Fish Focus With Water Supply Reliability

As discussed in Section 4.3.4 above, CP4 could result in (1) several localized project-level impacts related to exposure of structures and people to geologic hazards (less than significant), (2) alteration of fluvial geomorphology and hydrology of aquatic habitats (significant but mitigable), (3) soil erosion from shoreline processes (significant and unavoidable), (4) soil erosion from upland processes (less than significant), (5) location of project features on unstable geologic or soil units (less than significant), and (6) the suitability of soils for wastewater disposal systems (less than significant). As with many types of geologic impacts, these project-level impacts are localized and would not contribute to any cumulative impacts.

Also discussed in Section 4.3.4 above, CP4 could result in regional impacts related to a diminished availability of cement, concrete sand, and aggregate and a loss of soil productivity. When taken together with reasonable foreseeable future projects in the region, therefore, CP4 could contribute to significant cumulative impacts related to these mineral and soil biomass resources. Mitigation is not available for either of these impacts; therefore, these cumulative impacts would be considered significant and unavoidable.

As stated previously, effects of climate change on operations at Shasta Lake could include a higher frequency of high flow events, potentially resulting in changes to geomorphology. While implementation of CP4 could potentially diminish these effects through additional storage capacity of the reservoir available after construction, it is not expected to result in long-term changes to channel equilibrium downstream from Shasta Dam. In addition, potential impacts associated with channel meander and erosion under CP4 would be less than significant in the Shasta Lake and vicinity portion of the study area, the upper Sacramento River (Shasta Dam to Red Bluff) portion of the primary study area, and in the extended study area. When added to the anticipated effects of climate change, raising Shasta Dam would not have a significant cumulative effect.

CP5 – 18.5-Foot Dam Raise, Combination Plan

As discussed in Section 4.3.4 above, CP5 could result in several localized project-level impacts related to exposure of structures and people to geologic hazards (less than significant), alteration of fluvial geomorphology and hydrology of aquatic habitats (significant but mitigable), soil erosion from shoreline processes (significant and unavoidable), soil erosion from upland processes (less than significant), location of project features on unstable geologic or soil units (less than significant), and the suitability of soils for wastewater disposal systems (less than significant). As with many types of geologic impacts, these project-level impacts are localized and would not contribute to any cumulative impacts.

Also discussed in Section 4.3.4 above, CP5 could result in regional impacts related to a diminished availability of cement, concrete sand, and aggregate and a loss of soil productivity. When taken together with reasonable foreseeable future projects in the region, therefore, CP5 could contribute to significant cumulative impacts related to these mineral and soil biomass resources. Mitigation if not available for either of these impacts; therefore these cumulative impacts would be considered significant and unavoidable.

As stated previously, effects of climate change on operations at Shasta Lake could include a higher frequency of high flow events, potentially resulting in changes to geomorphology. While implementation of CP5 could potentially diminish these effects through additional storage capacity of the reservoir available after construction, it is not expected to result in long-term changes to channel equilibrium downstream from Shasta Dam. In addition, potential impacts associated with channel meander and erosion under CP5 would be less than significant in the Shasta Lake and vicinity portion of the study area, the upper Sacramento River (Shasta Dam to Red Bluff) portion of the primary study area, and in the extended study area. When added to the anticipated effects of climate change, raising Shasta Dam would not have a significant cumulative effect.

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Chapter 5
Air Quality and Climate

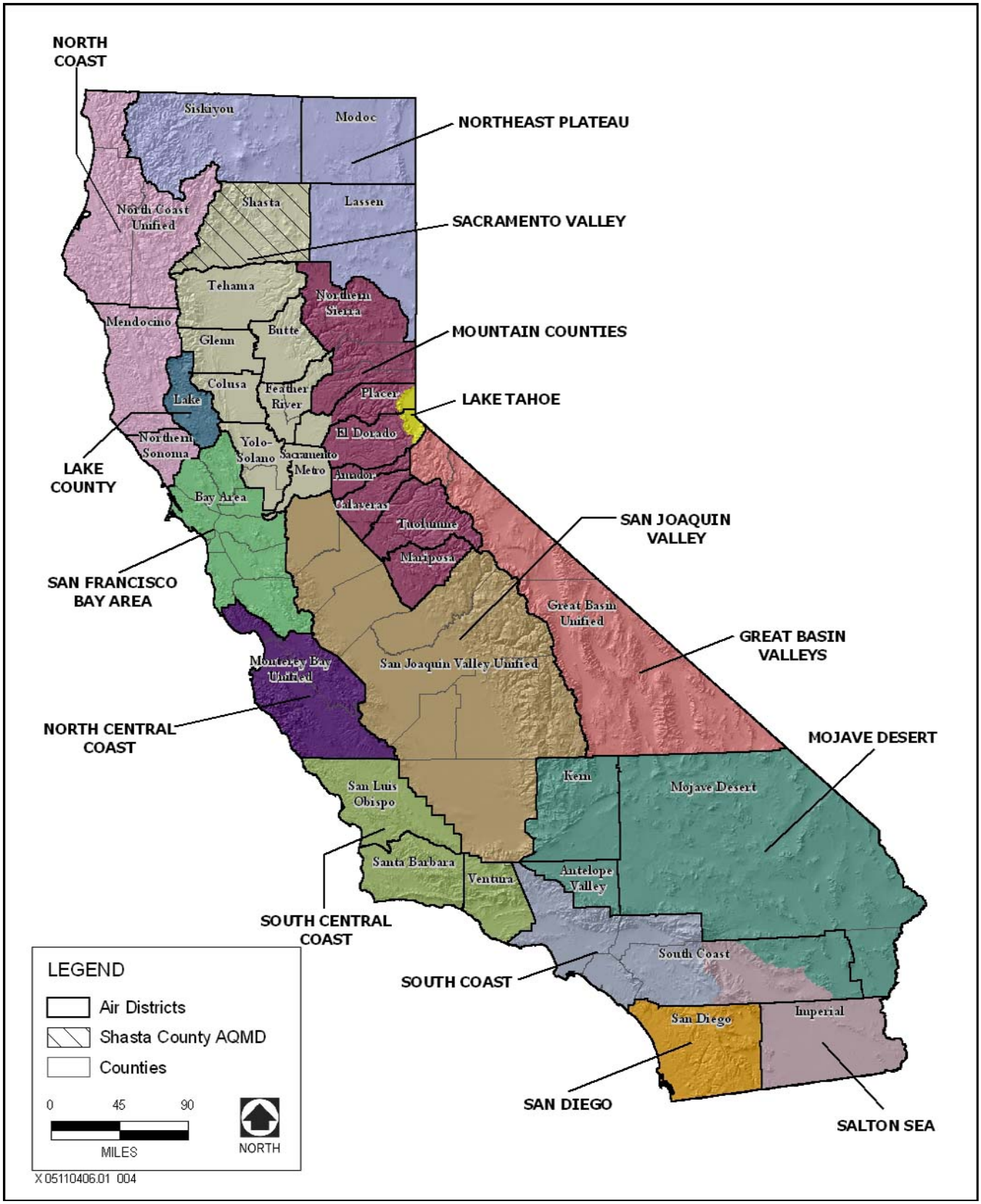
5.1 Affected Environment

This section describes existing air quality conditions in the primary study area for the dam and reservoir modifications proposed under the SLWRI. The climate and the emissions of criteria air pollutants and toxic air contaminants (TAC) at Shasta Lake and vicinity and the upper Sacramento River from Shasta Dam to Red Bluff are described. In addition, the attainment status of Shasta County relative to national and State air quality standards is summarized.

The primary study area for air quality analysis has two components—local and regional. The local area is the area immediately surrounding Shasta Dam and Shasta Lake where project construction would occur. Regionally, Shasta and Tehama counties are located in the Northern Sacramento Valley Air Basin (NSVAB), a subarea of the Sacramento Valley Air Basin (SVAB). The SVAB also includes all of Butte, Colusa, Glenn, Sacramento, Sutter, Yolo, and Yuba counties; the western portion of Placer County; and the eastern portion of Solano County. Figure 5-1 depicts the locations of these air basins, highlighting the Shasta County Air Quality Management District (SCAQMD) area. The NSVAB includes the seven counties located in the northern portion of the Sacramento Valley: Butte, Colusa, Glenn, Shasta, Sutter, Tehama, and Yuba.

The SLWRI would not include any construction or operational activities in the extended study area (the lower Sacramento River and Delta and the CVP and SWP service areas) that would affect air quality. Therefore, this section only minimally discusses air quality conditions in the extended study area. Details about conditions in the extended study area are available in the *Air Quality and Climate Technical Report*.

This section also summarizes current climate change effects of greenhouse gas (GHG) emissions on what is referred to in this chapter as the “global study area.”



Source: ARB 2004; data compiled by AECOM in 2011

Figure 5-1. Air Basins in California, Including the SCAQMD Area

5.1.1 Regional Climate in the Primary Study Area

The NSVAB is bounded on the north and west sides by the Coast Ranges and on the east side by the southern portion of the Cascade Range and the northern portion of the Sierra Nevada. These mountain ranges provide a substantial physical barrier to locally created air pollution, as well as pollution transported northward on prevailing winds from the Sacramento metropolitan area (NSVPAD 2010). The valley is often subject to inversion layers that, coupled with geographic barriers and high summer temperatures, create high potential for air pollution problems.

5.1.2 Criteria Air Pollutants

Concentrations of the following air pollutants are used as indicators of ambient air quality conditions: ozone, carbon monoxide (CO), nitrogen dioxide (NO_2), sulfur dioxide (SO_2), respirable and fine particulate matter (PM_{10} and $PM_{2.5}$), and lead. Because these are the most prevalent air pollutants known to be deleterious to human health, they are commonly referred to as "criteria air pollutants."

Each criteria air pollutant is described briefly below. A more in-depth discussion is provided in the *Air Quality and Climate Technical Report*.

Ozone

Ozone is a photochemical oxidant and the primary component of smog. Ozone is not directly emitted into the air, but is formed through complex chemical reactions between precursor emissions of reactive organic gases (ROG) and oxides of nitrogen (NO_X) in the presence of sunlight. ROG are volatile organic compounds (VOC). ROG emissions result primarily from incomplete combustion and the evaporation of chemical solvents and fuels. NO_X are a group of gaseous compounds of nitrogen and oxygen that results from the combustion of fuels.

Ozone located in the lower atmosphere is a major health and environmental concern. Meteorology and terrain play a major role in ozone formation. Low wind speeds or stagnant air coupled with warm temperatures and clear skies provide the optimum conditions for ozone formation. Therefore, summer is the peak ozone season. Ozone is a regional pollutant that often affects large areas. Ozone concentrations over or near urban and rural areas reflect an interplay of emissions of ozone precursors, transport, meteorology, and atmospheric chemistry (Godish 2004).

Carbon Monoxide

CO is a colorless, odorless, and poisonous gas produced by incomplete burning of carbon in fuels, primarily from mobile (transportation) sources. Approximately 77 percent of the nation's CO emissions are from mobile sources. The other 23 percent consist of CO emissions from wood-burning stoves, incinerators, and industrial sources. The highest concentrations are generally associated with cold, stagnant weather conditions that occur during

winter. In contrast to ozone, which is a regional pollutant, CO causes problems on a local scale.

Nitrogen Dioxide

NO_2 is a brownish, highly reactive gas that is present in all urban environments. The major human-made sources of NO_2 are combustion devices, such as boilers, gas turbines, and mobile and stationary combustion engines. NO_2 forms quickly from emissions from cars, trucks and buses, power plants, and off-road equipment. In addition to contributing to the formation of ground-level ozone and fine particle pollution, NO_2 is linked with a number of adverse effects on the respiratory system (EPA 2010). The combined emissions of NO and NO_2 are referred to as NO_X, which are reported as equivalent NO_2. Because NO_2 is formed and depleted by reactions associated with ozone, the NO_2 concentration in a particular geographical area may not be representative of the local NO_X emission sources.

Sulfur Dioxide

SO_2 is produced by such stationary sources as coal and oil combustion, steel mills, refineries, and pulp and paper mills. SO_2 is a respiratory irritant. On contact with the moist mucous membranes, SO_2 produces sulfurous acid.

Particulate Matter

Respirable particulate matter with an aerodynamic diameter of 10 micrometers or less is referred to as PM_{10}. PM_{10} consists of particulate matter emitted directly into the air, such as fugitive dust, soot, and smoke from mobile and stationary sources, construction operations, fires, and natural windblown dust, and particulate matter formed in the atmosphere by condensation and/or transformation of SO_2 and ROG. $PM_{2.5}$ includes a subgroup of finer particles that have an aerodynamic diameter of 2.5 micrometers or less (EPA 2011a).

Lead

Lead is a metal found naturally in the environment and in manufactured products. The major sources of lead emissions have historically been mobile and industrial sources. As a result of the phase-out of leaded gasoline, metal processing is currently the primary source of lead emissions. The highest levels of lead in air are generally found near lead smelters. Other stationary sources are waste incinerators, utilities, and lead-acid battery manufacturers.

5.1.3 Monitoring Station Data and Criteria Pollutant Attainment Area Designations

Shasta Lake and Vicinity and Upper Sacramento River (Shasta Dam to Red Bluff)

Concentrations of criteria air pollutants are measured at several monitoring stations in Shasta County. The Redding Health Department and Shasta Lake stations are the closest stations to the project construction area with recent data for ozone and particulate matter. In general, the ambient air quality

measurements from these stations are representative of the study area's air quality. Table 5-1 summarizes the air quality data from the most recent 3 years.

Table 5-1. Summary of Annual Ambient Air Quality Data (2007–2009)

	2007	2008	2009
OZONE			
Redding Health Department Monitoring Station			
Maximum concentration (1-hour/8-hour average, ppm)	0.089/0.073	0.090/0.82	0.084/0.069
Number of days State 1-hour/8-hour standard exceeded	0/5	0/13	0/0
Number of days national 1-hour/8-hour standard exceeded	0/0	0/4	0/0
FINE PARTICULATE MATTER ($PM_{2.5}$)			
Redding Health Department Monitoring Station			
Maximum concentration ($\mu g/m^3$)	18.6	200.2	20.2
Number of days national standard exceeded (measured[a])	0	5	0
RESPIRABLE PARTICULATE MATTER (PM_{10})			
Redding Health Department Monitoring Station			
Maximum concentration ($\mu g/m^3$)	36.0	232.0	32.6
Number of days State standard exceeded (measured/calculated[a])	0/0	5/32.7	0/0
Number of days national standard exceeded (measured/calculated[a])	0/0	1/6.6	0/0
Shasta Lake Monitoring Station			
Maximum concentration ($\mu g/m^3$)	57.0	104.9	32.2
Number of days State standard exceeded (measured/calculated[a])	1/-	3/19.5	0/0
Number of days national standard exceeded (measured/calculated[a])	0/0	0/0	0/0

Source: ARB 2011

Note:

[a] Measured days are those days that an actual measurement was greater than the level of the State daily standard or the national daily standard. Measurements are typically collected every 6 days. Calculated days are the estimated number of days that a measurement would have been greater than the level of the standard had measurements been collected every day. The number of days above the standard is not necessarily the number of violations of the standard for the year.

Key:

* = insufficient data available to determine value.

$\mu g/m^3$ = micrograms per cubic meter

$PM_{2.5}$ = fine particulate matter with an aerodynamic diameter of 2.5 micrometers or less

PM_{10} = respirable particulate matter with an aerodynamic diameter of 10 micrometers or less

ppm = parts per million

The monitoring data are used to designate areas according to their attainment status for criteria air pollutants. The purpose of these designations is to identify those areas with air quality problems and thereby initiate planning efforts for improvement. The three basic designation categories are "nonattainment," "attainment," and "unclassified." "Unclassified" is used in an area that cannot be classified on the basis of available information as meeting or not meeting the standards. In addition, the California designations include a subcategory of the nonattainment designation, "nonattainment-transitional," that is given to nonattainment areas that are progressing and nearing attainment. The most current attainment designations for Shasta County are shown in Table 5-2 for each criteria air pollutant.

Lower Sacramento River and Delta

The lower Sacramento River and Delta areas are within the SVAB and the San Joaquin Valley Air Basin. As described in greater detail in the *Air Quality and Climate Technical Report*, these basins are Federal and State nonattainment areas for ozone, PM_{10}, and $PM_{2.5}$.

CVP/SWP Service Areas

The CVP and SWP service areas extend beyond the Central Valley into the San Francisco Bay Area, North Central Coast, South Central Coast, and Mountain Counties air basins. Federal and State ozone attainment designations for all California counties and air basins are provided in the *Air Quality and Climate Technical Report*. All counties in California south of Shasta County, with the exception of Lake, Sonoma, Tuolumne, and Mariposa counties, are State nonattainment areas for PM_{10} (ARB 2010a).

5.1.4 Toxic Air Contaminants in the Primary Study Area

TACs, or in Federal terms hazardous air pollutants (HAP), are air pollutants that may cause or contribute to an increase in mortality or in serious illness, or that may pose a hazard to human health. TACs are usually present in minute quantities in the ambient air; however, their high toxicity or health risk may pose a threat to public health even at low concentrations. Of the TACs for which data are available in California, diesel particulate matter (diesel PM), naturally occurring asbestos, benzene, 1,3-butadiene, acetaldehyde, carbon tetrachloride, hexavalent chromium, para-dichlorobenzene, formaldehyde, methylene chloride, and perchloroethylene pose the greatest known health risks. Dioxins are also considered to pose substantial health risk and diesel PM poses the greatest health risk. Current facilities permitted by SCAQMD in the project vicinity are Lehigh Southwest Cement Company, Mountain Gate Quarry, Knauf Insulation, and Sierra Pacific Industries.

Table 5-2. Ambient Air Quality Standards and Designations

Pollutant	Averaging Time	California		National Standards [a]		
		Standards [b,c]	Attainment Status (Shasta County) [d]	Primary [c,e]	Secondary [c,f]	Attainment Status (Shasta County) [g]
Ozone	1-hour	0.09 ppm (180 µg/m^3)	N (Moderate)	*Note h*	Same as primary standard	–
	8-hour	0.070 ppm	–	0.075 ppm (147 µg/m^3)		U/A
Carbon monoxide	1-hour	20 ppm (23 mg/m^3)	U	35 ppm (40 mg/m^3)	–	U/A
	8-hour	9 ppm (10 mg/m^3)		9 ppm (10 mg/m^3)		
	8-hour (Lake Tahoe)	6 ppm (7 mg/m^3)	–	–	–	–
Nitrogen dioxide (NO_2)	Annual Arithmetic Mean	0.030 ppm (57 µg/m^3)	–	0.053 ppm (100 µg/m^3) [i]	Same as primary standard	U/A
	1-hour	0.18 ppm (339 µg/m^3)	A	0.100 ppm (188 µg/m^3) [i]		–
Sulfur dioxide (SO_2)	24-hour	0.04 ppm (105 µg/m^3)	A	–	–	U
	3-hour	–	–	–	0.5 ppm (1300 µg/m^3) [j]	
	1-hour	0.25 ppm (655 µg/m^3)	A	0.075 ppm (196 µg/m^3) [j]	–	–
Respirable particulate matter (PM_{10})	Annual Arithmetic Mean	20 µg/m^3	N	–	Same as primary standard	U/A
	24-hour	50 µg/m^3		150 µg/m^3 [f]		
Fine particulate matter ($PM_{2.5}$)	Annual Arithmetic Mean	12 µg/m^3	U	15 µg/m^3	Same as primary standard	U/A
	24-hour	–	–	35 µg/m^3		
Lead [k]	30-day Average	1.5 µg/m^3	A	–	–	–
	Calendar Quarter	–		1.5 µg/m^3	Same as primary standard	A
	Rolling 3 Month Average	–		0.15 µg/m^3		
Sulfates	24-hour	25 µg/m^3	A	No national standards		
Hydrogen sulfide	1-hour	0.03 ppm (42 µg/m^3)	U			
Vinyl chloride [k]	24-hour	0.01 ppm (26 µg/m^3)	U/A			
Visibility-reducing particle matter	8-hour	Extinction coefficient of 0.23 per kilometer—visibility of 10 mi or more	U			

Table 5-2. Ambient Air Quality Standards and Designations (contd.)

Sources: ARB 2010a, 2010b; EPA 2011b; data compiled by AECOM in 2011

Notes:

[a] National standards (other than ozone, particulate matter, and those based on annual averages or annual arithmetic means) are not to be exceeded more than once a year. The ozone standard is attained when the fourth highest 8-hour concentration in a year, averaged over 3 years, is equal to or less than the standard. The PM10 24-hour standard is attained when 99 percent of the daily concentrations, averaged over 3 years, are equal to or less than the standard. The PM2.5 24-hour standard is attained when 98 percent of the daily concentrations, averaged over 3 years, are equal to or less than the standard. Contact the U.S. Environmental Protection Agency (EPA) for further clarification and current Federal policies.

[b] California standards for ozone, CO (except Lake Tahoe), SO_2 (1- and 24-hour), NO_2, particulate matter, and visibility-reducing particles are values that are not to be exceeded. All others are not to be equaled or exceeded. California ambient air quality standards are listed in the Table of Standards in Section 70200 of Title 17 of the California Code of Regulations.

[c] Concentration expressed first in units in which it was promulgated (i.e., parts per million (ppm) or micrograms per cubic meter ($\mu g/m^3$)). Equivalent units given in parentheses are based upon a reference temperature of 25 degrees Celsius (°C) and a reference pressure of 760 torr. Most measurements of air quality are to be corrected to a reference temperature of 25°C and a reference pressure of 760 torr; ppm in this table refers to ppm by volume, or micromoles of pollutant per mole of gas.

[d] Unclassified (U): A pollutant is designated unclassified if the data are incomplete and do not support a designation of attainment or nonattainment.

Attainment (A): A pollutant is designated attainment if the State standard for that pollutant was not violated at any site in the area during a 3-year period.

Nonattainment (N): A pollutant is designated nonattainment if there was a least one violation of a State standard for that pollutant in the area.

Nonattainment/Transitional (NT): A subcategory of the nonattainment designation. An area is designated nonattainment/transitional to signify that the area is close to attaining the standard for that pollutant.

[e] National Primary Standards: The levels of air quality necessary, with an adequate margin of safety, to protect the public health.

[f] National Secondary Standards: The levels of air quality necessary to protect the public welfare from any known or anticipated adverse effects of a pollutant.

[g] Nonattainment (N): Any area that does not meet (or that contributes to ambient air quality in a nearby area that does not meet) the national primary or secondary ambient air quality standard for the pollutant.

Attainment (A): Any area that meets the national primary or secondary ambient air quality standard for the pollutant.

Unclassifiable (U): Any area that cannot be classified on the basis of available information as meeting or not meeting the national primary or secondary ambient air quality standard for the pollutant.

[h] The 1-hour ozone national ambient air quality standard was revoked on June 15, 2005, for all areas in California.

[i] To attain this standard, the 3-year average of the 98th percentile of the daily maximum 1-hour average at each monitor within an area must not exceed 0.100 part per million (ppm) (effective January 22, 2010). Note that the EPA standards are in units of parts per billion (ppb). California standards are in units of ppm. To directly compare the national standards to the California standards, the units can be converted from ppb to ppm. In this case, the national standards of 53 ppb and 100 ppb are identical to 0.053 ppm and 0.100 ppm, respectively.

[j] On June 2, 2010, EPA established a new 1-hour SO_2 standard, effective August 23, 2010, which is based on the 3-year average of the annual 99th percentile of 1-hour daily maximum concentrations. EPA also proposed a new automated Federal Reference Method (FRM) using ultraviolet technology, but will retain the older pararosaniline methods until the new FRM have adequately permeated State monitoring networks. EPA also revoked both the existing 24-hour SO_2 standard of 0.14 ppm and the annual primary SO_2 standard of 0.030 ppm, effective August 23, 2010.

The secondary SO_2 standard was not revised at that time; however, the secondary standard is undergoing a separate review by EPA. Note that the new standard is in ppb. California standards are in ppm. To directly compare the new primary national standard to the California standard the units can be converted to ppm. In this case, the national standard of 75 ppb is identical to 0.075 ppm.

[k] The California Air Resources Board has identified lead and vinyl chloride as toxic air contaminants with no threshold of exposure for adverse health effects determined. These actions allow for the implementation of control measures at levels below the ambient concentrations specified for these pollutants.

Key:

$\mu g/m^3$ = micrograms per cubic meter

mg/m^3 = milligrams per cubic meter

ppm = parts per million

5.1.5 Global Study Area

Atmospheric GHGs play a critical role in determining the earth's surface temperature. Solar radiation enters the earth's atmosphere from space. Prominent GHGs contributing to the greenhouse effect are carbon dioxide (CO_2), methane, nitrous oxide, hydrofluorocarbons, chlorofluorocarbons, and sulfur hexafluoride. Sources of GHG emissions associated with existing operations include vehicles used for operation and maintenance of the dam and recreation areas, vehicles used by recreational visitors, and fossil fuel–powered boats on Shasta Lake. Human-caused emissions of these GHGs that exceed natural ambient concentrations are responsible for intensifying the greenhouse effect and have led to a trend of unnatural warming of the earth's climate, known as global climate change or global warming (Ahrens 2003).

To provide a method of quantifying GHG emissions, the standard unit of CO_2e, or CO_2 equivalent, was developed. The definition of CO_2e is "The quantity of a given GHG multiplied by its total global warming potential (GWP). This is the standard unit for comparing the degree of warming that can be caused by GHGs" (CCAR 2009). The GWP of a GHG is dependent on the lifetime, or persistence, of the gas molecule in the atmosphere compared to CO_2. The GWP of methane is 23; the GWP of nitrous oxide is 296. Therefore, methane and nitrous oxide are more potent GHGs than CO_2. Expressing emissions in CO_2e takes the contributions of all GHG emissions to the greenhouse effect and converts them to a single unit equivalent to the effect that would occur if only CO_2 were being emitted. The most common quantity unit for CO_2e is million metric tons (MMT). In some reports, CO_2e is written as CO_2E, and million metric tons is written as MMT CO_2E.

Climate change is a global phenomenon. GHGs are global pollutants, unlike criteria air pollutants and TACs, which are pollutants of regional and local concern. Whereas pollutants with localized air quality effects have relatively short atmospheric lifetimes (about 1 day), GHGs have long atmospheric lifetimes (1 year to several thousand years). GHGs persist in the atmosphere for long enough time periods to be dispersed around the globe. Although the exact lifetime of any particular GHG molecule is dependent on multiple variables and cannot be pinpointed, it is understood that more CO_2 is emitted into the atmosphere than is sequestered by ocean uptake, vegetation, and other forms of sequestration. Of the total annual human-caused CO_2 emissions, approximately 54 percent is sequestered through ocean uptake, uptake by Northern Hemisphere forest regrowth, and other terrestrial sinks within a year, whereas the remaining 46 percent of human-caused CO_2 emissions remains stored in the atmosphere (Seinfeld and Pandis 1998).

Effects of GHGs are borne globally, as opposed to localized air quality effects of criteria air pollutants and TACs. The quantity of GHGs that it takes to ultimately result in climate change is not precisely known; suffice it to say that the quantity is enormous, and no single project alone would be expected to measurably contribute to a noticeable incremental change in the global average temperature,

or to global, local, or micro climate. From the standpoint of CEQA, GHG effects related to global climate change are inherently cumulative.

Please see the *Air Quality and Climate Technical Report* for a discussion of GHG feedback mechanisms and uncertainty.

5.2 Regulatory Framework

Air quality in Shasta County is regulated by such agencies as the U.S. Environmental Protection Agency (EPA), the California Air Resources Board (ARB), and SCAQMD. Each of these agencies develops rules, regulations, policies, and/or goals to comply with applicable legislation. Although EPA regulations may not be superseded, both State and local regulations may be more stringent.

5.2.1 Federal

Criteria Air Pollutants

At the Federal level, EPA implements national air quality programs. EPA's air quality mandates are drawn primarily from the Federal Clean Air Act (CAA), which was enacted in 1970 and most recently amended in 1990.

The CAA required EPA to establish primary and secondary national ambient air quality standards, as shown in Table 5-2. The CAA also required each state to prepare an air quality control plan referred to as a State implementation plan (SIP). The Federal Clean Air Act Amendments of 1990 (CAAA) added requirements for states with nonattainment areas to revise their SIPs to incorporate additional control measures to reduce air pollution. The SIP is modified periodically to reflect the latest emissions inventories, planning documents, and rules and regulations of the air basins as reported by their jurisdictional agencies. EPA reviews all SIPs to determine whether they conform to the mandates of CAA and its amendments, and whether implementation will achieve air quality goals. If EPA determines a SIP to be inadequate, a Federal implementation plan that imposes additional control measures may be prepared for the nonattainment area. Failure to submit an approvable SIP or to implement the plan within the mandated time frame may result in the application of sanctions to transportation funding and stationary air pollution sources in the air basin.

Hazardous Air Pollutants

Air quality regulations also focus on TACs, or in Federal parlance, HAPs. In general, for those TACs that may cause cancer, there is no concentration that does not present some risk. In other words, there is no threshold level below which adverse health effects may not be expected to occur. This contrasts with the criteria air pollutants, for which acceptable levels of exposure can be determined and for which the ambient standards have been established (Table

5-2). Instead, EPA and ARB regulate HAPs and TACs, respectively, through statutes and regulations that generally require the use of the maximum available control technology or best available control technology for toxics to limit emissions. These statutes and regulations establish the regulatory framework for TACs.

EPA has programs for identifying and regulating HAPs. Title III of the CAAA directed EPA to promulgate national emissions standards for HAPs. National emissions standards for HAPs vary depending on the pollutant source type. The national emissions standards for HAPs for major stationary sources of HAPs could therefore be different than those for area sources. Major sources are defined as stationary sources with potential to emit more than 10 tons per year of any HAP or more than 25 tons per year of any combination of HAPs; all other sources are considered area sources. The emissions standards were to be promulgated in two phases. In the first phase (1992 to 2000), EPA developed technology-based emission standards designed to produce the maximum emission reduction achievable. These standards are generally referred to as requiring maximum available control technology. For area sources, the standards may be different, based on generally available control technology. In the second phase (2001 to 2008), EPA was required to promulgate health risk–based emissions standards, where deemed necessary, to address risks remaining after implementation of the technology-based national emission standards for HAPs standards.

The CAAA also required EPA to promulgate vehicle or fuel standards containing reasonable requirements that control toxic emissions of benzene and formaldehyde at a minimum. Performance criteria were established to limit mobile-source emissions of toxics, including benzene, formaldehyde, and 1,3-butadiene. In addition, Section 219 required the use of reformulated gasoline in selected areas with the most severe ozone nonattainment conditions to further reduce mobile-source emissions.

General Conformity

The 1990 amendments to CAA Section 176 require EPA to promulgate rules to ensure that Federal actions conform to the appropriate SIP. These rules are known as the General Conformity Rule (40 Code of Federal Regulations Parts 51.850–51.860 and 93.150–93.160). Any Federal agency responsible for an action in a nonattainment/maintenance area must determine whether that action conforms to the applicable SIP or is exempt from General Conformity Rule requirements.

Shasta County, where the proposed action would occur, is neither a nonattainment area nor a maintenance area for the national ambient air quality standards. Therefore, the General Conformity Rule is not applicable to the project.

Greenhouse Gases

Mandatory Greenhouse Gas Reporting Rule On September 22, 2009, EPA released its final Greenhouse Gas Reporting Rule (Reporting Rule). The Reporting Rule is a response to the fiscal year 2008 Consolidated Appropriations Act (House Bill 2764; Public Law 110-161), which required EPA to develop "… mandatory reporting of greenhouse gases above appropriate thresholds in all sectors of the economy…." The Reporting Rule applies to most entities that emit 25,000 metric tons (MT) CO_2e or more per year. Since 2010, facility owners have been required to submit an annual GHG emissions report with detailed calculations of facility GHG emissions. The Reporting Rule also mandates recordkeeping and administrative requirements for EPA to verify annual GHG emissions reports.

U.S. Environmental Protection Agency Endangerment and Cause or Contribute Findings On December 7, 2009, the EPA Administrator signed two distinct findings regarding GHGs under Section 202(a) of the CAA:

- **Endangerment Finding** – The current and projected concentrations of the six key well-mixed GHGs – CO_2, methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride – in the atmosphere threaten the public health and welfare of current and future generations.

- **Cause or Contribute Finding** – The combined emissions of these well-mixed GHGs from new motor vehicles and new motor vehicle engines contribute to GHG pollution, which threatens public health and welfare.

Council on Environmental Quality Draft NEPA Guidelines Because of uneven treatment of climate change under NEPA, the International Center for Technology Assessment, Natural Resources Defense Council, and Sierra Club filed a petition with the Council on Environmental Quality (CEQ) in March 2008. The petition requested that climate change analyses be included in all Federal environmental review documents. In October 2009, President Barack Obama signed Executive Order 13514, "Federal Leadership in Environmental, Energy, and Economic Performance." The goal of this executive order is "to establish an integrated strategy towards sustainability in the Federal Government and to make reduction of greenhouse gas emissions (GHG) a priority for Federal agencies" (FedCenter 2011).

In response to the petition and subsequent Executive Order 13514, CEQ issued guidance on including GHG emissions and climate change impacts in environmental review documents under NEPA. CEQ's guidance (issued February 18, 2010) suggests that Federal agencies consider opportunities to reduce GHG emissions caused by proposed Federal actions, adapt their actions to climate change impacts throughout the NEPA process, and address these issues in the agencies' NEPA procedures. The following are the two main

factors to consider when addressing climate change in environmental documentation:

- The effects of a proposed action and alternative actions on GHG emissions
- The impacts of climate change on a proposed action or alternatives

CEQ notes that "significant" national policy decisions with "substantial" GHG impacts require analysis of their GHG effects. That is, the GHG effects of a Federal agency's proposed action must be analyzed if the action would cause "substantial" annual direct emissions; would implicate energy conservation or reduced energy use or GHG emissions; or would promote cleaner, more efficient renewable-energy technologies. Qualitative or quantitative information on GHG emissions that is useful and relevant to the decision should be used when deciding among alternatives.

CEQ states that if a proposed action would cause direct annual emissions of more than 25,000 MT CO_2e, a quantitative and qualitative assessment may be meaningful to decision makers and the public. If annual direct emissions would be less than 25,000 MT CO_2e, Federal agencies are encouraged to consider whether the action's long-term emissions should receive similar analysis.

5.2.2 State

ARB coordinates and oversees State and local air pollution control programs in California and implements the California Clean Air Act (CCAA).

Criteria Air Pollutants

The CCAA, which was adopted in 1988, required ARB to establish California ambient air quality standards (Table 5-2). The CCAA requires that all local air districts in the state endeavor to achieve and maintain California ambient air quality standards by the earliest practical date. The act specifies that local air districts should particularly focus on reducing emissions from transportation and areawide sources, and authorizes districts to regulate indirect sources. Among ARB's other responsibilities are to oversee local air district compliance with California and Federal laws; approve local air quality plans; submit SIPs to EPA; monitor air quality; determine and update area designations and maps; and set emissions standards for new mobile sources, consumer products, small utility engines, off-road vehicles, and fuels.

Toxic Air Contaminants

TACs in California are regulated primarily through the Tanner Air Toxics Act (Assembly Bill (AB) 1807 (Statutes of 1983)) and the Air Toxics Hot Spots Information and Assessment Act (AB 2588 (Statutes of 1987)). AB 1807 sets forth a formal procedure for ARB to designate substances as TACs. Research, public participation, and scientific peer review must be completed before ARB can designate a substance as a TAC. To date, ARB has identified more than 21

TACs and has adopted EPA's list of HAPs as TACs. Most recently, diesel PM was added to the ARB list of TACs.

Once a TAC is identified, ARB adopts an airborne toxics control measure for sources that emit that particular TAC. If a safe threshold exists for a substance at which there is no toxic effect, the control measure must reduce exposure below that threshold. If there is no safe threshold, the measure must incorporate best available control technology to minimize emissions.

AB 2588 requires facilities that emit toxic substances above a specified level to do all of the following:

- Prepare a toxic emissions inventory
- Prepare a risk assessment if emissions are significant
- Notify the public of significant risk levels
- Prepare and implement risk reduction measures

Greenhouse Gases

Various statewide initiatives to reduce California's contribution to GHG emissions have raised awareness that, even though the various contributors to and consequences of global climate change are not yet fully understood, global climate change is under way, and real potential exists for severe adverse environmental, social, and economic effects in the long term. The most relevant laws and orders are discussed in more detail below.

California Environmental Quality Act and SB 97 CEQA requires lead agencies to consider the reasonably foreseeable adverse environmental effects of projects they are considering for approval. GHG emissions have the potential to adversely affect the environment because they contribute to global climate change. In turn, global climate change has the potential to raise sea levels, affect rainfall and snowfall, and affect habitat.

Senate Bill 97 Senate Bill (SB) 97 was enacted in August 2007 as part of the State budget negotiations and is codified at Section 21083.05 of the California Public Resources Code. SB 97 directs the Governor's Office of Planning and Research (OPR) to propose guidance in the State CEQA Guidelines "for the mitigation of GHG emissions or the effects of GHG emissions." SB 97 directed OPR to develop text for the State CEQA Guidelines by July 2009. This legislation also directed the State Resources Agency (now Natural Resources Agency) – the agency charged with adopting the State CEQA Guidelines – to certify and adopt such guidelines by January 2010. In April 2009, OPR prepared draft CEQA Guidelines amendments and submitted them to the Natural Resources Agency (see below). On July 3, 2009, the Natural Resources Agency began the rulemaking process established under the Administrative Procedure Act.

The Natural Resources Agency recommended amendments for GHGs to fit within the existing CEQA framework for environmental analysis, which calls for lead agencies to determine baseline conditions and levels of significance and evaluate mitigation measures. The amendments to the State CEQA Guidelines do not identify a threshold of significance for GHG emissions, nor do they prescribe assessment methodologies or specific mitigation measures. The amendments encourage lead agencies to consider many factors in performing a CEQA analysis, but preserve the discretion that CEQA grants lead agencies to make their own determinations based on substantial evidence.

Section 15064.4, "Determining the Significance of Impacts from Greenhouse Gas Emissions," of the State CEQA Guidelines encourages lead agencies to consider three factors to assess the significance of GHG emissions:

(1) Will the project increase or reduce GHGs as compared to the baseline?

(2) Will the project's GHG emissions exceed the lead agency's threshold of significance?

(3) Does the project comply with regulations or requirements to implement a statewide, regional, or local GHG reduction or mitigation plan?

These questions are addressed in Section 5.3.

Section 15064.4 also recommends that lead agencies make a good-faith effort, based on available information, to describe, calculate, or estimate the amount of GHG emissions associated with a project.

Section 15126.4, "Consideration and Discussion of Mitigation Measures Proposed to Minimize Significant Effects," of the State CEQA Guidelines lists considerations for lead agencies related to feasible mitigation measures to reduce GHG emissions. Among those considerations are the following:

- Project features, project design, or other measures that are incorporated into the project to substantially reduce energy consumption or GHG emissions

- Compliance with the requirements in a previously approved plan or mitigation program to reduce or sequester GHG emissions, when the plan or program provides specific requirements that will avoid or substantially lessen the potential impacts of the project

- Measures that sequester carbon or carbon-equivalent emissions

Section 15126.4 also specifies that where mitigation measures are proposed to reduce GHG emissions through off-site actions or purchase of carbon offsets, these mitigation measures must be part of a reasonable plan of mitigation that the relevant agency commits itself to implementing.

In addition, as part of the amendments and additions to the State CEQA Guidelines, a new set of environmental checklist questions (VII. Greenhouse Gas Emissions) was added to Appendix G of the State CEQA Guidelines. The new set asks whether a project would do either of the following:

a) Generate greenhouse gas emissions, either directly or indirectly, that may have a significant impact on the environment?

b) Conflict with any applicable plan, policy or regulation of an agency adopted for the purpose of reducing the emissions of greenhouse gases?

Preliminary Draft Staff Proposal: Recommended Approaches for Setting Interim Significance Thresholds for Greenhouse Gases under CEQA CEQA gives discretion to lead agencies to establish thresholds of significance based on individual circumstances. To assist in that exercise, and because OPR believes the unique nature of GHGs warrants investigation of a statewide threshold of significance for GHG emissions, OPR asked ARB technical staff to recommend a methodology for setting thresholds of significance. In October 2008, ARB released *Preliminary Draft Staff Proposal: Recommended Approaches for Setting Interim Significance Thresholds for Greenhouse Gases under the California Environmental Quality Act* (ARB 2008). This draft proposal included a conceptual approach for thresholds associated with industrial, commercial, and residential projects. For nonindustrial projects, the steps to presuming a less than significant climate change impact generally involve analyzing whether the project meets the following criteria (ARB 2008):

- Is exempt under existing statutory or categorical exemptions
- Complies with a previously approved plan or target
- Meets specified minimum performance standards
- Falls below an as-yet-unspecified annual emissions level

The performance standards focus on construction activities, energy and water consumption, generation of solid waste, and transportation. For industrial projects, the draft proposal recommends a tiered analysis procedure similar to the procedure for analyzing nonindustrial projects. However, for industrial projects a quantitative limit for less than significant impacts is established at approximately 7,000 MT CO_2e per year. These standards have not yet been adopted or finalized as a basis for evaluating the significance of a project's contribution to climate change.

Executive Order S-3-05 Executive Order S-3-05 made California the first state to formally establish GHG emissions reduction goals. Executive Order S-3-05 includes the following GHG emissions reduction targets for California:

- By 2010, reduce GHG emissions to 2000 levels.

- By 2020, reduce GHG emissions to 1990 levels.
- By 2050, reduce GHG emissions to 80 percent below 1990 levels.

The final emission target of 80 percent below 1990 levels would put the state's emissions in line with estimates of the required worldwide reductions needed to bring about long-term climate stabilization and avoidance of the most severe impacts of climate change (IPCC 2007).

Executive Order S-3-05 also dictated that the Secretary of the California Environmental Protection Agency coordinate oversight of efforts to meet these targets with all of the following:

- The Secretaries of the Business, Transportation, and Housing Agency; California Department of Food and Agriculture; and California Natural Resources Agency
- The Chairpersons of ARB and the California Energy Commission
- The President of the California Public Utilities Commission

This group was subsequently named the Climate Action Team.

As laid out in Executive Order S-3-05, the Climate Action Team has submitted biannual reports to the Governor and State legislature describing progress made toward reaching the targets. The Climate Action Team is finalizing its second biannual report on the effects of climate change on California's resources.

Assembly Bill 32 In 2006, California passed the California Global Warming Solutions Act of 2006 (AB 32; California Health and Safety Code, Sections 38500 et seq.). AB 32 further details and puts into law the midterm GHG reduction target established in Executive Order S-3-05 – reduce GHG emissions to 1990 levels by 2020. AB 32 also identifies ARB as the State agency responsible for the design and implementation of emissions limits, regulations, and other measures to meet the target.

The statute lays out the schedule for each step of the regulatory development and implementation, as follows:

- By June 30, 2007, ARB had to publish a list of early-action GHG emission reduction measures.
- Before January 1, 2008, ARB had to identify the current level of GHG emissions by requiring statewide reporting and verification of GHG emissions from emitters and identify the 1990 levels of California GHG emissions.

- By January 1, 2010, ARB had to adopt regulations to implement the early-action measures.

In December 2007, ARB approved the 2020 GHG emission limit (1990 level) of 427 MMT CO_2e. The 2020 target requires the reduction of 169 MMT CO_2e, or approximately 30 percent below California's projected "business-as-usual" 2020 emissions of 596 MMT CO_2e.

Also in December 2007, ARB adopted mandatory reporting and verification regulations pursuant to AB 32. The regulations became effective January 1, 2009, with the first reports covering 2008 emissions. The mandatory reporting regulations require reporting for major facilities, those that generate more than 25,000 MT CO_2e per year. To date ARB has met all of the statutorily mandated deadlines for promulgation and adoption of regulations.

Climate Change Scoping Plan On December 11, 2008, pursuant to AB 32, ARB adopted the *Climate Change Scoping Plan*. This plan outlines how emissions reductions will be achieved from significant sources of GHGs via regulations, market mechanisms, and other actions. Six key elements, outlined in the scoping plan, are identified below to achieve emissions reduction targets:

- Expand and strengthen existing energy efficiency programs and building and appliance standards.

- Achieve a statewide renewable energy mix of 33 percent.

- Develop a California cap-and-trade program that links with other Western Climate Initiative partner programs to create a regional market system.

- Establish targets for transportation-related GHG emissions for regions throughout California, and pursue policies and incentives to achieve those targets.

- Adopt and implement measures pursuant to existing State laws and policies, including California's clean car standards, goods movement measures, and the Low Carbon Fuel Standard.

- Create targeted fees, including a public goods charge on water use, fees on high-GWP gases, and a fee to fund the administrative costs of the State's long-term commitment to AB 32 implementation.

The *Climate Change Scoping Plan* also recommended 39 measures that were developed to reduce GHG emissions from key sources and activities while improving public health, promoting a cleaner environment, preserving natural resources, and ensuring that the impacts of the reductions would be equitable and avoid disproportionately affecting low-income and minority communities.

These measures also put California on a path to meet the long-term 2050 goal of reducing statewide GHG emissions to 80 percent below 1990 levels. The measures in the approved scoping plan are being developed and will be in place by 2012.

Executive Order S-13-08 Executive Order S-13-08, issued November 14, 2008, directs the California Natural Resources Agency, DWR, OPR, the California Energy Commission, the State Water Resources Control Board, the California Department of Parks and Recreation, and California's coastal management agencies to participate in planning and research activities to advance California's ability to adapt to the effects of climate change. The order specifically directs agencies to work with the National Academy of Sciences to initiate the first California sea-level-rise assessment and to review and update the assessment every 2 years after completion; immediately assess the vulnerability of California's transportation system to sea level rise; and to develop a climate change adaptation strategy for California.

California Climate Change Adaptation Strategy Developed through cooperation and partnership among multiple State agencies, the 2009 *California Climate Adaptation Strategy* summarizes the best known science on climate change effects. The strategy describes effects of climate change on seven specific sectors—public health, biodiversity and habitat, ocean and coastal resources, water management, agriculture, forestry, and transportation and energy infrastructure—and recommends ways to manage against those threats.

Governor's Office of Planning and Research Technical Advisory In June 2008, OPR published a technical advisory on CEQA and climate change to provide interim advice to lead agencies regarding the analysis of GHGs in environmental documents (OPR 2008). The advisory encourages lead agencies to identify and quantify the GHGs that could result from a proposed project, analyze impacts of those emissions to determine whether they would be significant, and identify feasible mitigation measures or alternatives that would reduce adverse impacts to a less than significant level. The advisory recognized that OPR would develop, and the Natural Resources Agency would adopt, amendments to the State CEQA Guidelines pursuant to SB 97. (See "California Environmental Quality Act and SB 97," above.)

The advisory provides OPR's perspective on the emerging role of CEQA in addressing climate change and GHG emissions. It recognizes that approaches and methodologies for calculating GHG emissions and determining their significance are rapidly evolving. OPR concludes in the technical advisory that climate change is ultimately a cumulative impact, and that no individual project could have a significant impact on global climate. Thus, projects must be analyzed with respect to the incremental impact of the project when added to other past, present, and reasonably foreseeable probable future projects. OPR recommends that lead agencies undertake an analysis, consistent with available

guidance and current CEQA practice, to determine cumulative significance (OPR 2008).

The technical advisory points out that neither CEQA nor the State CEQA Guidelines prescribe thresholds of significance or particular methodologies for performing an impact analysis. "This is left to lead agency judgment and discretion, based upon factual data and guidance from regulatory agencies and other sources where available and applicable" (OPR 2008). OPR states that "the global nature of climate change warrants investigation of a statewide threshold of significance for GHG emissions" (OPR 2008). Until such a standard is established, OPR advises that each lead agency should develop its own approach to performing an analysis for projects that generate GHG emissions (OPR 2008).

OPR sets out the following process for evaluating GHG emissions. First, agencies should determine whether GHG emissions may be generated by a proposed project, and if so, quantify or estimate the emissions by type or source. Calculation, modeling, or estimation of GHG emissions should include the emissions associated with vehicular traffic, energy consumption, water usage, and construction activities (OPR 2008).

Agencies should then assess whether the emissions are "cumulatively considerable" even though a project's GHG emissions may be individually limited. OPR states: "Although climate change is ultimately a cumulative impact, not every individual project that emits GHGs must necessarily be found to contribute to a significant cumulative impact on the environment" (OPR 2008). Individual lead agencies may undertake a project-by-project analysis, consistent with available guidance and current CEQA practice (OPR 2008).

Finally, if the lead agency determines that emissions are a cumulatively considerable contribution to a significant cumulative impact, the lead agency must investigate and implement ways to mitigate the emissions (OPR 2008). OPR (2008) states:

> *Mitigation measures will vary with the type of project being contemplated, but may include alternative project designs or locations that conserve energy and water, measures that reduce vehicle miles traveled by fossil-fueled vehicles, measures that contribute to established regional or programmatic mitigation strategies, and measures that sequester carbon to offset the emissions from the project.*

OPR concludes that "A lead agency is not responsible for wholly eliminating all GHG emissions from a project; the CEQA standard is to mitigate to a level that is "less than significant" (OPR 2008). Attachment 3 to the technical advisory includes a list of GHG reduction measures that can be applied on a project-by-project basis.

California Air Pollution Officers Association In January 2008, the California Air Pollution Control Officers Association issued a "white paper" on evaluating and addressing GHGs under CEQA (CAPCOA 2008). This resource guide was prepared to support local governments as they develop their climate change programs and policies. Though not a guidance document, the paper provides information about key elements of CEQA GHG analyses, including a survey of different approaches to setting quantitative significance thresholds. The following are some of the thresholds discussed:

- Zero (all emissions are significant)
- 900 MT CO_2e per year (90 percent market capture for residential and nonresidential discretionary development)
- 10,000 MT CO_2e per year (potential ARB mandatory reporting level for cap-and-trade program)
- 25,000 MT CO_2e per year (ARB's mandatory reporting level for the statewide emissions inventory)
- Unit-based thresholds, based on identifying thresholds for each type of new development and quantifying significance by a 90 percent capture rate

5.2.3 Regional and Local

Shasta Lake and Vicinity and Upper Sacramento River (Shasta Dam to Red Bluff)

Shasta County Air Quality Management District SCAQMD is the primary local agency regulating air quality for all of Shasta County. SCAQMD attains and maintains air quality conditions in Shasta County through a comprehensive program of planning, regulation, enforcement, technical innovation, and promotion of the understanding of air quality issues. The clean-air strategy of SCAQMD is to prepare plans and programs for the attainment of ambient air quality standards, adopt and enforce rules and regulations, and issue permits for stationary sources. SCAQMD also inspects stationary sources, responds to citizen complaints, monitors ambient air quality and meteorological conditions, and implements other programs and regulations required by the CAA, CAAA, and CCAA.

Rules and Regulations All projects in Shasta County are subject to SCAQMD rules and regulations in effect at the time of construction. Specific rules applicable to the project may include the following:

- **Rule 2:1A: Permits Required** – Any person who is building, erecting, altering, or replacing any article, machine, equipment or other contrivance, or multicomponent system including same, portable or

stationary and who is not exempt under Section 42310 of the California Health and Safety Code, the use of which may cause the issuance of air contaminants, shall first obtain written authority for such construction from the Air Pollution Control Officer.

- **Rule 2:7: Conditions for Open Burning** – All material to be burned must be arranged so that it will burn with a minimum of smoke and must be reasonably free of dirt, soil, and visible surface moisture. All vegetative wastes to be burned shall be ignited only with approved ignition devices and shall be free of tires, illegal residential waste, tar paper, construction debris, and combustible and flammable waste. No burning shall cause emissions to be transported into smoke sensitive areas. No burning shall be conducted when such burns, in conjunction with present or predicted meteorology, could cause or contribute to a violation of an ambient air quality standard.

- **Rule 3:15: Cutback and Emulsified Asphalt** – A person shall not manufacture, sell, offer for sale, use, or apply for paving, construction, or maintenance of parking lots, driveways, streets, or highways any rapid- or medium-cure cutback asphalt, slow-cure cutback asphalt material that contains more than 0.5 percent by volume VOCs that boil at 500 degrees Fahrenheit (°F) (260 degrees Celsius) (°C) or less, or any emulsified asphalt material that contains more than 3.0 percent by volume of VOCs that evaporate at 500°F (260°C) or less.

- **Rule 3:16: Fugitive, Indirect, or Nontraditional Sources** – The Air Pollution Control Officer may place reasonable conditions upon any source, as delineated below, that will mitigate the emissions from such sources to below a level of significance or to a point that such emissions no longer constitute a violation of Health and Safety Code Sections 41700 and/or 41701: fugitive sources, indirect sources, and nontraditional sources.

- **Rule 3:22: Asbestos** – No person shall use or apply serpentine material for surfacing in California unless the material has been tested using ARB Test Method 435 and determined to have an asbestos content of 5 percent or less. A written receipt or other record documenting the asbestos content shall be retained by any person who uses or applies serpentine material for at least 7 years from the date of use or application, and shall be provided to the Air Pollution Control Officer, or his or her designate, for review upon request.

- **Rule 3:31: Architectural Coatings** – The developer or contractor is required to use coatings that comply with the VOC content limits specified in the rule.

Criteria Pollutants SCAQMD has adopted pollutant emission thresholds and mitigation requirements that are used in the analysis of project impacts. The thresholds and mitigation requirements are discussed below in Section 5.3.2, "Criteria for Determining Significance of Effects."

Attainment Plan Air quality planning in the NSVAB has been undertaken on a joint basis by the air districts in seven counties. The current plan, the *Northern Sacramento Valley Planning Area 2009 Triennial Air Quality Attainment Plan* (AQAP), is an update of plans prepared in 1994, 1997, 2000, 2003, and 2006. The purpose of the plan is to achieve and maintain healthful air quality throughout the air basin. The 2009 AQAP addresses the progress made in implementing the 2006 plan and proposes modifications to the strategies necessary to attain the California ambient air quality standards for the 1-hour ozone standard at the earliest practicable date.

The AQAP is based on each county's projected emission inventory, which includes stationary, areawide, and mobile sources. Emission inventories are based on general plans and anticipated development.

Toxic Air Contaminants At the local level, air pollution control or management districts may adopt and enforce ARB control measures. Under SCAQMD Rule V, "Additional Procedures For Issuing Permits To Operate For Sources Subject To Title V Of The Federal Clean Air Act Amendments Of 1990," Rule 2:1, "New Source Review," and Rule 2:1A, "Permits Required," all sources that possess the potential to emit TACs are required to obtain permits from the district. Permits may be granted to these operations if they are constructed and operated in accordance with applicable regulations, including new-source-review standards and air-toxics control measures. SCAQMD limits emissions and public exposure to TACs through a number of programs. SCAQMD prioritizes TAC-emitting stationary sources based on the quantity and toxicity of the TAC emissions and the proximity of the facilities to sensitive receptors.

Shasta County General Plan The Air Quality Element of the *Shasta County General Plan* (Shasta County 2004) contains objectives and policies aimed at protecting and improving Shasta County's air quality, meeting the requirements of the Federal CAA and CCAA, and integrating planning efforts (e.g., transit, land use) to reduce air pollution contaminants, among others.

Tehama County Air Pollution Control District The southern portion of the primary study area is in Tehama County. The Tehama County Air Pollution Control District is the primary local agency with respect to air quality for Tehama County. The Tehama County Air Pollution Control District has rules and regulations similar to those described for SCAQMD. The Tehama County Air Pollution Control District is in the NSVAB and is therefore a participant in NSVAB's 2003 AQAP.

Lower Sacramento River and Delta and CVP/SWP Service Areas

All areas of California are within the jurisdiction of an air pollution control district or an air quality management district. Each district has rules and regulations similar to those described above for SCAQMD. Districts that are classified as nonattainment for one or more criteria pollutants have attainment plans or similar documents as required by ARB. Most districts have guidance documents for the analysis of air quality impacts for CEQA compliance.

Global Study Area—Greenhouse Gases

There are no regional or local policies, regulations, or laws pertaining to GHG emissions.

5.3 Environmental Consequences and Mitigation Measures

5.3.1 Methods and Assumptions

Criteria Air Pollutants

The proposed SLWRI alternatives are quite complex. They consist of implementing construction activities for the dam structure; clearing the reservoir area that would be affected by the increase in pool height; relocating and modifying bridges, roads, utilities, and recreation areas; and completing other related tasks. At the current stage of project development (April 2011), project planning, design, and engineering is preliminary. Detailed development of construction plans and schedule is not anticipated until an alternative is selected and approved. However, potential air quality impacts from emissions of criteria pollutants may be assessed quantitatively by estimating emissions for major project elements and understanding the implications of additional emissions from project activities that are not quantified.

The URBEMIS2007 emissions model was used to generate estimates of construction activity emissions. The URBEMIS2007 software package, Version 9.2.4, is a calculation tool designed to estimate air pollutant emissions from land use development projects based on development type and size. The emissions factors and calculation methodologies contained in the URBEMIS2007 program were developed in cooperation with ARB and many air districts in California. Among the inputs to the model for construction analysis are the following:

- Types and quantities of construction equipment to be used and hours of use
- Areas of land to be graded
- Number of truck trips and trip distances for export of spoils and import of materials
- Volumes of buildings to be demolished

- Areas of buildings to be built
- Areas of land to be paved

Attachment 1 of the *Air Quality and Climate Technical Report* contains the worksheets generated by URBEMIS2007 documenting the input and output for this analysis.

The Sacramento Metropolitan Air Quality Management District's Road Construction Emissions Model, version 6.3.2, was used to estimate emissions from the Reading Island portion of the project proposed under CP4 and CP5. This model is used for linear projects, such as Reading Island, and uses emission factors from EMFAC2007 and OFFROAD2007 databases developed by ARB. Inputs in the Road Construction Emissions Model include construction equipment populations, material and soil hauling, and construction phase timelines.

For postconstruction activities, principal inputs are the number of vehicle trips and average trip distances. Attachment 1 of the *Air Quality and Climate Technical Report* contains the worksheets generated by the model URBEMIS2007 documenting the input and output for this analysis.

SCAQMD and the Tehama County Air Pollution Control District standards are discussed relative to impact thresholds.

Toxic Air Contaminants and Odors

TACs and odors are discussed in accordance with SCAQMD, ARB, and EPA policies and rules.

Global Warming

Emissions of CO_2 from construction activities and from recreational visitors' vehicles were calculated using the URBEMIS2007 program. Data on CO_2 emissions avoided by generation of electricity from Shasta Dam were obtained from Chapter 5 of the *Shasta Lake Water Resources Investigation Plan Formulation Report* (Reclamation 2007). Emissions of CO_2 from cleared and burned vegetation were estimated using the Carbon Online Estimator (COLE Development Group 2011). Indirect emissions from cement production and CO_2 absorption by water and vegetation are discussed but not quantified.

5.3.2 Criteria for Determining Significance of Effects

An environmental document prepared to comply with NEPA must consider the context and intensity of the environmental effects that would be caused by, or result from, the proposed action. Under NEPA, the significance of an effect is used solely to determine whether an environmental impact statement must be prepared. An environmental document prepared to comply with CEQA must identify the potentially significant environmental effects of a proposed project. A "[s]ignificant effect on the environment" means a substantial, or potentially

substantial, adverse change in any of the physical conditions within the area affected by the project" (State CEQA Guidelines, Section 15382). CEQA also requires that the environmental document propose feasible measures to avoid or substantially reduce significant environmental effects (State CEQA Guidelines, Section 15126.4(a)).

The following significance criteria were developed based on guidance provided by the State CEQA Guidelines, and consider the context and intensity of the environmental effects as required under NEPA. Impacts of an alternative on air quality and climate would be significant if project implementation would do any of the following:

- Conflict with or obstruct implementation of the applicable air quality plan
- Violate any air quality standard or contribute substantially to an existing or projected air quality violation
- Result in a cumulatively considerable net increase of a criteria air pollutant for which the project region is nonattainment under any applicable Federal or State ambient air quality standard (including releasing emissions that exceed quantitative thresholds for ozone precursors)
- Expose sensitive receptors to substantial pollutant concentrations
- Create objectionable odors affecting a substantial number or people
- Generate GHG emissions, either directly or indirectly, that may have a significant impact on the environment
- Conflict with any applicable plan, policy, or regulation of an agency adopted for the purpose of reducing the emissions of GHGs

As stated in Appendix G of the State CEQA Guidelines, the significance criteria established by the applicable air quality management or air pollution control district may be relied upon to make the above determinations. SCAQMD has adopted air quality thresholds (Table 5-3). These thresholds are based on SCAQMD New Source Review Rule 2:1. The thresholds and policy are published in the *Shasta County General Plan*.

Table 5-3. Shasta County Air Quality Management District's Air Quality Emission Thresholds

NO_X	ROG	PM_{10}	CO
Level A Thresholds			
25 lb/day	25 lb/day	80 lb/day	500 lb/day
Level B Thresholds			
137 lb/day	137 lb/day	137 lb/day	500 lb/day

Source: Shasta County 2004

Note:
These thresholds will be applied during the Shasta County Planning Division's CEQA review process. The CO thresholds do not appear in the general plan, but are included in SCAQMD policy.

Key:
CEQA = California Environmental Quality Act
CO = carbon monoxide
lb/day = pounds per day
NO_X = oxides of nitrogen
PM_{10} = respirable particulate matter
ROG = reactive organic gases
SCAQMD = Shasta County Air Quality Management District

The policy includes standard mitigation measures (SMM) and best available mitigation measures (BAMM). Briefly, the policy for applying SMMs and BAMMs is as follows:

- Apply SMM to all projects; this effort will help contribute to reducing cumulative effects.
- Apply SMM and appropriate BAMM when a project exceeds Level A thresholds.
- Apply SMM, BAMM, and special BAMM when a project exceeds Level B thresholds.
- If application of the above procedures will reduce project emissions below Level B thresholds, the project can proceed with an environmental determination of a mitigated negative declaration, assuming that other project impacts do not require more extensive environmental review.
- If project emissions cannot be reduced to below Level B thresholds, emission offsets will be required. If, after applying the emissions offsets, the project emissions still exceed the Level B threshold, an environmental impact report will be required before the project can be considered for action by the reviewing authority.

Thus, as recommended by SCAQMD, impacts of an alternative on air quality would be significant if either of the following would occur as a result of project implementation:

- Emissions of criteria air pollutants or precursors in Shasta County during construction or long-term operations would exceed the SCAQMD Level B thresholds of 137 pounds per day (lb/day) of ROG, NO_X, or PM_{10} and 500 lb/day of CO after the application of mitigation measures.

- Emissions of criteria air pollutants or precursors in Tehama County during construction or long-term operations would exceed 137 lb/day of ROG, NO_X, or PM_{10} after the application of mitigation measures.

SCAQMD has not adopted a numeric significance criterion for GHGs generated by nonindustrial projects. (However, two California air districts, the Bay Area Air Quality Management District and the South Coast Air Quality Management District, have adopted thresholds for GHG emissions generated by development projects.) No numeric thresholds adopted by any air district or by ARB would be applicable to the action alternatives. However, by adopting AB 32, the State has established GHG reduction targets. Further, the State has determined that GHG emissions, as they relate to global climate change, are a source of adverse environmental impacts in California and should be addressed under CEQA. AB 32 did not amend CEQA, although the legislation identifies the myriad environmental problems in California caused by global warming (Health and Safety Code, Section 38501(a)). SB 97, in contrast, did amend CEQA by requiring OPR to revise the State CEQA Guidelines to address the mitigation of GHG emissions or their consequences (California Public Resources Code, Sections 21083.05 and 21097).

Based on the size, scope, and purpose of this project, the following significance criteria will be used to determine the significance of GHG emissions from this project:

- Whether the project has the potential to conflict with or is consistent with the following plans to reduce or mitigate GHG emissions:

  – The six key elements of the *Climate Change Scoping Plan* (described previously)

  – ARB's 39 recommended actions in the *Climate Change Scoping Plan*

  – Regulations or requirements adopted to implement a statewide, regional, or local plan for the reduction or mitigation of GHG emissions

- Whether the project is part of a plan that includes overall reductions in GHG emissions

- Whether the relative amounts of GHG emissions over the life of the project are small in comparison to the amount of GHG emissions for major facilities that are required to report such emissions (25,000 MT CO_2e per year)

- Whether the project has the potential to contribute to a lower carbon future, through factors such as the following:

  – The design of the proposed project is inherently energy efficient

  – All applicable best management practices that would reduce GHG emissions are incorporated into the project design

  – The project implements or funds its fair share of a mitigation strategy designed to alleviate climate change

  – There are process improvements or efficiencies gained by implementing the project

5.3.3 Topics Eliminated from Further Consideration

No topics related to air quality and climate change that are included in the significance criteria listed above were eliminated from further consideration. All relevant topics are analyzed below.

5.3.4 Direct and Indirect Effects

No-Action Alternative

Shasta Lake and Vicinity and Upper Sacramento River (Shasta Dam to Red Bluff)

Impact AQ-1 (No-Action): Short-Term Emissions of Criteria Air Pollutants and Precursors at Shasta Lake and Vicinity During Project Construction No short-term, construction-related increases in emissions of criteria air pollutants or precursors at Shasta Lake or in the vicinity would result from implementation of the No-Action Alternative. No impact would occur.

Under the No-Action Alternative, no new facilities would be constructed at Shasta Lake or in the vicinity. No changes to Reclamation's existing facilities would occur that would directly or indirectly result in any increases in emissions of criteria air pollutants or precursors in this portion of the primary study area. Therefore, no impact would occur. Mitigation is not required for the No-Action Alternative.

Impact AQ-2 (No-Action): Long-Term Emissions of Criteria Air Pollutants and Precursors During Project Operation No long-term operational increases in emissions of criteria air pollutants or precursors in the primary study area would

result from implementation of the No-Action Alternative. However, PM_{10} emissions are expected to continue increasing through 2020 because of increased growth in the area. This impact would be less than significant.

Under the No-Action Alternative, no changes to Reclamation's existing operations in the primary study area would occur that would directly or indirectly result in any increases in emissions of criteria air pollutants or precursors in the primary study area. According to ARB, emission levels for ROG, NO_X, and CO are trending downward from 1990 to 2020 in the project area even with increased population growth (ARB 2009). More stringent mobile-source emission standards, cleaner burning fuels, and new rules have largely contributed to this decline. However, PM_{10} emissions are expected to continue increasing through 2020 because of increased growth in the area and associated emissions (e.g., from travel on paved and unpaved roads). Thus, such emissions will likely be worse in the future. Therefore, this impact would be less than significant. Mitigation is not required for the No-Action Alternative.

Impact AQ-3 (No-Action): Exposure of Sensitive Receptors to Substantial Pollutant Concentrations The No-Action Alternative would not change existing exposure of sensitive receptors to pollutants. No impact would occur.

Sensitive receptors in the primary study area are not currently exposed to substantial pollutant concentrations. There is no indication of circumstances under the No-Action Alternative that would change exposure levels. Therefore, no impact would occur. Mitigation is not required for the No-Action Alternative.

Impact AQ-4 (No-Action): Exposure of Sensitive Receptors to Odor Emissions The No-Action Alternative would not change existing exposure of sensitive receptors to odors. No impact would occur.

Sensitive receptors in the primary study area are not currently exposed to substantial concentrations of odors. There is no indication of circumstances under the No-Action Alternative that would change the exposure. Therefore, no impact would occur. Mitigation is not required for the No-Action Alternative.

Impact AQ-5 (No-Action): Short-Term Emissions of Criteria Air Pollutants and Precursors Below Shasta Dam During Project Construction No short-term, construction-related increases in emissions of criteria air pollutants or precursors below Shasta Dam would result from implementation of the No-Action Alternative. No impact would occur.

The Gravel Augmentation Program (proposed under CP4 and CP5, as described below) would not be implemented under the No-Action Alternative. No new facilities would be constructed below Shasta Dam. Furthermore, no changes to Reclamation's existing facilities or operations would occur that would directly or indirectly result in any increases in emissions of criteria air pollutants in this

portion of the primary study area. No impact would occur. Mitigation is not required for the No-Action Alternative.

Lower Sacramento River and Delta and CVP/SWP Service Areas No effects on climate and air quality are expected to occur in the lower Sacramento River and Delta and CVP/SWP service areas under the No-Action Alternative; therefore, potential effects in those geographic regions are not discussed further in this PDEIS.

Global Study Area

Impact AQ-6 (No-Action): Generation of Greenhouse Gases State goals to reduce project-related GHG emissions would not be implemented under this alternative; however, the No-Action Alternative would not obstruct or conflict with those goals. This impact would be less than significant.

Under the No-Action Alternative, no new facilities would be constructed. No changes to Reclamation's existing facilities or operations would occur that would directly or indirectly result in any increases or decreases in GHG emissions. Therefore, no efforts would be made to reduce existing GHG emissions in the project vicinity under this alternative. Although the State of California's goals to reduce GHG emissions would not be implemented, the No-Action Alternative would not obstruct or conflict with those goals. Therefore, this impact would be less than significant. Mitigation is not required for the No-Action Alternative.

CP1 – 6.5-Foot Dam Raise, Anadromous Fish Survival and Water Supply Reliability

Shasta Lake and Vicinity

Impact AQ-1 (CP1): Short-Term Emissions of Criteria Air Pollutants and Precursors at Shasta Lake and Vicinity During Project Construction Project construction would result in short-term NO_X emissions that would exceed applicable SCAQMD thresholds, and could result in emissions that would exceed PM_{10} and ROG thresholds. This conclusion is based on calculations of estimated emissions for major elements of the project, and projection of additional emissions for other elements where calculation is not reasonable at the current level of project definition. Shasta County is a nonattainment area for the State ozone and PM_{10} standards. Thus, short-term emissions generated during construction could contribute substantially to an existing or projected air quality violation. This impact would be significant.

Construction emissions are described as "short-term" or temporary in duration because they would cease when the dam raise and associated construction projects are completed. The emissions of ozone precursors ROG and NO_X are associated primarily with gas and diesel engine equipment exhaust from off-road equipment and on-road vehicles. Off-road equipment anticipated in the project includes construction equipment such as bulldozers, cranes, welders, water trucks, loaders, and concrete batch plants. An additional off-road source

would be engine exhaust from helicopters used to airlift wood from clearing operations. On-road vehicles include trucks that would bring materials to the project site and haul excavated spoils and materials cleared from lands away from the project site. An additional on-road source would be the vehicles used by workers commuting to and from the project site. Engine equipment exhaust also emits CO, PM_{10}, and $PM_{2.5}$.

The primary sources of PM_{10} and $PM_{2.5}$ emissions are fugitive dust from site preparation, vehicle travel on unpaved and paved roads, and storage piles. Emissions vary as a function of such parameters as soil silt content, soil moisture, wind speed, acreage of disturbance area, and vehicle miles traveled by construction vehicles on- and off-site. Burning of cleared vegetation would be a substantial source of particulate emissions. PM_{10} and $PM_{2.5}$ would also be emitted during the materials handling processes associated with operation of a concrete batch plant.

Major construction elements under CP1 would be the dam raise of 6.5 feet and the clearing of land that would be inundated by the larger full pool. Land-clearing equipment used would be based on the terrain, and would range from full-size bulldozers to smaller backhoes and hand tools. In steep terrain helicopters would be used for material removal. In addition, wing dams and reservoir dikes would be constructed; railroad and roadway bridges would be replaced; roads, structures, and utilities would be relocated; and excavation and loading would occur at borrow areas to provide materials for dam construction.

To provide an initial, partial estimate of daily emission rates, it was assumed that the following construction activities would occur concurrently for a 3-year-long period:

- Dam raise, requiring two cranes, four off-road trucks, three dozers, two welders, two water trucks, and four other pieces of diesel engine equipment
- Trucking of materials to the dam site, with approximately 58 round trips per day of 20 miles per trip
- Clearing of acreage around the reservoir at a rate of 1.5 acres per day, using one tractor, two loader/backhoes, one water truck, and seasonal helicopters
- Trucking of materials cleared from the land, with approximately 23 round trips per day of 20 miles per trip

Emissions were calculated using the URBEMIS2007 model described above in Section 5.3.1, “Methods and Assumptions.” The results are shown in Table 5-4. (URBEMIS air quality modeling outputs for the comprehensive plans are presented in Attachment 1 to the *Air Quality and Climate Technical Report*.) As

seen in Table 5-4, NO_X emissions for the selected activities would exceed the Shasta County Level B threshold of 137 lb/day, which would result in a significant impact.

Particulate emissions from operation of a concrete batch plant are not included in the above calculations. Batch plants must obtain operating permits from Shasta County Air Pollution Control District. The granting of a permit would assure that the impact of PM_{10} and $PM_{2.5}$ emissions from batch plant sources would be less than significant.

Table 5-4 represents the initial partial emissions scenario. It is very likely that many other project-related activities using diesel-engine equipment would occur concurrently with the dam raise and the land clearing. It is also possible that the intensity of the dam raise and land clearing would be greater than assumed for the calculations. For example, the calculations for the dam raise assume an 8-hour work day; however, it is likely that some construction activities, such as mass concrete pours, would require 16- to 24-hour work days. With increases in concurrent activities and intensity of activity, it is anticipated that ROG and PM_{10} emissions would exceed the Level A significance threshold, and the potential exists for ROG and PM_{10} emissions to exceed the Level B thresholds of 137 lb/day.

Based on the data in Table 5-4 and the preceding discussion, short-term emissions generated during construction could contribute substantially to an existing or projected air quality violation. As a result, this impact would be significant.

The Shasta County standards require standard mitigation measures for all projects and additional mitigation measures when project emissions are anticipated to reach intermediate levels of 25 lb/day for ROG and NO_X, and 80 lb/day of PM_{10}. Mitigation for this impact that incorporates these mitigation measures is proposed in Section 5.3.5.

Table 5-4. Construction Emissions for Postulated Dam Raise and Land Clearing, 3-Year Construction Period – CP1[a]

Activity	Emissions—pounds per day				
	ROG	NO_X	CO	PM_{10}	$PM_{2.5}$
Dam Raise and Materials Trucking					
Off-road diesel	17	157	63	6	6
On-road diesel	2	37	12	2	1
Worker trips	<0.5	<0.5	5	<0.5	<0.5
Subtotal	20	194	81	8	7
Land Clearing and Spoils Trucking					
Fugitive dust	<0.5	<0.5	<0.5	30	6
Off-road diesel	3	18	9	1	1
On-road diesel	1	22	7	1	1
Worker trips	<0.5	<0.5	1	<0.5	<0.5
Subtotal	4	40	18	32	8
Total Dam Raise and Land Clearing (Year 1)[b]	**24**	**235**	**99**	**40**	**15**
Total Dam Raise and Land Clearing (Year 2)[b]	**22**	**219**	**92**	**39**	**15**
Total Dam Raise and Land Clearing (Year 3)[b]	**21**	**202**	**86**	**38**	**14**
SCAQMD Level A Significance Thresholds	**25**	**25**	**500**	**80**	**None**
SCAQMD Level B Significance Thresholds	**137**	**137**	**500**	**137**	**None**

Source: Data compiled by AECOM in 2011

Notes:
[a] Totals may not add due to rounding
[b] Years modeled were 2009, 2010, 2011.

Key:
CO = carbon monoxide
CP = Comprehensive Plan
NO_X = oxides of nitrogen
$PM_{2.5}$ = fine particulate matter
PM_{10} = respirable particulate matter
ROG = reactive organic gases
SCAQMD = Shasta County Air Quality Management District

Impact AQ-2 (CP1): Long-Term Emissions of Criteria Air Pollutants and Precursors During Project Operation Long-term project operation is not anticipated to result in ROG, NO_X, PM_{10}, or CO emissions that exceed applicable SCAMQD thresholds. Thus, long-term operational emissions would not be anticipated to violate an air quality standard or contribute substantially to an existing or projected air quality violation. This impact would be less than significant.

Long-term operational emissions would come from stationary, area, and mobile sources. Stationary sources could include emergency generators powered by

diesel engines or pumps, boilers, and major kitchen equipment. No new stationary sources of note are anticipated as part of the project. Replacement equipment that would emit pollutants is anticipated to be similar to equipment presently in operation.

Area sources include gas-fired building heating and hot water equipment, landscape maintenance equipment, and architectural coatings (paints, lacquers) used in maintenance. Area-source increases are anticipated to be negligible.

After completion of the dam raise, the principal sources of long-term emissions would be mobile sources; an increase in vehicle trips would result from increased recreational activity at Shasta Lake and the associated recreation areas. It is assumed that maintenance activity for the dam and recreation areas would not change markedly. No new stationary sources of emissions are anticipated as part of the project.

Enlarging Shasta Dam and including facilities to ensure that at least the existing recreation opportunities are maintained would affect recreation participation by increasing the reservoir's surface area throughout the year. Table 5-5 compares user days (visitor days) for each of the comprehensive plans to existing and future conditions. Studies are under way to identify increases in recreation facilities and recreation uses to be included in CP1. See the Economic Valuation Appendix for a full discussion of increases in user days.

Table 5-5. Average Annual Predicted Increase in User Days[a]

Item	CP1	CP2	CP3	CP4[b]	CP5
Increase in user days (thousands)	83	141	224	224	224

Source: Data compiled by EDAW (now AECOM) in 2008

Notes:
[a] All alternatives are to include features to, at minimum, maintain existing Shasta Lake recreation capacity.
[b] The extent of increased recreation due to added facilities is under development. Recreation use would surpass that for CP3 and CP5.

The increase in recreational opportunities and visitor days would generate vehicle trips for the travel of visitors to and from the Shasta Lake area. Increased vehicle emissions were calculated using the URBEMIS2007 model and the following assumptions:

- The average visitor stay is 2.5 days.
- The average number of visitors per vehicle is 2.5.
- The recreation season for most visitors is 180 days.
- The average one-way trip distance for visitors is 25 miles.
- The first year of operations is expected to be 2015 or later.

With these assumptions and the value of 83,000 increased visitor days from Table 5-5, there would be an increase of an average of 148 one-way trips per day under CP1. The results of the emissions calculations are shown in Table 5-6. Anticipated emissions would be less than the SCAQMD significance thresholds.

Table 5-6. Operations Emissions for Shasta Dam Raise, 2015 – CP1

Activity	Emissions—pounds per day				
	ROG	NO_X	CO	PM_{10}	$PM_{2.5}$
Vehicle trips for increase in recreational visitors	2	4	35	6	1
SCAQMD Level A Significance Thresholds	**25**	**25**	**500**	**80**	**None**
SCAQMD Level B Significance Thresholds	**137**	**137**	**500**	**137**	**None**

Source: Data compiled by EDAW (now AECOM) in 2008

Note: Totals may not add due to rounding.

Key:
CO = carbon monoxide
CP = Comprehensive Plan
NO_X = oxides of nitrogen
$PM_{2.5}$ = fine particulate matter
PM_{10} = respirable particulate matter
ROG = reactive organic gases
SCAQMD = Shasta County Air Quality Management District

Based on the above analysis, operation under CP1 would not result in ROG, NO_X, PM_{10}, or CO emissions that exceed applicable SCAQMD Level A thresholds. Consequently, long-term emissions during project operation under CP1 would not be anticipated to violate an air quality standard or contribute substantially to an existing or projected air quality violation. This impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact AQ-3 (CP1): Exposure of Sensitive Receptors to Substantial Pollutant Concentrations Neither short-term construction nor long-term operational sources would expose sensitive receptors to substantial concentrations of CO, PM_{10}, $PM_{2.5}$, or TACs. This impact would be less than significant.

Pollutants of concern for exposure of sensitive receptors include CO, PM_{10} and $PM_{2.5}$, and TACs. Local exposure of CO may occur near severe congestion on major roadways. The project is not anticipated to generate areas of severe roadway congestion, nor would the project locate receptors near major roadways; no local CO impact would occur.

Sensitive receptors could be exposed to substantial amounts of PM_{10} and $PM_{2.5}$ if receptors were located near large areas of grading or earthmoving and dust generation was not controlled. Similarly, substantial exposure to particulates and other smoke-borne pollutants could result if receptors were near areas

where cleared brush would be burned. There are no sensitive receptors near the dam raise areas; however, there may be sensitive receptors near the some of the lands that would be cleared before inundation by the expanded reservoir. Dust control measures would be required for all land clearing activities; these measures would prevent most PM_{10} and $PM_{2.5}$ from reaching sensitive receptors. Similarly, smoke control measures would be required by SCAQMD Rule 2:7. The impact of exposure of sensitive receptors to PM_{10} and $PM_{2.5}$ would be less than significant.

The principal TAC of concern for project construction is diesel PM. Diesel PM would be generated in the exhaust of diesel engine construction equipment. The largest concentration of diesel engines would be located at the dam raise site. There are no sensitive receptors within one-half mile of the dam site, and sensitive receptors would not be exposed to diesel PM from that source. Diesel equipment would be used for land clearing operations, and there may be sensitive receptors near the land clearing. The dose to which receptors are exposed is the primary factor used to determine health risk (i.e., potential exposure to TAC emission levels that exceed applicable standards). Dose is a function of the concentration of a substance or substances in the environment and the duration of exposure to the substance. Dose is positively correlated with time, meaning that a longer exposure period would result in a higher exposure level for the maximally exposed individual. Thus, the risks estimated for a maximally exposed individual are higher if a fixed exposure occurs over a longer period of time. According to the Office of Environmental Health Hazard Assessment, health risk assessments, which determine the exposure of sensitive receptors to TAC emissions, should be based on a 70-year exposure period; however, such assessments should be limited to the period/duration of activities associated with the project. Thus, because the use of off-road construction equipment would be limited to a few days near any sensitive receptor, short-term construction activities would not result in exposure of sensitive receptors to substantial TAC emissions.

Project implementation is not expected to result in the operation of any new significant sources of TAC emissions after construction is complete. Thus, short-term construction and long-term operational sources would not expose sensitive receptors to substantial TAC concentrations. As a result, this impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact AQ-4 (CP1): Exposure of Sensitive Receptors to Odor Emissions
Short-term construction and long-term operational sources would not expose sensitive receptors to substantial odor emissions. This impact would be less than significant.

The occurrence and severity of odor impacts depend on numerous factors: the nature, frequency, and intensity of the source; wind speed and direction; and the presence of sensitive receptors. Although offensive odors rarely cause any

physical harm, they still can be very unpleasant, leading to considerable distress and often generating citizen complaints to local governments and regulatory agencies.

Diesel exhaust has some odor, but it dissipates rapidly from the source with an increase in distance. There are no sensitive receptors immediately adjacent to the project site and people would not be exposed to substantial odors in that area. At other work sites, construction equipment use would be intermittent and temporary, resulting in an odor impact that would be less than significant.

Project implementation would not develop any major sources of odor. The project does not include one of the common types of facilities that are known to produce odors such as a landfill or a coffee roaster. Thus, short-term construction and long-term operational sources would not expose sensitive receptors to substantial odor emissions. This impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Upper Sacramento River (Shasta Dam to Red Bluff)
Impact AQ-5 (CP1): Short-Term Emissions of Criteria Air Pollutants and Precursors Below Shasta Dam During Project Construction The Gravel Augmentation Program and habitat restoration at Reading Island proposed under CP4 and CP5 would not be implemented under CP1. No other project construction or long-term operation activities that would affect emissions of criteria air pollutants and precursors are planned in the Shasta Dam–to–Red Bluff area under CP1. Therefore, no impact would occur.

The Gravel Augmentation Program and habitat restoration at Reading Island (proposed under CP4 and CP5, as described below) would not be implemented under CP1. No new facilities would be constructed below Shasta Dam under this alternative, and no changes in Reclamation's existing facilities or operations would occur that would directly or indirectly result in any increases in criteria air pollutant emissions in this portion of the primary study area. No impact would occur. Mitigation for this impact is not needed, and thus not proposed.

Lower Sacramento River and Delta and CVP/SWP Service Areas No effects on climate and air quality are expected to occur in the lower Sacramento River and Delta and CVP/SWP service areas under CP1; therefore, potential effects in those geographic regions are not discussed further in this PDEIS.

Global Study Area
Impact AQ-6 (CP1): Generation of Greenhouse Gases Project construction activities would result in emission of a less than significant quantity of GHGs. Project operation would result in beneficial effects on GHG emissions because generation of electricity at Shasta Dam would increase. This impact would be less than significant.

There are no established quantitative criteria under CEQA for determining a significant impact related to GHG emissions. The criteria suggested by various agencies principally address long-term emissions, and not the relatively short-term emissions of construction activities. One of the more commonly suggested mass emissions thresholds is 25,000 MT CO_2e per year. This value has been selected because it is the threshold established for mandatory emissions reporting for most sources in California under AB 32.

For an initial estimate of construction-phase GHG emissions, the URBEMIS model was used with the same assumptions that were used to estimate criteria pollutant emissions, as described above for Shasta Lake and vicinity (see Impact AQ-1 (CP1)). URBEMIS calculations found that the dam raise and land clearing activities would generate 2,283–3,938 tons per year of CO_2 for the 3 years of construction, which is equal to 2,071–3,572 MT. URBEMIS does not calculate emissions of GHGs other than CO_2; for emissions that are generated primarily by construction equipment, the CO_2e value would be 3–5 percent greater than the CO_2 value. As described above, there could be considerably more construction activity and more intense activity than assumed for the calculations. Further, the calculations are limited to CO_2 produced by construction equipment and on-road vehicles, and do not include CO_2 emissions attributed to processes such as making concrete or welding. Therefore, it is not unreasonable to assume that construction activities could emit GHGs on the order of 10,000 MT CO_2e per year.

GHG emissions of sequestered carbon in removed vegetation were calculated at 4,034 MT CO_2e per year for CP1. This calculation assumes that all vegetation removal, overstory removal, and relocation acreages (473 acres total) would be covered in 70-year-old stands of forest vegetation (Ponderosa pine, Douglas-fir, montane hardwood-conifer, and montane hardwood forest) and that all above-ground vegetation would be disposed of in a manner that releases the sequestered carbon into the atmosphere. All 473 acres would not be covered with 70-year forest as used in the model (ages would vary) or release all carbon to the atmosphere. Also, most utilities would be relocated in roadways, but separate relocation (and additional disturbance) was assumed in the estimated relocation acreages. This approach was applied to ensure that underestimating would not occur.

With implementation of CP1, increased activity by recreational visitors to the Shasta Lake area would result in additional vehicle trips and estimated CO_2 emissions of 3,435 lb/day, as calculated with URBEMIS. The calculations assumed 180 days of visitor activity; the annual emissions would be 309 tons per year of CO_2. Vehicles emit other GHGs in addition to CO_2; the annual GHG emissions are estimated at 324 tons (approximately 294 MT) CO_2e.

Increasing the size of Shasta Dam and Shasta Lake would result in the ability to increase hydropower generation at Shasta generating facilities. Generation of electricity by hydropower reduces the need for fossil-fuel generation of

electricity and the GHG emissions that would occur with that generation. Raising Shasta Dam by 6.5 feet and implementing the operational strategy for CP1 would result in a net increase in power generation of 17 gigawatt-hours (GWh) per year (Table 5-7). This net generation estimate accounts for the energy required for pumping the increased water supplies. Fossil-fuel generation of 17 GWh of energy would produce an estimated 15,100 MT of CO_2, also shown in Table 5-7. Therefore, the increased generation of electricity at Shasta Dam would reduce the need to build facilities for fossil-fueled generation of 17 GWh per year in the global study area.

Table 5-7. Average Annual Hydropower Generation Benefits

Item	CP1	CP2	CP3	CP4	CP5
Net increased generation (GWh/year)	17	42	54	94	54
CO_2 displaced (1,000 metric tons)	15.1	37.5	48.2	83.4	48.2

Source: Data compiled by EDAW (now AECOM) in 2008

Key:
CO_2 = carbon dioxide
CP = Comprehensive Plan
GWh/year = gigawatt-hours per year

The results of the above analysis show that CP1 would result in short-term emissions of GHG for the years of construction, followed by long-term benefits of GHG reduction through generation of electricity at Shasta Dam. The magnitude of the GHG "savings" for each year of operation, approximately 15,000 MT, would be greater than the potential annual construction emissions, which may be on the order of 14,034 MT (10,000 from exhaust emission, 4,034 from loss of carbon sequestered in vegetation). Further, construction emissions of 14,034 MT CO_2e per year would be less than the suggested significance threshold of 25,000 MT.

The GHG emissions from construction activities would be temporary in duration and mitigated to the extent feasible; therefore, such emissions would not conflict with State or regional planning efforts or emit GHG in excess of mandatory reporting standards. GHG emissions from long-term operations would likely have a net benefit as a result of increased hydroelectric generation and would thus also not conflict with planning efforts or mandatory reporting thresholds. This impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

In addition to the effects described above, the loss of vegetation presently in the area that would be inundated would likely result in a loss of CO_2 absorption by that vegetation, as well as increased emissions of decomposing material present in the lake as a result of increases volume. There may be some offset to this effect with increased surface area of Shasta Lake for absorption. These effects are speculative and infeasible to quantify at this time.

CP2 – 12.5-Foot Dam Raise, Anadromous Fish Survival and Water Supply Reliability

Shasta Lake and Vicinity

Impact AQ-1 (CP2): Short-Term Emissions of Criteria Air Pollutants and Precursors at Shasta Lake and Vicinity During Project Construction Project construction would result in short-term NO_X emissions that would exceed applicable SCAMQD thresholds, and could result in emissions that would exceed PM_{10} or ROG thresholds. This conclusion is based on calculations of estimated emissions for major elements of the project, and projection of additional emissions for other elements where calculation is not reasonable at the current level of project definition. Shasta County is a nonattainment area for the State ozone and PM_{10} standards. Thus, short-term emissions generated during construction could contribute substantially to an existing or projected air quality violation. This impact would be significant.

This impact would be similar to Impact AQ-1 (CP1). CP2 would include a dam raise of 12.5 feet and land clearing of an area likely to be greater than for CP1. These are larger values than for CP1, but the construction period would be longer and not substantially more intense. The SCAQMD thresholds are based on maximum daily emissions, and the maximum daily activity is not anticipated to be extraordinarily greater with CP2 than with CP1. For the same reasons as described for CP1, this impact would be significant. Mitigation for this impact is proposed in Section 5.3.5.

Impact AQ-2 (CP2): Long-Term Emissions of Criteria Air Pollutants and Precursors During Project Operation Long-term project operation is not anticipated to result in ROG, NO_X, PM_{10}, or CO emissions that exceed applicable SCAQMD thresholds. Thus, long-term operational emissions would not be anticipated to violate an air quality standard or contribute substantially to an existing or projected air quality violation. This impact would be less than significant.

Long-term operational emissions would come from stationary, area, and mobile sources. This impact would be the same as Impact AQ-2 (CP1) for stationary and area sources and similar to Impact AQ-2 (CP1) for mobile sources. With CP2, there would be an annual increase of 141,000 visitor days, as was shown in Table 5-5, resulting in 251 average daily trips. The associated daily emissions are shown in Table 5-8.

Based on the above analysis, operation under CP2 would not result in ROG, NO_X, PM_{10}, or CO emissions that exceed applicable SCAQMD Level A thresholds. Consequently, long-term emissions during project operation under CP2 would not violate an air quality standard or contribute substantially to an existing or projected air quality violation. This impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Table 5-8. Operations Emissions for Shasta Dam Raise, 2015 – CP2

Activity	Emissions—pounds per day				
	ROG	NO_X	CO	PM_{10}	$PM_{2.5}$
Vehicle trips for increase in recreational visitors	4	7	59	11	2
SCAQMD Level A significance thresholds	25	25	500	80	None
SCAQMD Level B significance thresholds	137	137	500	137	None

Source: Data compiled by EDAW (now AECOM) in 2008

Key:
CO = carbon monoxide
CP = Comprehensive Plan
NO_X = oxides of nitrogen
$PM_{2.5}$ = fine particulate matter
PM_{10} = respirable particulate matter
ROG = reactive organic gases
SCAQMD = Shasta County Air Quality Management District

Impact AQ-3 (CP2): Exposure of Sensitive Receptors to Substantial Pollutant Concentrations Neither short-term construction nor long-term operational sources would expose sensitive receptors to substantial concentrations of CO, PM_{10}, $PM_{2.5}$, or TACs. This impact would be less than significant.

This impact would be the same as Impact AQ-3 (CP1) and would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact AQ-4 (CP2): Exposure of Sensitive Receptors to Odor Emissions Short-term construction and long-term operational sources would not expose sensitive receptors to substantial odor emissions. This impact would be less than significant.

This impact would be the same as Impact AQ-4 (CP1) and would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Upper Sacramento River (Shasta Dam to Red Bluff)
Impact AQ-5 (CP2): Short-Term Emissions of Criteria Air Pollutants and Precursors Below Shasta Dam During Project Construction The Gravel Augmentation Program and habitat restoration at Reading Island proposed under CP4 and CP5 would not be implemented under CP2. No other project construction or long-term operation activities that would affect emissions of criteria air pollutants and precursors are planned in the Shasta Dam–to–Red Bluff area under CP2. Therefore, no impact would occur.

This impact would be the same as Impact AQ-5 (CP1). No impact would occur. Mitigation for this impact is not needed, and thus not proposed.

Lower Sacramento River and Delta and CVP/SWP Service Areas No effects on climate and air quality are expected to occur in the lower Sacramento

River and Delta and CVP/SWP service areas under CP2; therefore, potential effects in those geographic regions are not discussed further in this PDEIS.

Global Study Area

Impact AQ-6 (CP2): Generation of Greenhouse Gases Project construction activities would result in a less than significant quantity of emission of GHG. Project operations would result in beneficial effects on GHG emissions because generation of electricity at Shasta Dam would increase. This impact would be less than significant.

This impact would be similar to Impact AQ-6 (CP1) for construction and operations. With implementation of CP2, increased activity by recreational visitors to the Shasta Lake area would result in additional vehicle trips and estimated CO_2 emissions of 5,825 lb/day, as calculated with URBEMIS. The annual GHG emissions are estimated at 550 tons (approximately 500 MT) CO_2e. This amount would be approximately 225 MT greater than CP1.

Raising Shasta Dam by 12.5 feet and implementing the operational strategy for CP2 would result in a net increase in power generation of 42 GWh per year (Table 5-7). Fossil-fuel generation of 42 GWh of energy would produce an estimated 37,500 MT CO_2, also shown in Table 5-7. Thus, CP2 would reduce the need to build facilities for fossil-fueled generation of 17 GWh per year in the global study area.

CP2 would result in short-term emissions of GHG for the years of construction, followed by long-term benefits of GHG reduction through generation of electricity at Shasta Dam. The magnitude of the GHG "savings" for each year of operation, approximately 37,000 MT, would be greater than the potential annual construction emissions, which may be on the order of 10,000 MT from exhaust emissions and 5,910 MT from loss of carbon sequestered in existing vegetation. Further, construction emissions of 15,910 MT CO_2e per year would be less than the suggested significance threshold of 25,000 MT. It is concluded that the short-term impact would be less than significant, and that the overall net impact would be beneficial. Mitigation for this impact is not needed, and thus not proposed.

CP3 – 18.5-Foot Dam Raise, Anadromous Fish Survival and Water Supply

Shasta Lake and Vicinity

Impact AQ-1 (CP3): Short-Term Emissions of Criteria Air Pollutants and Precursors at Shasta Lake and Vicinity During Project Construction Project construction would result in short-term NO_X emissions that would exceed applicable SCAQMD thresholds, and could result in emissions that would exceed PM_{10} or ROG thresholds. This conclusion is based on calculations of estimated emissions for major elements of the project, and projection of additional emissions for other elements where calculation is not reasonable at the current level of project definition. Shasta County is a nonattainment area for the State ozone and PM_{10} standards. Thus, short-term emissions generated

during construction could contribute substantially to an existing or projected air quality violation. This impact would be significant.

This impact would be similar to Impact AQ-1 (CP1). CP3 would include a dam raise of 18.5 feet and land clearing of approximately 1,000 acres. These are larger values than for CP1, but the construction period would be longer and not substantially more intense, considering the margins for increase discussed in Impact AQ-1 (CP1). The SCAQMD thresholds are based on maximum daily emissions, and the maximum daily activity is not anticipated to be substantially greater with CP3 than with CP1. For the same reasons as described for CP1, this impact would be significant. Mitigation for this impact is proposed in Section 5.3.5.

Impact AQ-2 (CP3): Long-Term Emissions of Criteria Air Pollutants and Precursors During Project Operation Long-term project operation is not anticipated to result in ROG, NO_X, PM_{10}, or CO emissions that exceed applicable SCAQMD thresholds. Thus, long-term operational emissions would not be anticipated to violate an air quality standard or contribute substantially to an existing or projected air quality violation. This impact would be less than significant.

Long-term operational emissions would come from stationary, area, and mobile sources. This impact would be the same as Impact AQ-2 (CP1) for stationary and area sources and similar to Impact AQ-2 (CP1 and CP2) for mobile sources. With CP3, there would be an annual increase of 224,000 visitor days, as was shown in Table 5-5, resulting in 398 average daily trips. The associated daily emissions are shown in Table 5-9. Overall trip levels would be greater than under CP1 and CP2, but emissions would remain below significance thresholds.

Table 5-9. Operations Emissions for Shasta Dam Raise, 2015—CP3

Activity	Emissions—pounds per day				
	ROG	NO_X	CO	PM_{10}	$PM_{2.5}$
Vehicle trips for increase in recreational visitors	6	11	94	17	3
SCAQMD Level A significance thresholds	25	25	500	80	None
SCAQMD Level B significance thresholds	137	137	500	137	None

Source: Data compiled by EDAW (now AECOM) in 2008

Key:
CO = carbon monoxide
CP = Comprehensive Plan
NO_X = oxides of nitrogen
$PM_{2.5}$ = fine particulate matter
PM_{10} = respirable particulate matter
ROG = reactive organic gases
SCAQMD = Shasta County Air Quality Management District

Based on the above analysis, operation under CP3 would not result in ROG, NO_X, PM_{10}, or CO emissions that exceed SCAQMD Level A thresholds.

Consequently, long-term emissions during operation under CP3 would not violate an air quality standard or contribute substantially to an existing or projected air quality violation. This impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact AQ-3 (CP3): Exposure of Sensitive Receptors to Substantial Pollutant Concentrations Neither short-term construction nor long-term operational sources would expose sensitive receptors to substantial concentrations of CO, PM_{10}, $PM_{2.5}$, or TACs. This impact would be less than significant.

This impact would be the same as Impact AQ-3 (CP1) and would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact AQ-4 (CP3): Exposure of Sensitive Receptors to Odor Emissions Short-term construction and long-term operational sources would not expose sensitive receptors to substantial odor emissions. This impact would be less than significant.

This impact would be the same as Impact AQ-4 (CP1) and would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Upper Sacramento River (Shasta Dam to Red Bluff)
Impact AQ-5 (CP3): Short-Term Emissions of Criteria Air Pollutants and Precursors Below Shasta Dam During Project Construction The Gravel Augmentation Program and habitat restoration at Reading Island proposed under CP4 and CP5 would not be implemented under CP3. No other project construction or long-term operation activities that would affect emissions of criteria air pollutants and precursors are planned in the Shasta Dam–to–Red Bluff area under CP3. Therefore, no impact would occur.

This impact would be the same as Impact AQ-5 (CP1). No impact would occur. Mitigation for this impact is not needed, and thus not proposed.

Lower Sacramento River and Delta and CVP/SWP Service Areas No effects on climate and air quality are expected to occur in the lower Sacramento River and Delta and CVP/SWP service areas under CP3; therefore, potential effects in those geographic regions are not discussed further in this PDEIS.

Global Study Area
Impact AQ-6 (CP3): Generation of Greenhouse Gases Project construction activities would result in a less than significant quantity of emission of GHGs. Project operations would result in beneficial effects on GHG emissions because generation of electricity at Shasta Dam would increase. This impact would be less than significant.

This impact would be similar to Impact AQ-6 (CP1) for construction and operations. With implementation of CP3, increased activity by recreational visitors to the Shasta Lake area would result in additional vehicle trips and

estimated CO_2 emissions of 9,238 lb/day, as calculated with URBEMIS. The annual GHG emissions are estimated at 873 tons (approximately 792 MT) CO_2e.

Raising Shasta Dam by 18.5 feet and implementing the operational strategy for CP3 would result in a net increase in power generation of 54 GWh per year, as was shown in Table 5-7. Fossil-fuel generation of 54 GWh of energy would produce an estimated 48,500 MT of CO_2, also shown in Table 5-7. Thus, CP3 would reduce the need to build facilities for fossil-fueled generation of 17 GWh per year in the global study area.

CP3 would result in relatively small short-term emissions of GHGs for the years of construction, followed by long-term benefits of GHG reduction through generation of electricity at Shasta Dam. The magnitude of the GHG "savings" for each year of operation, approximately 48,500 MT, would be greater than the potential annual construction emissions, which may be on the order of 10,000 MT from exhaust emissions and 8,163 MT from loss of carbon sequestered in existing vegetation. Further, construction emissions of 18,163 MT CO_2e per year would be less than the suggested significance threshold of 25,000 MT. It is concluded that the short-term impact would be less than significant, and that the overall net impact would be beneficial. Mitigation for this impact is not needed, and thus not proposed.

CP4 – 18.5-Foot Dam Raise, Anadromous Fish Focus with Water Supply Reliability

Shasta Lake and Vicinity

Impact AQ-1 (CP4): Short-Term Emissions of Criteria Air Pollutants and Precursors at Shasta Lake and Vicinity During Project Construction Project construction would result in short-term NO_X emissions that would exceed applicable SCAQMD thresholds, and could result in emissions that would exceed PM_{10} or ROG thresholds. This conclusion is based on calculations of estimated emissions for major elements of the project, and projection of additional emissions for other elements where calculation is not reasonable at the current level of project definition. Shasta County is a nonattainment area for the State ozone and PM_{10} standards. Thus, short-term emissions generated during construction could contribute substantially to an existing or projected air quality violation. This impact would be significant.

This impact would be similar to Impact AQ-1 (CP3) and would be significant. Mitigation for this impact is proposed in Section 5.3.5.

Impact AQ-2 (CP4): Long-Term Emissions of Criteria Air Pollutants and Precursors During Project Operation Long-term project operation is not anticipated to result in ROG, NO_X, PM_{10}, or CO emissions that exceed applicable SCAQMD thresholds. Thus, long-term operational emissions would not be anticipated to violate an air quality standard or contribute substantially to

an existing or projected air quality violation. This impact would be less than significant.

Long-term operational emissions would come from stationary, area, and mobile sources. This impact would be the same as Impact AQ-2 (CP1) for stationary and area sources and the same as Impact AQ-2 (CP3) for mobile sources. This impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact AQ-3 (CP4): Exposure of Sensitive Receptors to Substantial Pollutant Concentrations Neither short-term construction nor long-term operational sources would expose sensitive receptors to substantial concentrations of CO, PM_{10}, $PM_{2.5}$, or TACs. This impact would be less than significant.

This impact would be the same as Impact AQ-3 (CP1) and would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact AQ-4 (CP4): Exposure of Sensitive Receptors to Odor Emissions Short-term construction and long-term operational sources would not expose sensitive receptors to substantial odor emissions. This impact would be less than significant.

This impact would be the same as Impact AQ-4 (CP1) and would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Upper Sacramento River (Shasta Dam to Red Bluff)

Impact AQ-5 (CP4): Short-Term Emissions of Criteria Air Pollutants and Precursors Below Shasta Dam During Project Construction The Gravel Augmentation Program proposed for areas along the upper Sacramento River would add to emissions of ROG, NO_X, and PM_{10} from project construction. Habitat restoration activities at Reading Island would also add ROG, NO_X, and PM_{10} emissions. However, these emissions separately and combined would add negligible amounts to annual emission levels. This impact would be less than significant.

The Gravel Augmentation Program proposed under CP4 would add an additional 1 lb/day of ROG, 16 lb/day of NO_X, and 1 lb/day of PM_{10} to project construction emission levels. Emissions from gravel augmentation would be from gravel material hauling consisting of approximately 18 trips per day, 40 miles round trip to sites identified to the south along the Sacramento River. Gravel augmentation would only occur for 2 months out of the year; therefore, these emissions would add negligible amounts to annual emission levels.

Habitat restoration at Reading Island proposed under CP4 would add an additional 6.7 lb/day of ROG, 50.1 lb/day of NO_X, and 12.4 lb/day of PM_{10} to project construction emission levels. During habitat restoration, emissions would be generated from removing vegetation from the Sacramento River's side channel, removing noxious invasive plant species from the island, minor

grading, and hauling away waste materials (approximately 25 trips per day). Restoration activities would occur for only 2 months for a total of 44 8-hour work days; therefore, these emissions would add negligible amounts to annual emission levels.

The combined emissions from the Gravel Augmentation Program and habitat restoration at Reading Island would be 7.7 lb/day of ROG, 76 lb/day of NO_X, and 13.4 lb/day of PM_{10}. These emissions are below SCAQMD's Level A thresholds of 25 lb/day of ROG, 25 lb/day of NO_X, and 80 lb/day of PM_{10}. This impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Lower Sacramento River and Delta and CVP/SWP Service Areas No effects on climate and air quality are expected to occur in the lower Sacramento River and Delta and CVP/SWP service areas under CP4; therefore, potential effects in those geographic regions are not discussed further in this PDEIS.

Global Study Area

Impact AQ-6 (CP4): Generation of Greenhouse Gases Project construction activities would result in a less than significant quantity of emission of GHGs. Project operation would result in beneficial effects on GHG emissions because generation of electricity at Shasta Dam would increase. This impact would be less than significant.

This impact would be similar to Impact AQ-6 (CP1) for construction and operations. With implementation of CP4, increased activity by recreational visitors to the Shasta Lake area would result in additional vehicle trips and estimated CO_2 emissions of 9,238 lb/day, as calculated with URBEMIS. The annual GHG emissions are estimated at 872 tons (approximately 792 MT) CO_2e.

Raising Shasta Dam by 18.5 feet and implementing the operational strategy for CP4 would result in a net increase in power generation of 94 GWh per year (Table 5-7). Fossil-fuel generation of 94 GWh of energy would produce an estimated 83,400 MT CO_2 (Table 5-7). Thus, CP4 would reduce the need to build facilities for fossil-fueled generation of 17 GWh per year in the global study area.

CP4 would result in short-term emissions of GHGs for the years of construction, followed by long-term benefits of GHG reduction through generation of electricity at Shasta Dam. The magnitude of the GHG "savings" for each year of operation, approximately 83,400 MT, would be greater than the potential annual construction emissions, which may be on the order of 10,000 MT from exhaust emissions and 8,163 MT from loss of carbon sequestered in existing vegetation. Further, construction emissions of 18,163 MT CO_2e per year would be less than the suggested significance threshold of 25,000 MT. It is concluded that the short-term impact would be less than significant, and that the

overall net impact would be beneficial. Mitigation for this impact is not needed, and thus not proposed.

CP5 – 18.5-Foot Dam Raise, Combination Plan

Shasta Lake and Vicinity

Impact AQ-1 (CP5): Short-Term Emissions of Criteria Air Pollutants and Precursors at Shasta Lake and Vicinity During Project Construction Project construction would result in short-term NO_X emissions that would exceed applicable SCAQMD thresholds, and could result in emissions that would exceed PM_{10} or ROG thresholds. This conclusion is based on calculations of estimated emissions for major elements of the project, and projection of additional emissions for other elements where calculation is not reasonable at the current level of project definition. Shasta County is a nonattainment area for the State ozone and PM_{10} standards. Thus, short-term emissions generated during construction could contribute substantially to an existing or projected air quality violation. This impact would be significant.

This impact would be similar to Impact AQ-1 (CP3) and would be significant. Mitigation for this impact is proposed in Section 5.3.5.

Impact AQ-2 (CP5): Long-Term Emissions of Criteria Air Pollutants and Precursors During Project Operation Long-term project operation is not anticipated to result in ROG, NO_X, PM_{10}, or CO emissions that exceed applicable SCAQMD thresholds. Thus, long-term operational emissions would not be anticipated to violate an air quality standard or contribute substantially to an existing or projected air quality violation. This impact would be less than significant.

Long-term operational emissions would come from stationary, area, and mobile sources. This impact would be the same as Impact AQ-2 (CP1) for stationary and area sources and similar to Impact AQ-2 (CP3) for mobile sources. With CP5, the annual increase in visitor days has not been estimated, as was shown in Table 5-5; however, visitor days are expected to surpass the 224,000 forecast for CP3 and CP4. For purposes of impact assessment, it was assumed that there would be an annual increase of 400,000 visitor days with CP5, resulting in 711 average daily trips. The associated daily emissions are shown in Table 5-10.

Based on the above analysis, operation of CP5 would not result in ROG, NO_X, PM_{10}, or CO emissions that exceed applicable SCAQMD Level A thresholds. Consequently, long-term operational emissions would not violate an air quality standard or contribute substantially to an existing or projected air quality violation. As a result, this impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Table 5-10. Operations Emissions for Shasta Dam Raise, 2015 – CP5

Activity	Emissions—pounds per day				
	ROG	NO_X	CO	PM_{10}	$PM_{2.5}$
Vehicle trips for increase in recreational visitors	11	20	168	31	6
SCAQMD Level A significance thresholds	25	25	500	80	None
SCAQMD Level B significance thresholds	137	137	500	137	None

Source: Data compiled by EDAW (now AECOM) in 2008

Key:
CO = carbon monoxide
CP = Comprehensive Plan
NO_X = oxides of nitrogen
$PM_{2.5}$ = fine particulate matter
PM_{10} = respirable particulate matter
ROG = reactive organic gases
SCAQMD = Shasta County Air Quality Management District

Impact AQ-3 (CP5): Exposure of Sensitive Receptors to Substantial Pollutant Concentrations Neither short-term construction nor long-term operational sources would expose sensitive receptors to substantial concentrations of CO, PM_{10}, $PM_{2.5}$, or TACs. This impact would be less than significant.

This impact would be the same as Impact AQ-3 (CP1) and would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact AQ-4 (CP5): Exposure of Sensitive Receptors to Odor Emissions Short-term construction and long-term operational sources would not expose sensitive receptors to substantial odor emissions. This impact would be less than significant.

This impact would be the same as Impact AQ-4 (CP1) and would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Upper Sacramento River (Shasta Dam to Red Bluff)
Impact AQ-5 (CP5): Short-Term Emissions of Criteria Air Pollutants and Precursors Below Shasta Dam During Project Construction The Gravel Augmentation Program proposed for areas along the upper Sacramento River would add to emissions of ROG, NO_X, and PM_{10} from project construction. However, these emissions would add negligible amounts to annual emission levels. This impact would be less than significant.

This impact would be the same as Impact AQ-5 (CP4) and would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Lower Sacramento River and Delta and CVP/SWP Service Areas No effects on climate and air quality are expected to occur in the lower Sacramento

River and Delta and CVP/SWP service areas under CP5; therefore, potential effects in those geographic regions are not discussed further in this PDEIS.

Global Study Area

Impact AQ-6 (CP5): Generation of Greenhouse Gases Project construction activities would result in a less than significant quantity of emission of GHG. Project operation would result in beneficial effects on GHG emissions because generation of electricity at Shasta Dam would increase. This impact would be less than significant.

This impact would be similar to Impact AQ-5 (CP1) for construction and for operations. With implementation of CP5, increased activity by recreational visitors to the Shasta Lake area would result in additional vehicle trips and estimated CO_2 emissions of 16,503 lb/day, as calculated with URBEMIS. The annual GHG emissions are estimated at 1,560 tons (approximately 1,415 MT) CO_2e.

Raising Shasta Dam by 18.5 feet and implementing the operational strategy for CP5 would result in a net increase in power generation of 54 GWh per year, as was shown in Table 5-7. Fossil fuel generation of 54 GWh of energy would produce an estimated 48,500 MT CO_2, also shown in Table 5-7. Thus, CP5 would reduce the need to build facilities for fossil-fueled generation of 17 GWh per year in the global study area.

CP5 would result in short-term emissions of GHGs for the years of construction, followed by long-term benefits of GHG reduction through generation of electricity at Shasta Dam. The magnitude of the GHG "savings" for each year of operation, approximately 48,500 MT, would be greater than the potential annual construction emissions, which may be on the order of 10,000 MT from exhaust emissions and 8,311 MT from loss of carbon sequestered in existing vegetation. Further, construction emissions of 18,311 MT CO_2e per year would be less than the suggested significance threshold of 25,000 MT. It is concluded that the short-term impact would be less than significant, and that the overall net impact would be beneficial. Mitigation for this impact is not needed, and thus not proposed.

5.3.5 Mitigation Measures

Table 5-11 presents a summary of mitigation measures for air quality and climate.

Table 5-11. Summary of Mitigation Measures for Air Quality and Climate Change

		No-Action Alternative	CP1	CP2	CP3	CP4	CP5
Impact AQ-1: Short-Term Emissions of Criteria Air Pollutants and Precursors at Shasta Lake and Vicinity During Project Construction	LOS before Mitigation	NI	S	S	S	S	S
	Mitigation Measure	None required.	Mitigation Measure AQ-1: Implement Standard Measures and Best Available Mitigation Measures to Reduce Emissions Levels.				
	LOS after Mitigation	NI	SU	SU	SU	SU	SU
Impact AQ-2: Long-Term Emissions of Criteria Air Pollutants and Precursors During Project Operation	LOS before Mitigation	LTS	LTS	LTS	LTS	LTS	LTS
	Mitigation Measure	None required.	None needed; thus, none proposed.				
	LOS after Mitigation	LTS	LTS	LTS	LTS	LTS	LTS
Impact AQ-3: Exposure of Sensitive Receptors to Substantial Pollutant Concentrations	LOS before Mitigation	NI	LTS	LTS	LTS	LTS	LTS
	Mitigation Measure	None required.	None needed; thus, none proposed.				
	LOS after Mitigation	NI	LTS	LTS	LTS	LTS	LTS
Impact AQ-4: Exposure of Sensitive Receptors to Odor Emissions	LOS before Mitigation	NI	LTS	LTS	LTS	LTS	LTS
	Mitigation Measure	None required.	None needed; thus, none proposed.				
	LOS after Mitigation	NI	LTS	LTS	LTS	LTS	LTS
Impact AQ-5: Short-Term Emissions of Criteria Air Pollutants and Precursors Below Shasta Dam During Project Construction	LOS before Mitigation	NI	NI	NI	NI	LTS	LTS
	Mitigation Measure	None required.	None needed; thus, none proposed.				
	LOS after Mitigation	NI	NI	NI	NI	LTS	LTS
Impact AQ-6: Generation of Greenhouse Gases	LOS before Mitigation	LTS	LTS	LTS	LTS	LTS	LTS
	Mitigation Measure	None required.	None needed; thus, none proposed.				
	LOS after Mitigation	LTS	LTS	LTS	LTS	LTS	LTS

Notes:
LOS = level of significance
LTS = less than significant
NA = not applicable
NI = no impact
PS = potentially significant
SU = significant and unavoidable

No-Action Alternative

No mitigation measures are needed for this alternative.

CP1 – 6.5-Foot Dam Raise, Anadromous Fish Survival and Water Supply Reliability

No mitigation is needed for Impacts AQ-2 (CP1), AQ-3 (CP1), AQ-4 (CP1), AQ-5, and AQ-6 (CP1). Mitigation is provided below for the remaining impact of CP1 on air quality.

Mitigation Measure AQ-1 (CP1): Implement Standard Measures and Best Available Mitigation Measures to Reduce Emissions Levels Reclamation (referred to below as "the project applicant" or "the applicant") and its primary construction contractor(s) will implement the mitigation measures listed below to reduce emissions of criteria air pollutants and precursors generated during construction.

Standard Mitigation Measures The following SCAQMD standard mitigation measures are applicable to all projects.

PM_{10} Controls

- Alternatives to open burning of vegetative material on the project site shall be used by the project applicant unless otherwise deemed infeasible by SCAQMD. Among suitable alternatives is chipping, mulching, or conversion to biomass fuel.

- The applicant shall be responsible for ensuring that all adequate dust control measures are implemented in a timely and effective manner during all phases of project development and construction.

- All material excavated, stockpiled, or graded shall be sufficiently watered to prevent fugitive PM_{10} dust emissions from leaving the property boundaries and causing a public nuisance or a violation of an ambient air standard. Watering shall occur at least twice daily with complete site coverage, preferably in the mid-morning and after work is completed each day.

- All areas (including unpaved roads) with vehicle traffic shall be watered periodically or dust palliatives applied for stabilization of fugitive PM_{10} dust emissions.

- All on site vehicles shall be limited to a speed of 15 miles per hour on unpaved roads.

- All land clearing, grading, earthmoving, or excavation activities on a project shall be suspended when winds are expected to exceed 20 miles per hour.

- All inactive portions of the development site shall be seeded and watered until a suitable grass cover is established.

- The applicant shall be responsible for applying Shasta County Department of Public Works–approved nontoxic soil stabilizers (according to manufacturers' specifications) to all inactive construction areas (previously graded areas that remain inactive for 96 hours) in accordance with the Shasta County Grading Ordinance.

- All trucks hauling dirt, sand, soil, or other loose material shall be covered or maintain at least 2 feet of freeboard (i.e., minimum vertical distance between top of the load and the trailer) in accordance with the requirements of California Vehicle Code Section 23114. This provision shall be enforced by local law enforcement agencies.

- All material transported off site shall be either sufficiently watered or securely covered to prevent a public nuisance.

- During initial grading, earthmoving, or site preparation, the project shall be required to construct a paved (or dust palliative–treated) apron, at least 100 feet in length, onto the project site from the adjacent paved road(s).

- Paved streets adjacent to the development site shall be swept or washed at the end of each day to remove excessive accumulations of silt and/or mud that may have accumulated as a result of activities on the development site.

- Adjacent paved streets shall be swept (water sweeper with reclaimed water recommended) at the end of each day if substantial volumes of soil materials have been carried onto adjacent public paved roads from the project site.

- Wheel washers shall be installed where project vehicles and/or equipment enter and/or exit onto paved streets from unpaved roads. Vehicles and/or equipment shall be washed before each trip.

- Before final occupancy, the applicant shall reestablish ground cover on the construction site through seeding and watering in accordance with the Shasta County Grading Ordinance.

Streets

- The project shall provide for temporary traffic control as appropriate during all phases of construction to improve traffic flow as deemed appropriate by the Shasta County Department of Public Works and/or the California Department of Transportation.

- Construction activities shall be scheduled that direct traffic flow to off-peak hours as much as practicable.

Energy Conservation For any new or relocated structures, the following features will be incorporated as much as practicable:

- The project shall provide for the use of energy-efficient lighting, including controls, and process systems such as water heaters, furnaces, and boiler units.

- The project shall use a central water heating system featuring the use of low-NO_X hot water heaters.

Best Available Mitigation Measures None of the SCAQMD BAMMs are appropriate for the project. Therefore, the following measures will be incorporated into the project:

- The project applicant will prepare and submit to SCAQMD for approval a plan demonstrating that the heavy-duty (equal to or greater than 50 horsepower) off-road vehicles to be used in the construction project, including owned, leased, and subcontractor vehicles, shall achieve a projectwide fleet-average 20 percent NO_X reduction and 45 percent particulate reduction compared to the most recent ARB fleet average at time of construction. Acceptable options for reducing emissions may include use of late-model engines, low-emission diesel products, alternative fuels, engine retrofit technology, after-treatment products, and/or other options as they become available.

- The project applicant will locate all construction equipment maintenance and staging areas at the farthest distance possible from nearby sensitive land uses.

- Idling of diesel-powered vehicles and equipment will not be permitted during periods of nonactive vehicle use. Diesel-powered engines will not be allowed to idle for more than 5 consecutive minutes in a 60-minute period when the equipment is not in use, occupied by an operator, or otherwise in motion, except under the following conditions:

  – When equipment is forced to remain motionless because of traffic conditions or mechanical difficulties over which the operator has no control

  – When it is necessary to operate auxiliary systems installed on the equipment, only when such system operation is necessary to accomplish the intended use of the equipment

- To bring the equipment to the manufacturer's recommended operating temperature
- When the ambient temperature is below 40ºF or above 85ºF
- When equipment is being repaired

Implementation of the above mitigation measure would reduce ROG, NO_X, and PM_{10} emissions from on-site heavy-duty equipment exhaust by approximately 5 percent, 20 percent, and 45 percent, respectively, and fugitive PM_{10} dust emissions by 75 percent. However, NO_X emissions generated during construction would still exceed the SCAQMD Level B threshold of 137 lb/day. Thus, this impact would be significant and unavoidable**.**

CP2 – 12.5-Foot Dam Raise, Anadromous Fish Survival and Water Supply Reliability

No mitigation is needed for Impacts AQ-2 (CP2), AQ-3 (CP2), AQ-4 (CP2), AQ-5, and AQ-6 (CP2). Mitigation is provided below for the remaining impact of CP2 on air quality.

Mitigation Measure AQ-1 (CP2): Implement Standard Measures and Best Available Mitigation Measures to Reduce Emissions Levels This mitigation measure is identical to Mitigation Measure AQ-1 (CP1). For the reasons described above under Mitigation Measure AQ-1 (CP1), this impact would be significant and unavoidable.

CP3 – 18.5-Foot Dam Raise, Anadromous Fish Survival and Water Supply

No mitigation is needed for Impacts AQ-2 (CP3), AQ-3 (CP3), AQ-4 (CP3), AQ-5, and AQ-6 (CP3). Mitigation is provided below for the remaining impact of CP3 on air quality.

Mitigation Measure AQ-1 (CP3): Implement Standard Measures and Best Available Mitigation Measures to Reduce Emissions Levels This mitigation measure is identical to Mitigation Measure AQ-1 (CP1). For the reasons described above under Mitigation Measure AQ-1 (CP1), this impact would be significant and unavoidable.

CP4 – 18.5-Foot Dam Raise, Anadromous Fish Focus with Water Supply Reliability

No mitigation is needed for Impacts AQ-2 (CP4), AQ-3 (CP4), AQ-4 (CP4), AQ-5, and AQ-6 (CP4). Mitigation is provided below for the remaining impact of CP4 on air quality.

Mitigation Measure AQ-1 (CP4): Implement Standard Measures and Best Available Mitigation Measures to Reduce Emissions Levels This mitigation measure is identical to Mitigation Measure AQ-1 (CP1). For the reasons described above under Mitigation Measure AQ-1 (CP1), this impact would be significant and unavoidable.

CP5 – 18.5-Foot Dam Raise, Combination Plan

No mitigation is needed for Impacts AQ-2 (CP5), AQ-3 (CP5), AQ-4 (CP5), AQ-5, and AQ-6 (CP5). Mitigation is provided below for the remaining impact of CP5 on air quality.

Mitigation Measure AQ-1 (CP5): Implement Standard Measures and Best Available Mitigation Measures to Reduce Emissions Levels This mitigation measure is identical to Mitigation Measure AQ-1 (CP1). For the reasons described above under Mitigation Measure AQ-1 (CP1), this impact would be significant and unavoidable.

5.3.6 Cumulative Effects

The effects of climate change on operations at Shasta Lake could potentially result in changes downstream. As described in the Climate Change Projection Appendix, climate change could result in higher reservoir releases in the future due to an increase in winter and early spring inflow into the lake from high intensity storm events. The change in reservoir releases could be necessary to manage for flood events resulting from these potentially larger storms. The potential increase in releases from the reservoir could lead to long-term changes in downstream channel equilibrium.

Growth is likely to occur throughout the primary and extended study areas and some future projects are reasonably foreseeable, but substantial increases in emissions of criteria air pollutants or precursors in the primary and extended study areas are unlikely to make a cumulatively considerable contribution to an overall cumulatively significant impact on air quality. For cumulative effects of climate change on other resource areas, please see the "Cumulative Effects" sections in other chapters of this PDEIS.

Shasta Lake and Vicinity and Upper Sacramento River (Shasta Dam to Red Bluff)

Under the project alternatives (CP1–CP5), construction activities would result in short-term emissions of ROG, NO_X, and PM_{10} that without mitigation would exceed applicable SCAQMD thresholds. After implementing the best available and all feasible mitigation measures, ROG and PM_{10} emissions would not exceed applicable thresholds; and in combination with past, present, and reasonably foreseeable future projects, would not result in an overall cumulatively significant impact. Therefore, with mitigation, these emissions would not be cumulatively considerable. Emissions of NO_X, however, would still exceed the applicable SCAQMD threshold after implementation of the best available mitigation measures. These emissions would be cumulatively considerable, and this would be a cumulatively significant and unavoidable impact.

Operation of any of the action alternatives would not result in cumulatively considerable emissions of ROG, NO_X, and PM_{10}. Also, neither short-term construction nor long-term operational sources would expose sensitive receptors

to substantial concentrations of CO, PM_{10}, $PM_{2.5}$, TACs, or odors. None of these emissions would be cumulatively considerable contributions to a significant cumulative impact of ROG, NO_X, and PM_{10}.

Lower Sacramento River and Delta and CVP/SWP Service Areas

The project alternatives would not generate any short-term or long-term air pollutant emissions in the extended study area. Therefore, there would be no cumulative air quality impact.

Global Study Area—Climate Change

As discussed in Section 5.1, "Affected Environment," of this chapter, climate change is a global phenomenon. All GHG emissions are considered cumulative. The impact analyses for Impacts AQ-6 (CP1), AQ-6 (CP2), AQ-6 (CP3), AQ-6 (CP4), and AQ-6 (CP5), in Section 5.3.4, "Direct and Indirect Effects," of this chapter are cumulative analyses. All five project alternatives (CP1–CP5) would result in short-term cumulative impacts that would be less than the suggested significance threshold for this cumulative effect, and therefore are considered to not make a cumulatively considerable incremental contribution to a significant cumulative impact, and would have beneficial long-term effects. For cumulative effects of climate change on other resource areas, please see the "Cumulative Effects" sections in other chapters of this PDEIS.

Chapter 6
Hydrology, Hydraulics, and Water Management

6.1 Affected Environment

The environmental setting section first presents background information and then describes storage and diversion facilities, and hydrology, hydraulics, and water management (H&H), including flood management, south Delta water levels, and groundwater resources. For a more in-depth description of the affected environment, see the *Hydraulics, Hydrology, and Water Management Technical Report*.

6.1.1 Storage Facilities

Facilities described below include Shasta Dam and Powerplant, Keswick Dam and Powerplant, Anderson-Cottonwood Irrigation District Diversion Dam, and Red Bluff Diversion Dam (RBDD).

Shasta Lake and Vicinity

This section describes storage facilities in the Shasta Lake area.

Shasta Dam and Powerplant Shasta Dam is a curved, gravity-type, concrete structure that rises 533 feet above the streambed with a total height above the foundation of 602 feet. The dam has a crest width of about 41 feet and a length of 3,460 feet. Shasta Reservoir has a storage capacity of 4,550,000 acre-feet, and water surface area at full pool of 29,600 acres. Maximum seasonal flood management storage space in Shasta Reservoir is 1.3 million acre-feet (MAF). Releases from Shasta Dam can be mad e through the power plant, over the spillway, or through the river outlets. The power plant has a maximum release capacity of nearly 20,000 cubic feet per second (cfs), the river outlets can release a maximum of 81,800 cfs at full pool, and the maximum release over the drum-gated spillway is 186,000 cfs.

Upper Sacramento River (Shasta Dam to Red Bluff)

This section describes storage facilities along the Upper Sacramento River.

Keswick Dam and Powerplant Keswick Dam is about 9 miles downstream from Shasta Dam. In addition to regulating outflow from the dam, Keswick Dam controls runoff from 45 square miles of drainage area. Keswick Dam is a concrete, gravity-type structure with a spillway over the center of the dam. The spillway has four 50- by 50-foot fixed wheel gates with a combined discharge capacity of 248,000 cfs at full or full pool elevation (587 feet). Storage capacity below the top of the spillway gates at full pool is 23,800 acre-feet. The

powerplant has a nameplate generating capacity of 105,000 kilowatts and can pass about 15,000 cfs at full pool.

6.1.2 Diversion Facilities

Below Keswick Dam, two diversion dams regulate flows on the Sacramento River, the Anderson-Cottonwood Irrigation District Diversion Dam and RBDD. The primary purpose of these two facilities is to divert water into canals for local agricultural use.

In the Delta, the CVP and SWP primarily make diversions through two pumping plants, the CVP C.W. "Bill" Jones (Jones) and SWP Harvey O. Banks (Banks) pumping plants. These two pumping plants supply water to the CVP/SWP service areas south of the Delta. While other diversion facilities are located between the RBDD and the Delta, they have less of an effect on project operations than those discussed above.

6.1.3 Hydrology and Hydraulics

The Sacramento Valley contains the Sacramento, Feather, and American River basins, covering an area of more than 24,000 square miles in the northern portion of the Central Valley. The Sacramento Valley encompasses three major drainage basins: the McCloud River, Pit River, and the Sacramento River in the north; the Delta in the south; the Sierra Nevada Mountains and Cascade Ranges in the east; and the Coast Range and Klamath Mountains in the west. Drainage in the northern portion of the Central Valley is provided by the Sacramento, Feather, and American Rivers, and major and minor streams and rivers that drain the east and west sides of the valley.

Shasta Lake and Vicinity

The most northern portion of the Sacramento River basin, upstream from Shasta Dam, is drained by the Pit River, the McCloud River, Squaw Creek, and the headwaters of the Sacramento River.

The four major tributaries to Shasta Lake are the Sacramento River, McCloud River, Pit River, and Squaw Creek, in addition to numerous minor tributary creeks and streams.

Upper Sacramento River (Shasta Dam to Red Bluff)

Flows in the Sacramento River in the 65-river-mile (RM) reach between Shasta Dam and Red Bluff (RM 244) are regulated by Shasta Dam and reregulated downstream at Keswick Dam (RM 302). In this reach, flows are influenced by tributary inflow. Major west side tributaries to the Sacramento River in this reach of the river include Clear and Cottonwood creeks. Major east side tributaries to the Sacramento River in this reach of the river include Battle, Bear, Churn, Cow, and Paynes creeks.

Lower Sacramento River and Delta

The Sacramento River enters the Sacramento Valley about 5 miles north of Red Bluff. From Red Bluff to Chico Landing (52 miles), the river receives flows from Antelope, Mill, Deer, Big Chico, Rock, and Pine creeks on the east side and Thomes, Elder, Reeds, and Red Bank creeks on the west side. From Chico Landing to Colusa (50 miles) the Sacramento River meanders through alluvial deposits between widely spaced levees. Stony Creek is the only major tributary in this segment of the river. There are no tributaries entering the Sacramento River between Stoney Creek and its confluence with the Feather River.

Floodwaters in the Sacramento River overflow the east bank at three sites in a reach referred to by the State as the Butte Basin Overflow Area. In this river reach, several Federal projects begin, including the Sacramento River Flood Control Project, Sacramento River Major and Minor Tributaries Project, and Sacramento River Bank Protection Project. Levees of the Sacramento River Flood Control Project begin in this reach, downstream from Ord Ferry on the west (RM 184), and downstream from RM 176 above Butte City on the east side of the river.

Shasta Reservoir is also operated to meet a flow requirement in the Sacramento River, at Wilkins Slough near Grimes (RM 125), also known as the Navigation Control Point. Downstream from Wilkins Slough, the Feather River, the largest east side tributary to the Sacramento River, enters the river just above Verona. Between Wilkins Slough and Verona, floodwater is diverted at two places in this segment of the river – Tisdale Weir into the Tisdale Bypass and Fremont Weir into the Yolo Bypass. The bypass system routes floodwater away from the mainstem Sacramento River to discharge into the Delta.

Below Verona, the Sacramento River flows 79 miles to the Delta, passing the City of Sacramento. The Yolo Bypass parallels this river reach to the west. Flows enter this river reach at various points. First, flows from the Natomas Cross Canal enter the Sacramento River approximately 1 mile downstream from the Feather River mouth. The American River flows into the Sacramento River in the City of Sacramento. When Sacramento River system flood flows are the highest, a portion of the flow is diverted into the Yolo Bypass at the Sacramento Weir about 3 miles upstream from the American River confluence in downtown Sacramento. At the downstream end, Yolo Bypass flows reenter the Sacramento River near Rio Vista. As the river enters the Delta, Georgiana Slough branches off from the mainstem of the Sacramento River, routing a portion of the flow into the central Delta.

The hydraulics of the Delta are complicated by tidal influences, a multitude of agricultural and municipal and industrial (M&I) diversions for use within the Delta itself, and by CVP and SWP exports. The principal factors affecting Delta hydrodynamics are (1) river inflow and outflow from the Sacramento River and San Joaquin River systems, (2) daily tidal inflow and outflow through San

Francisco Bay, and (3) export pumping from the south Delta, primarily through the Jones and Banks pumping plants.

The Jones Pumping Plant consists of six pumps, with a maximum export capacity of 4,600 cfs during the irrigation season, and 4,200 cfs during the winter nonirrigation season. Limitations at the Jones Pumping Plant are the result of a Delta-Mendota Canal freeboard constriction near O'Neill Forebay and current water demand in the upper sections of the Delta-Mendota Canal. The Jones Pumping Plant is at the end of an earth-lined intake channel about 2.5 miles long.

The SWP Banks Pumping Plant supplies water for the South Bay Aqueduct and the California Aqueduct, with an installed capacity of 10,300 cfs. Under current operational constraints, exports from Banks Pumping Plant are generally limited to a daily average of 6,680 cfs, except between December 15 and March 15, when exports can be increased by 33 percent of San Joaquin River flow. The Banks Pumping Plant exports water from the Clifton Court Forebay, a 31,000 acre-foot reservoir that provides storage for off-peak pumping, and moderates the effect of the pumps on the fluctuation of flow and stage in adjacent Delta channels.

Contra Costa Water District (CCWD) supplies CVP water to its users via a pumping plant at the end of Rock Slough. The Rock Slough diversion capacity of 350 cfs gradually decreases to 22 cfs at the terminus. CCWD also constructed and operates the 100,000 acre-foot Los Vaqueros Reservoir, which has an intake and pumping plant on the Old River for diverting surplus Delta flows to reservoir storage or contract water to CCWD users. Because tidal inflows are approximately equivalent to tidal outflows during each daily tidal cycle, tributary inflows and export pumping are the principal variables that define the range of hydrodynamic conditions in the Delta. Excess outflow occurs almost entirely during the winter and spring months. Average winter outflow is about 32,000 cfs, while the average summer outflow is 6,000 cfs.

CVP/SWP Service Areas

This section describes the hydrology and hydraulics of the CVP/SWP service areas south of the primary study area.

Downstream from the Jones Pumping Plant, CVP water flows in the Delta-Mendota Canal and can be either diverted by the O'Neill Pumping-Generating Plant into the O'Neill Forebay, or can continue down the Delta-Mendota Canal for delivery to CVP contractors. The O'Neill Pumping-Generating Plant consists of six pump-generating units, with a capacity of 700 cfs each.

The O'Neill Forebay is a joint CVP/SWP facility, with a storage capacity of about 56,000 acre-feet. In addition to its interactions with the Delta-Mendota Canal via the O'Neill Pumping-Generating Plant, it is a part of the SWP California Aqueduct. The O'Neill Forebay serves as a regulatory body for San

Luis Reservoir; the William R. Gianelli Pumping-Generating Plant, also a joint CVP/SWP facility, can pump flows from the O'Neill Forebay into San Luis Reservoir, and also make releases from San Luis Reservoir to the O'Neill Forebay for diversion to either the Delta-Mendota Canal or the California Aqueduct. Also, several water districts receive diversions directly from the O'Neill Forebay. The William R. Gianelli Pumping-Generating Plant consists of eight units, with 1,375 cfs of capacity each.

San Luis Reservoir provides offstream storage for excess winter and spring flows diverted from the Delta. It is sized to provide seasonal carryover storage, with a total capacity of 2,027,840 acre-feet. The CVP share of the storage is 965,660 acre-feet; the remaining 1,062,180 acre-feet are the SWP share. During spring and summer, water demands and schedules are greater than the capability of Reclamation and DWR to pump water from the Jones and Banks pumping plants; water stored in San Luis Reservoir is used to make up the difference. The CVP share of San Luis Reservoir is typically at its lowest in August and September, and at its maximum in April. The San Felipe Division of the CVP supplies water to customers in Santa Clara and San Benito counties from San Luis Reservoir. The operation of San Luis Reservoir has the potential to affect the water quality and reliability of these supplies if reservoir storage drops below 300 thousand acre-feet (TAF).

South of the O'Neill Forebay, the Delta-Mendota Canal terminates in the Mendota Pool, about 30 miles west of Fresno. From the Delta-Mendota Canal, the CVP makes diversions to multiple water users and refuges. Delta-Mendota Canal capacity at the terminus is 3,211 cfs. Parallel to the Delta-Mendota Canal, the San Luis Canal-California Aqueduct is a joint-use facility for the CVP and SWP. It begins on the southeast edge of the O'Neill Forebay and extends about 101.5 miles southeasterly to a point near Kettleman City. Water from the canal serves the San Luis Federal service area, mostly for agricultural purposes and for some M&I uses. The canal has a capacity ranging from 8,350 cfs to 13,100 cfs.

South of Banks Pumping Plant, the California Aqueduct flows into Bethany Reservoir, a 5,000-acre-foot forebay for the South Bay Pumping Plant. Exiting the Bethany Forebay, the California Aqueduct flows through a series of checks to the aforementioned O'Neill Forebay, and is either pumped into San Luis Reservoir or released to the San Luis Canal, the CVP/SWP joint-use portion of the California Aqueduct. Deliveries are made from the California Aqueduct to agricultural and M&I contractors.

6.1.4 Surface Water Supply

While water supply reliability is one of the two primary planning objectives of the SLWRI, operations for Shasta Reservoir are primarily focused on delivering water supply to CVP contractors. However, because of the interconnectivity of the CVP and SWP, water supply operations of the SWP could be affected by changes in operations of the CVP associated with the SLWRI.

CVP/SWP Service Areas

This section describes surface water supply to CVP and SWP contractors.

CVP Contractors At certain times of the year, operations of Shasta Reservoir are driven by water supply needs of the CVP contractors. The CVP provides water to settlement contractors in the Sacramento Valley, exchange contractors in the San Joaquin Valley, agricultural and M&I water service contractors in both the Sacramento and San Joaquin Valleys, and wildlife refuges both north and south of the Delta. At the beginning of each year, Reclamation evaluates hydrologic conditions throughout California and uses this information to forecast CVP operations, and to estimate the amount of water to be made available to the Federal water service contractors for the year.

The majority of the Federal water service contractors have service areas located south of the Delta. In general, allocations to CVP water service contractors south of the Delta are lower than allocations to service contractors in the Sacramento Valley. Because of water rights secured before construction of the CVP, Sacramento Valley settlement contractors and San Joaquin Valley exchange contractors have a higher level of reliability for their supplies; except in extremely dry years, when the water year type, as defined by the Shasta Hydrologic Index, is classified as critical, settlement and exchange contractors receive 100 percent of their contract amounts. In Shasta critical years, settlement and exchange contractors receive 75 percent of their contract amounts. A Shasta critical year is defined as a year when the total inflow to Shasta Reservoir is below 3.2 MAF, or the average inflow for a 2-year period is below 4.0 MAF and the total 2-year deficiency for deliveries is higher than 0.8.

SWP Contractors The CVP and SWP are intrinsically linked through the Delta; shared responsibilities under their respective water rights and coordinated operations agreements mean that a change in flow from one project could result in a flow change from the other. Accordingly, SWP water supply operations are discussed below.

The SWP operates under long-term contracts with public water agencies throughout California. These agencies, in turn, deliver water to wholesalers or retailers, or deliver it directly to agricultural and M&I water users (DWR 1999). The SWP contracts between DWR and individual State water contractors define several classifications of water available for delivery under specific circumstances.

6.1.5 Flood Management

This section describes major features of the flood management system in the primary and extended study areas, including reservoirs, levees, weirs, and bypasses. Historical operation of these facilities is also described.

Shasta Lake and Vicinity

Releases from Shasta Dam are often made for flood management. Releases for flood management either occur in the fall, beginning in early October, to reach the prescribed vacant flood space, or to evacuate space during or after a storm event to maintain the prescribed vacant flood space in the reservoir. During a storm event, releases for flood management occur either over the spillway during large events or through river outlets for smaller events. Between 1950 and 2006, flows over the spillway occurred in 12 years, or in 21 percent of years. During the same time interval, releases for flood management (either for seasonal space evacuation or during a flood event, and including spills over the spillway) occurred in about 37 years, or nearly 70 percent of the years.

Upper Sacramento River (Shasta Dam to Red Bluff)

Historically, the largest flood events along the upper Sacramento River have been from heavy rainfall, with a relatively smaller component of the flows coming from snowmelt in the upper basin. Flood management operations at Shasta Dam include forecasting runoff into Shasta Lake as well as runoff of unregulated creek systems downstream from Keswick Dam. A critical component of upper Sacramento River flood operations is the forecast of local runoff entering the Sacramento River between Keswick Dam and Bend Bridge near Red Bluff.

The unregulated creeks (major tributaries include Cottonwood, Cow, and Battle creeks) discharging into the Sacramento River between Keswick Dam and Bend Bridge can produce high runoff rates into the Sacramento River in short periods of time. During large flood events, the local runoff between Keswick Dam and Bend Bridge can exceed 100,000 cfs.

Lower Sacramento River and Delta

Flood management facilities along the lower Sacramento River and in the Delta include the levees, weirs, and bypasses of upper and lower Butte Basin, the Sacramento River between Colusa and Verona, and the Sacramento River between Verona and Collinsville. The levees, weirs, and bypasses are features of the Sacramento River Flood Control Project, which began operation in the 1930s and was significantly expanded in the 1950s.

When Sacramento River flows exceed between 90,000 and 100,000 cfs at Ord Ferry, water flows naturally over the banks of the river into Butte Basin. In addition to the Sacramento River overbank flows at Ord Ferry, the basin receives inflow over the Colusa and Moulton weirs and from tributary streams draining from the northeast, principally Cherokee Canal and Butte Creek. Before construction of the Feather River levees, Butte Basin also received overflows from the Feather River north of the Sutter Buttes. Outflows from Butte Basin move through the Sutter Bypass when the Sacramento River is high or through the Butte Slough outfall gates (RM 139) into the Sacramento River when the river is low.

The Sacramento River meanders through the 64 miles between Colusa (RM 143) and Verona (RM 79). The levee system continues along both sides of this river reach. The levee spacing (or channel width), east to west, is wider between the upstream sections, from RM 176 to RM 143 at Colusa, than the levee spacing downstream from Colusa. The Feather River, the largest east side tributary to the Sacramento River, enters the river just above Verona. Flood management diversions occur at two places in this segment of the river: at the Tisdale Weir and Fremont Weir.

Below Verona, the Sacramento River flows 79 miles to Collinsville, at the mouth of the Delta, passing the City of Sacramento along the way. The Yolo Bypass parallels this river reach to the west. Flows enter this river reach at various points. First, flows from the Natomas Cross Canal enter the Sacramento River approximately 1 mile downstream from the Feather River mouth (RM 80). The American River (RM 60), the southernmost major Sacramento River tributary, enters the river at the City of Sacramento. Flows in the Yolo Bypass reenter the river near Rio Vista (RM 12). As the river enters the Delta, Georgiana Slough branches off from the mainstream Sacramento River, routing flows into the central Delta. The one diversion point for flood management is at Sacramento Weir, where floodwaters are diverted from the Sacramento River through the Sacramento Bypass to the Yolo Bypass under the highest flow conditions.

CVP/SWP Service Areas

This section describes flood management facilities in the CVP/SWP service areas by river basin, including the Feather River, American River, San Joaquin River, and east side tributaries to the Delta (Littlejohns Creek, Calaveras River, and Mokelumne River).

The primary flood management feature of the Feather River basin is Oroville Reservoir, with a flood management reservation volume of 750 TAF. Oroville Reservoir releases are used to help meet the objective flow on the Feather River of 150,000 cfs, and in conjunction with New Bullards Bar Reservoir on the Yuba River, to meet an objective flow below the Yuba River confluence of 300,000 cfs. Levees line the Feather River from its confluence with the Sacramento River up to the City of Oroville (RM 63).

The lower American River is primarily protected from flooding by Folsom Dam. The Folsom Reservoir flood management reservation volume is variable, ranging from 400 TAF to 670 TAF. The objective release on the American River is 115,000 cfs; however, some damage to infrastructure along the American River occurs at flows above 20,000 cfs. The American River is leveed from its confluence with the Sacramento River to near the Carmichael Bluffs on the north bank, and to near the Sunrise Boulevard Bridge on the south bank (RM 19).

The San Joaquin River basin is protected by an extensive reservoir system, including the following:

- Friant Dam and Millerton Lake (RM 270), with a flood management reservation volume of 170 TAF.
- Big Creek Dam, on Big Creek, with a flood management reservation of 30.2 TAF.
- Hidden Dam and Hensley Lake on the Fresno River, with a flood management reservation of 65 TAF.
- Buchanan Dam and H.V. Eastman Lake on the Chowchilla River, with a flood management reservation of 45 TAF.
- Los Banos Detention Dam on Los Banos Creek, with a flood management reservation of 14 TAF.
- Merced County Stream Group Project, consisting of five dry dams (Bear, Burns, Owens, Mariposa, and Castle) and two diversion structures, with a total flood storage capacity of 30.5 TAF.
- New Exchequer Dam and Lake McClure on the Merced River, with a flood management reservation of 350 TAF.
- Don Pedro Dam and Lake on the Tuolumne River, with a flood management reservation of 340 TAF.
- New Melones Dam and Lake on the Stanislaus River, with a flood management reservation of 450 TAF.

The streams in the northern portion of the San Joaquin River basin, between the American and Stanislaus rivers, are commonly referred to as the eastside tributaries to the Delta. These rivers flow into the San Joaquin River within the boundaries of the Delta. Flood management features on the eastside tributaries to the Delta include the following:

- Farmington Dam and Reservoir on Littlejohns Creek, with a flood management reservation of 52 TAF.
- New Hogan Dam and Lake on the Calaveras River, with a flood management reservation of 165 TAF.
- Camanche Dam and Reservoir on the Mokelumne River, with a flood management reservation of 200 TAF.

6.1.6 South Delta Water Levels

This section discusses the variability of water levels in the south Delta, as part of CVP/SWP operations in the extended study area.

In the south Delta, decreases in water levels due to CVP and SWP export pumping are a concern for local agricultural diverters because during periods of low water levels, sufficient pump draft cannot be maintained and irrigation can be interrupted. Historically, the highest minimum stage in the Middle River typically occurs in February and is about 0.1 foot below mean sea level (msl). The lowest minimum stage typically occurs in August and is about 0.8 foot below msl. During dry and critical years, under existing conditions, the highest minimum stage in the Middle River typically occurs in April and is about 0.6 foot below msl. The lowest minimum stage typically occurs in September and is about 0.7 foot below msl (CALFED 2000a).

6.1.7 Groundwater Resources

The use and sustainable management of groundwater resources is an important component in meeting water demands in California. Information specific to groundwater resources includes groundwater levels and budget and groundwater quality.

Shasta Lake and Vicinity

Shasta Lake and vicinity are located in the foothill area northwest of the Redding groundwater basin. Small groundwater basins underlying Shasta Lake and vicinity do not have significant groundwater availability for use as a source of supply (Shasta County Water Agency 1998). Groundwater basins underlying Shasta County include the Fall River Valley groundwater basin, Lake Britton groundwater basin, and North Fork Battle Creek. Of these three groundwater basins, the Fall River Valley groundwater basin covers the largest area (54,800 acres) and groundwater extraction for agricultural use in this basin is the highest (approximately 19,000 acre-feet). Estimated groundwater extraction for M&I use in these subbasins ranges from 5 acre-feet to 240 acre-feet. Deep percolation from applied water is minor, ranging from 10 acre-feet to 4,800 acre-feet. Groundwater quality in Shasta Lake and vicinity is typically good. Total dissolved solids (TDS) concentrations in the Fall River Valley groundwater basin are low, ranging from 115 to 232 milligrams per liter (mg/L).

Upper Sacramento River (Shasta Dam to Red Bluff)

The upper Sacramento River study area extends from Redding to Red Bluff, and includes the Redding groundwater basin and the northern portion of the Sacramento groundwater basin.

The Redding groundwater basin underlies most of the upper Sacramento River area between Shasta Dam and Red Bluff. The basin is bordered on the north, east, and west by foothills, and on the south by the Sacramento Valley groundwater basin (Tehama GMP 1996). The foothill areas that constitute the eastern and western portions of Shasta and Tehama counties, adjacent to the

Redding groundwater basin, are designated as “highland” areas, noted for their relative scarcity of groundwater resources. DWR Bulletin 118 (2003b) subdivides the Redding groundwater basin into six subbasins: Anderson, Enterprise, Millville, Rosewood, Bowman, and South Battle Creek.

The Sacramento groundwater basin extends from the Redding groundwater basin to the San Joaquin Valley, and includes Tehama, Glenn, Butte, Yuba, Colusa, Placer, and Yolo counties.

In general, groundwater flows southeasterly on the west side of the Redding groundwater basin and southwesterly on the east side, toward the Sacramento River (Reclamation and DWR 2003). Historically, groundwater levels in the Redding groundwater basin have remained relatively stable, with no apparent long-term trend of declining or increasing levels. Generally, groundwater levels have a seasonal fluctuation of approximately 2 to 15 feet (Reclamation and DWR 2003). DWR has estimated the total quantity of groundwater storage in the Redding groundwater basin at approximately 6.9 MAF (Reclamation and DWR 2003).

In the northern portion of the Sacramento groundwater basin, the following three subbasins are included in upper Sacramento River study area: Red Bluff, Antelope, and Bend subbasins. Groundwater extraction in the Red Bluff subbasin is nearly 90,000 acre-feet.

Groundwater in the Redding area is of good quality, as shown by low TDS concentrations, ranging from 70 to 360 mg/L. This range is below the U.S. Environmental Protection Agency and California Environmental Protection Agency secondary drinking water standard of 500 mg/L and also below the agricultural water quality goal of 450 mg/L. Areas of high salinity and poor quality are generally found on the basin margins where groundwater is derived from marine sedimentary rock (Reclamation and DWR 2003).

Groundwater quality in the Sacramento groundwater basin is generally good, and sufficient for agricultural and M&I uses, with TDS levels ranging from 200 to 500 mg/L (Reclamation and DWR 2003). Localized groundwater quality issues occur as a result of natural water quality impairments at the north end of the Sacramento Valley, where marine sedimentary rocks containing brackish to saline water are near the surface (Reclamation and DWR 2003).

Lower Sacramento River and Delta

The groundwater basins underlying the lower Sacramento River and Delta areas include the Sacramento Valley groundwater basin, and North and South San Joaquin Valley groundwater basins.

In the Sacramento groundwater basin, groundwater flows inward from the edges of the basin and south parallel to the Sacramento River. Groundwater extraction in some local areas resulted in groundwater depressions and local groundwater

gradients (Reclamation and DWR 2003). Before the completion of CVP facilities (1964 through 1971), pumping along the west side of the basin caused groundwater levels to decline. In the Sacramento groundwater basin, a slight decline of 2 to 12 feet was experienced in groundwater levels as a result of the 1976 through 1977 and 1987 through 1994 droughts. This was followed by a recovery to predrought conditions of the early 1970s and 1980s. Generally, groundwater level data show an average seasonal fluctuation ranging from 2 to 15 feet. Groundwater production in the basin increased from 500,000 acre-feet in the 1940s to 2 MAF annually in the mid-1990s.

As mentioned, groundwater quality in the Sacramento groundwater basin is generally good, and sufficient for agricultural and M&I uses, with TDS levels ranging from 200 to 500 mg/L (Reclamation and DWR 2003).

CVP/SWP Service Areas

The groundwater basins underlying the CVP/SWP service areas include the San Joaquin Valley, Santa Clara Valley, Antelope Valley, Fremont Valley, Coastal Plain of Los Angeles, and Coastal Plain of Orange County groundwater basins, and multiple other smaller groundwater basins underlying areas that receive water from the CVP/SWP system.

The San Joaquin Valley Groundwater Basin is a regional basin and is the largest in California, extending approximately from the Delta to Bakersfield. Areas within the San Joaquin Valley Groundwater Basin are heavily groundwater-reliant. Groundwater accounts for about 30 percent of the annual supply used for agricultural and urban purposes (Reclamation and DWR 2003). Groundwater production in the north San Joaquin Valley Groundwater Basin alone increased from 1.5 MAF annually in the 1920s to more than 3.5 MAF annually in 1990 (Reclamation and DWR 2003). In the south San Joaquin Valley Groundwater Basin, groundwater production for agriculture rose from approximately 3.0 MAF per year in the 1920s to more than 5.0 MAF per year 1980s (Reclamation and DWR 2003). Much of the San Joaquin groundwater basin is in overdraft conditions due to extensive groundwater pumping and irrigation, although the extent of overdraft varies widely from region to region.

Groundwater quality throughout the San Joaquin Valley is in general suitable for most urban and agricultural uses. Average TDS concentrations range from 218 to 1,190 mg/L. Areas of high TDS concentration, primarily along the west side of the San Joaquin Valley, are the result of streamflow recharge that originates from marine sediments. High TDS concentrations are also seen in the trough of the Sacramento Valley due to concentration of salts resulting from evaporation and poor drainage (Reclamation and DWR 2003). Agricultural pesticides and herbicides have been detected in groundwater throughout the region, but primarily along the east side of the San Joaquin Valley, where soil permeability is higher and depth to groundwater is shallower. From 1994 to 2000, 523 public wells out of 689 wells sampled met the State primary maximum contamination levels for drinking water. The remaining wells have

constituents that exceed one or more maximum contamination levels (Reclamation and DWR 2003).

6.2 Regulatory Setting

The regulatory setting for this report includes Federal, State, and local applicable laws, regulations, standards, and plans.

6.2.1 Federal

The following Federal laws, regulations, standards, and plans are discussed as part of the regulatory setting:

- NMFS 1993 and 2004 Winter-Run Chinook salmon Biological Opinion (BO) (NMFS 1993, NMFS 2004)
- Central Valley Project Improvement Act (CVPIA) (Reclamation 1999)
- CVP long-term water service contracts
- Trinity River Record of Decision (ROD) (Reclamation 2000)
- Flow objective for navigation (Wilkins Slough)
- Flood management requirements

National Marine Fisheries Service 2004 Biological Opinion

The regulatory conditions for the SLWRI alternatives include BOs from the NMFS (2004) and USFWS (2005). In response to litigation, the 2004 and 2005 BOs were remanded to the USFWS and NMFS for revision, but were not vacated. The USFWS and NMFS released revised BOs in 2008 and 2009 (USFWS 2008, NMFS 2009), respectively; since the revised BOs continue to be locked in controversy and litigation, the 2004 and 2005 BOs are assumed to be govern operations for SLWRI analysis. Further revised BOs are anticipated before the release of the final version of this document; final analysis will consider conditions dictated by the BOs in place at that time.

In October 2004, NMFS issued the Long-Term BO for operation of the CVP and SWP for Sacramento River winter-run Chinook salmon, Central Valley spring-run Chinook salmon, and Central Valley steelhead (NMFS 2004). The BO includes a Reasonable and Prudent Alternative (RPA) that addresses CVP operations criteria for temperature control objectives. The Shasta-Trinity Division section of the 2004 RPA includes operational elements relating to temperature control objectives, as described in this section.

Under the current RPA, Reclamation must make its February 15 forecast of deliverable water based on an estimate of precipitation and runoff at least as

conservative as the 90 percent probability-of-exceedence forecast. Subsequent updates of water delivery commitments must also be based on the 90 percent probability of exceedence forecast or a more conservative value.

Under the current RPA, Reclamation must target a minimum end-of-water-year (September 30) carryover storage in Shasta Reservoir of 1.9 MAF. The 1.9 MAF Shasta Reservoir carryover target is intended to increase the probability of sufficient cold-water resources to maintain suitable water temperature conditions for the following water year winter-run incubation and spawning season needs.

The BO requires that Reclamation manage the cold-water supply within Shasta Reservoir and make cold-water releases from Shasta Reservoir to provide suitable habitat between Keswick Dam and Bend Bridge. Reclamation was instructed to target daily average Sacramento River water temperatures between Keswick Dam and Bend Bridge such that water temperatures not exceed 56 degrees Fahrenheit (°F) at compliance locations between Balls Ferry and Bend Bridge from April 15 through September 30, and not exceed 60°F at the same locations between Balls Ferry and Bend Bridge between October 1 and October 31, provided operations and temperature forecasts demonstrate the capability to achieve and sustain compliance. If conditions were not sufficient to support compliance at Balls Ferry, Reclamation was instructed to reinitiate consultation and convene the Sacramento River Temperature Task Group (SRTTG) to provide input regarding annual cold-water management alternatives before announcement of the CVP water service delivery allocations. Selection of downstream compliance locations is determined through an annual adaptive management process initiated by Reclamation in consultation with NMFS, with recommendations from the SRTTG, and based on a technical assessment of cold-water resources. The annual adaptive management process focuses efforts to analyze annual cold-water management flexibility to provide thermal protection to winter-run Chinook salmon, spring-run Chinook salmon, and steelhead, as envisioned in the State Water Resources Control Board (SWRCB) Order 90-5. The initial technical analysis considers the compliance location shown in Table 6-1, based on projected cold-water availability and spawning distribution in the upper Sacramento River (NMFS 2004).

Table 6-1. Relationship Between Shasta Cold-Water Volume and Sacramento River Water Temperature Compliance Location

May 1, Shasta Reservoir Cold-Water Volume Below 52°F	Compliance Location
<3.3 MAF	Balls Ferry
>3.3 MAF but <3.6 MAF	Jellys Ferry
>3.6 MAF	Bend Bridge

Key:
°F = degrees Fahrenheit
MAF = million acre-feet

In almost every year since 1993, Reclamation has reconsulted with NMFS to modify the compliance point or allow short-term fluctuation above the 56°F objective because of insufficient cold-water resources, extreme ambient air temperature events, or high downstream tributary flows of warm water. The reconsultation actions have been coordinated through the SRTTG to the extent possible. Decisions by Reclamation to reconsult, and resulting decisions by NMFS, have reflected the best available information on cold-water resources and locations of Chinook salmon spawning activity.

Central Valley Project Improvement Act

Reclamation's evolving mission was written into law on October 30, 1992, with the passage by Congress, and signing by President George H. W. Bush, of Public Law 102-575, the Reclamation Projects Authorization and Adjustment Act of 1992. Included in the law was Title 34, the CVPIA (Reclamation 1999). The CVPIA amended previous authorizations of the CVP to include fish and wildlife protection, restoration, and mitigation as project purposes having equal priority with irrigation and domestic water supply uses, and fish and wildlife enhancement having equal priority with power generation. Among the changes mandated by the CVPIA are the following:

- Dedicating 800,000 acre-feet annually to fish, wildlife, and habitat restoration.
- Authorizing water transfers outside the CVP service area.
- Implementing the Anadromous Fish Restoration Program.
- Creating a restoration fund financed by water and power users.
- Providing for the Shasta Dam temperature control device (TCD).
- Implementing fish passage measures at the RBDD.
- Planning to increase the CVP yield.
- Mandating firm water supplies for Central Valley wildlife refuges.
- Meeting Federal trust responsibility to protect fishery resources on the Trinity River.

The CVPIA is being implemented on a broad front. The Final Programmatic Environmental Impact Statement (Reclamation 1999) for the CVPIA analyzes projected conditions in 2022, 30 years from the CVPIA's adoption in 1992. The Final Programmatic Environmental Impact Statement was released in October 1999, and the CVPIA ROD was signed on January 9, 2001.

Operations of the CVP reflect provisions of the CVPIA, particularly Sections 3406 (b)(1), (b)(2), and (b)(3). The Department of the Interior Decision on Implementation of Section 3406 (b)(2) of the CVPIA, October 5, 1999, provides the basis for implementing upstream and Delta actions with CVP delivery capability. The Vernalis Adaptive Management Program assumes that San Joaquin River water will be acquired under Section 3406 (b)(3) to support increased Vernalis flows during certain times of the year. Similarly, the Anadromous Fish Restoration Program assumes Sacramento River water will be acquired under Section 3406 (b)(2).

Central Valley Project Long-Term Water Service Contracts

In accordance with CVPIA Section 3404c, Reclamation is renegotiating long-term water service contracts. As many as 113 CVP water service contracts located within the Central Valley of California may be renewed during this process. Reclamation issued a Notice of Intent for long-term contract renewal in October 1998. Environmental documentation was prepared on a regional basis. In February 2005, Reclamation issued decisions (a ROD or Finding of No Significant Impact) for renewing contracts of the Sacramento River, San Luis, and Delta-Mendota Canal divisions, the Sacramento River settlement contracts, and several individual contracts. Preparation of environmental documents for other divisions and contracts is ongoing.

Trinity River Record of Decision

Export of Trinity River water to the Sacramento basin provides increased water supply for the CVP and is a major source of CVP power generation. The amounts and timing of the Trinity exports are determined after consideration is given to forecasted Trinity water supply available and Trinity in-basin needs, including carryover storage. Trinity exports are also a key component of water temperature control operations on the upper Sacramento River.

Based on the December 19, 2000, Trinity River Mainstem ROD (Reclamation 2000), 368.6 to 815 TAF are allocated annually for Trinity River flows. After several challenges and injunctions, on July 13, 2004, the Ninth Circuit Court upheld the ROD flows for the Trinity River.

Flow Objective for Navigation (Wilkins Slough)

Historical commerce on the Sacramento River resulted in the requirement to maintain minimum flows of 5,000 cfs at Chico Landing to support navigation. There is currently no commercial traffic between Sacramento and Chico Landing, and USACE has not dredged this reach to preserve channel depths since 1972. However, long-time water users diverting from the river have set their pump intakes just below this level. Therefore, the CVP is operated to meet the navigation flow requirement of 5,000 cfs to Wilkins Slough under all but the most critical water supply conditions to facilitate pumping.

At flows below 5,000 cfs at Wilkins Slough, diverters have reported increased pump cavitation as well as greater pumping head requirements. Diverters

operate for extended periods at flows of 4,000 cfs at Wilkins Slough, but pumping operations are severely affected and some pumps become inoperable at flows lower than 4,000 cfs. Flows may drop as low as 3,500 cfs for short periods while changes are made in Keswick releases to reach target levels at Wilkins Slough, but using the 3,500 cfs rate as a target level for an extended period would have major impacts on diverters.

No criteria have been established that specify when the navigation minimum flow should be relaxed. However, the basis for Reclamation's decision to operate at less than 5,000 cfs is the increased importance of conserving water when water supplies are not sufficient to meet full contractual deliveries and other operational requirements.

Flood Management Requirements

Shasta Dam provides flood protection to the nearby communities of Redding, Anderson, Red Bluff, and Tehama, as well as to agricultural lands, industrial developments, and communities downstream along the Sacramento River. Shasta Dam is operated for an objective release of 100,000 cfs at Bend Bridge in Red Bluff, subject to consideration of the following:

- Releases are not to be increased more than 15,000 cfs or decreased more than 4,000 cfs in any 2-hour period.

- The 2,500-square-mile uncontrolled drainage area between Keswick Dam and Bend Bridge can produce flows well in excess of the design channel capacity of 100,000 cfs. These high-magnitude flows can occur very rapidly, requiring release changes based on official flow forecasts, and are complicated by the 8- to 12-hour travel time between Keswick Dam and Bend Bridge.

- Recently installed gages on major east side tributaries (Cow, Battle, and Paynes creeks) between Keswick Dam and Red Bluff are very helpful in coordinating operations of Shasta Dam and Reservoir with flows from uncontrolled downstream areas. The most critical flood forecast for the Sacramento River is that of local runoff entering the Sacramento River between Keswick Dam and Bend Bridge. As the Bend Bridge flow is projected to recede, Keswick Dam releases are increased to evacuate water stored in the flood management space in Shasta Reservoir.

The following constraints are considered when making release changes at Keswick Dam:

- The maximum capacity of the Shasta Powerplant is about 18,000 cfs, but this varies considerably with head. Maximum powerplant release is required when Shasta Reservoir storage encroaches on the flood

management space by 25 percent or less, with actual or forecasted inflows of 40,000 cfs or less.

- The capacity of the Keswick Powerplant is about 16,000 cfs, which represents a maximum release rate when no flood management space is being used. The Keswick Dam release must include discharge from the Spring Creek Powerplant, releases from Spring Creek Debris Dam, and local flows into Keswick Reservoir.

- Flows greater than 36,000 cfs begin to cause flood coordination efforts in the local Redding area to close riverfront roads and parks. These coordination efforts require some advance notice to increase Keswick releases above this rate.

All outflows from Shasta Dam flow into and through Keswick Reservoir, located about 5 miles west of Redding. Keswick Reservoir also receives inflow from the 45-square-mile drainage area of Whiskeytown Reservoir on Clear Creek.

Flood Management Space Requirements Shasta Reservoir capacity is 4,552 TAF, with a maximum objective release capacity of 79,000 cfs. The end-of-September storage target for Shasta Reservoir is 1,900 TAF, except in the driest 10 percent of water years, to conserve sufficient cold water for meeting temperature criteria for the winter-run Chinook incubation period (summer to early fall). Storage levels are lowest by October to provide sufficient flood protection and capture capacity during the following wet months. The storage target gradually increases from October to full pool in May. Storage is then withdrawn for high water demand (i.e., municipal, agricultural, fishery, and water quality uses) during summer.

A storage space of up to 1.3 MAF below a full pool elevation of 1,067 feet is also kept available for flood management purposes in the reservoir in accordance with the Shasta Dam and Lake Flood Control Diagram (USACE 1977) , as prescribed by USACE (USACE 1977) (see Exhibit B to the *Hydrology, Hydraulics, and Water Management Technical Report*). Under the diagram, flood management storage space increases from zero on October 1 to 1.3 MAF (elevation 1,018.55) on December 1 and is maintained until December 23. From December 23 to June 15, the required flood management space varies according to parameters based on the accumulation of seasonal inflow. This variable space allows for the storage of water for conservation purposes, unless it is required for flood management based on basin wetness parameters and the level of seasonal inflow. Daily flood management operation consists of determining the required flood storage space reservation, and scheduling releases in accordance with flood operations criteria.

Objective Flow The current regulation of Shasta Dam for flood management requires that releases be restricted to quantities that will not cause downstream

flows or stages to exceed, insofar as possible, (1) a flow of 79,000 cfs at the tailwater of Keswick Dam and (2) a stage of 39.2 feet for the Sacramento River at the Bend Bridge gaging station near Red Bluff (corresponding roughly to a flow of 100,000 cfs).

Tributary Inflows Shasta Lake collects flow in the upper Sacramento River watershed, but many uncontrolled tributaries enter the Sacramento River downstream from the dam. Stream gages have been added to major uncontrolled tributaries entering downstream from Shasta Lake (Cow, Battle, Cottonwood, and Thomes creeks). To a limited extent, operators of Shasta Dam can adjust releases containing these uncontrolled flows to try to reduce downstream peak flows. Accordingly, the influence of Shasta Dam and Reservoir operation on reducing peak flood flows diminishes downstream on the Sacramento River.

6.2.2 State

The following State laws, regulations, standards, and plans are discussed as part of the regulatory setting:

- SWRCB Orders 90-05 and 91-01
- 1960 DFG-Reclamation Memorandum of Agreement (DFG 1960)
- Water Quality Control Plan (WQCP) for the San Francisco Bay/San Joaquin Delta Estuary (SWRCB 1995)
- SWRCB Revised Water Right Decision 1641 (RD-1641) (SWRCB 2000)
- Coordinated Operations Agreement (COA) (Reclamation and DWR 1986)
- Groundwater regulations

State Water Resources Control Board Orders 90-05 and 91-1

In 1990 and 1991, SWRCB issued Water Right Orders 90-05 and 91-01 modifying Reclamation's water rights for the Sacramento River. The orders included a narrative water temperature objective for the Sacramento River, and stated that Reclamation shall operate Keswick and Shasta dams and the Spring Creek Powerplant to meet a daily average water temperature of 56°F at the RBDD in the Sacramento River during periods when higher temperatures would be harmful to fisheries.

Under the orders, the water temperature compliance point may be modified when the objective cannot be met at the RBDD. The SRTTG, a multiagency group, develops temperature operational plans for the Shasta and Trinity divisions of the CVP pursuant to SWRCB Water Rights Orders 90-5 and 91-1. These temperature plans consider the impacts to winter-run Chinook salmon

and other races of Chinook salmon from project operations. Previous plans have included releases of water from the low-level outlets at Shasta Dam and Trinity Dam, operation of the TCD, warm water releases, and manipulating the timing of Trinity River diversions through the Spring Creek Powerplant. Warm water releases from the upper level outlets have been made to conserve cold water in Shasta Lake for temperature control in the late summer and to induce winter-run Chinook salmon to spawn as far upstream as possible. The SRTTG typically first meets in the spring once the cold-water availability in Shasta Lake is known. In every year since the SWRCB issued the orders, those plans have included modifying the RBDD compliance point to make the best use of the cold-water resources based on the location of spawning Chinook salmon (NMFS 2004).

The water right orders also recommended construction of a TCD to improve management of the limited cold-water resources. Reclamation constructed the TCD on Shasta Dam in 1997. This device releases cool water from Shasta Lake through low-level river outlets that bypass the power plant. The TCD provides flexibility to Shasta Dam operations and allows downstream temperature goals to be consistently achieved (Reclamation 2004).

Reclamation operates the Shasta, Sacramento River, and Trinity River divisions of the CVP to meet, to the extent possible, the provisions of SWRCB Order 90-05 and 91-01 and the NMFS 2004 Operations Criteria and Plan BO, shown as in Table 1-33.

1960 California Department of Fish and Game-Reclamation Memorandum of Agreement

An April 5, 1960, Memorandum of Agreement between DFG and Reclamation (DFG 1960) originally established flow objectives in the Sacramento River for the protection and preservation of fish and wildlife resources. The agreement provided for minimum releases into the natural channel of the Sacramento River at Keswick Dam for normal and critically dry years. Since October 1981, Keswick Dam has been operated based on a minimum release of 3,250 cfs for normal years from September 1 through the end of February, in accordance with an agreement between DFG and Reclamation. This release schedule was included in Order 90-05, which maintains a minimum release of 3,250 cfs at Keswick Dam and the RBDD from September through the end of February in all water years, except critically dry years.

Water Quality Control Plan for the San Francisco Bay/San Joaquin Delta Estuary

The 1995 Bay-Delta WQCP (SWRCB 1995) established water quality control objectives for the protection of beneficial uses in the Delta. The 1995 WQCP identified (1) beneficial uses of the Delta to be protected, (2) water quality objectives for the reasonable protection of beneficial uses, and (3) a program of implementation for achieving the water quality objectives. Because these new beneficial objectives and water quality standards were more protective than

those of the previous SWRCB Water Right Decision 1485, the new objectives were adopted in 1995 through a water right order for operation of the CVP and SWP. Key features of the 1995 WQCP include estuarine habitat objectives for Suisun Bay and the western Delta (consisting of salinity measurements at several locations), export/inflow (E/I) ratios intended to reduce entrainment of fish at the export pumps, Delta Cross Channel gate closures, and San Joaquin River electrical conductivity (EC) and flow standards. The SWRCB adopted a new Bay-Delta WQCP on December 13, 2006. However, this new WQCP made only minor changes to the 1995 WQCP.

State Water Resources Control Board Revised Water Right Decision 1641

The 1995 Bay-Delta WQCP contains current water quality objectives. SWRCB RD-1641 (SWRCB 2000) and Water Right Order 2001-05 contain the current water right requirements to implement the 1995 WQCP. RD-1641 incorporates water right settlement agreements between Reclamation and DWR and certain water users in the Delta and upstream watersheds regarding contributions of flows to meet water quality objectives. However, SWRCB imposed terms and conditions on water rights held by Reclamation and DWR that require these two agencies, in some circumstances, to meet many of the water quality objectives established in the 1995 WQCP. RD-1641 also authorizes the CVP and SWP to use joint points of diversion (JPOD) in the south Delta, and recognizes the CALFED Bay-Delta Program (CALFED) Operations Coordination Group process for operational flexibility in applying or relaxing certain protective standards.

Delta Outflow Requirement Delta outflow, inflow that is not exported or diverted, is the primary factor controlling water quality in the Delta. When Delta outflow is low, seawater is able to intrude further into the Delta, impacting water quality at drinking water intakes. RD-1641 specifies minimum monthly Delta outflow objectives to maintain a reasonable range of salinity in the estuarine aquatic habitat based on the Net Delta Outflow Index (NDOI). The NDOI is a measure of the freshwater outflow and is determined from a water balance that considers river inflows, precipitation, agricultural consumptive demand, and project exports. The NDOI does not take into account the semidiurnal and spring-neap tidal cycles.

The monthly minimum values of the NDOI specified in RD-1641 depend on the water year type. Minimum flows are specified for the months of January and July to December. The outflow objectives from February to June are determined based on the X2[1] objective.

Delta Salinity Objectives Salinity standards for the Delta are stated in terms of EC (for protection of agricultural and fish and wildlife beneficial uses), and chloride (for protection of M&I uses). Compliance values vary with water year

[1] X2 is the most downstream location of either the maximum daily average or the 14-day running average of 2.64 millimhos per centimeter (mmhos/cm) isohaline, as measured in river kilometers from the Golden Gate Bridge.

and month. The salinity objectives at Emmaton on the Sacramento River, and at Jersey Point on the San Joaquin River, often control Delta outflow requirements during the irrigation season from April through August, requiring additional releases from upstream CVP and SWP reservoirs.

X2 Objective The location of X2, the 2 parts per thousand salinity unit isohaline at 1 meter above the bottom of the Sacramento River channel, is used as a surrogate measure of ecosystem health in the Delta. The X2 objective requires specific daily surface EC criteria to be met for a certain numbers of days each month, from February through June. Compliance can also be achieved by meeting a 14-day running average salinity or 3-day average outflow equivalent. These requirements were designed to provide improved shallow water habitat for fish species in the spring. Because of the relationship between seawater intrusion and interior Delta water quality, the X2 objective also improves water quality at Delta drinking water intakes.

Maximum Export/Inflow Ratio RD-1641 includes a maximum E/I standard to limit the fraction of Delta inflows that are exported. This requirement was developed to protect fish species and to reduce entrainment losses. Delta exports are defined as the combined pumping of water at Banks and Jones pumping plants. Delta inflows are the gaged or estimated river inflows. The maximum E/I ratio is 0.35 for February through June and 0.65 for the remainder of the year. If the January eight-river runoff index is less than 1.0 MAF, the February E/I ratio is increased to 0.45. The CVP and SWP have agreed to share the allowable exports equally if the E/I ratio is limiting exports.

Joint Point of Diversion The JPOD refers to the CVP and SWP use of each other's pumping facilities in the south Delta to export water from the Delta. The CVP and SWP have historically coordinated use of Delta export pumping facilities to assist with deliveries and to aid each other during times of facility failures. In 1978, by agreement with DWR, and with authorization from SWRCB, the CVP began using the SWP Banks Pumping Plant for replacement pumping (195 TAF per year) for pumping capacity lost at Jones Pumping Plant because of striped bass pumping restrictions in SWRCB Water Right Decision 1485. In 1986, Reclamation and DWR formally agreed that "either party may make use of its facilities available to the other party for pumping and conveyance of water by written agreement" and that the SWP would pump CVP water to make up for striped bass protection measures (Reclamation and DWR 1986).

Reclamation filed a number of temporary petitions with SWRCB to use Banks Pumping Plant for purposes other than replacement pumping and CVP deliveries that contractually relied on SWP conveyance. Such uses included deliveries to Cross Valley Contractors, the Musco Olive Company, and the San Joaquin National Cemetery. In RD-1641, the SWRCB conditionally approved the use of the JPOD in three separate stages:

- Stage 1 is the use of the JPOD to serve Cross Valley Canal contractors, the Musco Olive Company and the San Joaquin National Cemetery; to support a recirculation study; and to recover export reductions made to benefit fish. Authorization for Stage 1 JPOD pumping to recover export reductions prohibits the CVP and SWP from annually exporting more water than each would have exported without the use of each other's pumping facilities. Stage 1 pumping is subject to SWRCB approval of a water level response plan, and a water quality response plan.

- Stage 2 is the use of the JPOD for any purpose authorized in the water rights permits up to the limitations contained in the USACE permit. In addition to the Stage 1 requirements, Stage 2 pumping is subject to SWRCB approval of an operations plan to protect aquatic resources and other legal users of water.

- Stage 3 is the use of the JPOD for any purpose authorized under the water right permits up to the physical capacity of the export pumps. Stage 3 is subject to the operation of barriers or other means to protect water levels in the south Delta, an SWRCB-approved operations plan that adequately protects aquatic resources and other legal users of water, and certification of a project-level Environmental Impact Report by DWR for the South Delta Improvements Program.

It has been the policy of SWRCB that all water transfers must meet similar criteria and conditions, as set forth for the JPOD, and SWRCB has mandated a "response plan" evaluation process for real-time incremental export operations to determine the effects of water transfers and JPOD operations. SWRCB approval of the 2006 and 2007 Accord Pilot Programs included the provision that rediversion of transfer water at Banks and Jones pumping plants must be in compliance with the various plans under RD-1641 that are prerequisites for the use of the JPOD by Reclamation and DWR.

Reclamation and DWR have produced the following response plans:

- Water Level Response Plan to address incremental effects of additional export, at the time of the export, to water levels in the south Delta environment (Reclamation and DWR 2004a).

- Water Quality Response Plan to address incremental effects of additional export, at the time of the export, to water quality in the Delta, and south Delta specifically (Reclamation and DWR 2004b).

- Operations Plan to protect fish and wildlife, and other legal uses of water.

Coordinated Operations Agreement

The COA defines how Reclamation and DWR share their joint responsibility to meet Delta water quality standards and the water demands of senior water right holders, and how the two agencies share surplus flows (Reclamation and DWR 1986). The COA defines the Delta as being in either "balanced water conditions" or "excess water conditions." Balanced water conditions are periods when Delta inflows are just sufficient to meet water user demands within the Delta, outflow requirements for water quality and flow standards, and export demands. Under excess water conditions, Delta outflow exceeds the flow required to meet the water quality and flow standards. Typically, the Delta is in balanced water conditions from June to November, and in excess water conditions from December through May. However, depending on the volume and timing of winter runoff, excess or balanced water conditions may extend throughout the year.

With the goal of using coordinated management of surplus flows in the Delta to improve Delta export and conveyance capability, the COA received Congressional approval in 1986 and became Public Law 99-546. The COA, as modified by interim agreements, coordinates operations between the CVP and SWP, and provides for the equitable sharing of surplus water supply. The COA requires that the CVP and SWP operate in conjunction to meet State water quality objectives in the San Francisco Bay/Sacramento-San Joaquin River Delta (Bay-Delta) estuary, except as specified. Under this agreement, the CVP and SWP can each contract from the other for the purchase of surplus water supplies, potentially increasing the efficiency of water operations.

Since 1986, the COA principles have been modified to reflect changes in regulatory standards, facilities, and operating conditions. At its inception, the COA water quality standards were those of the 1978 WQCP; these were subsequently modified in the 1991 WQCP. The adoption of the 1995 WQCP by SWRCB superseded those requirements. The Environmental Water Account was established by CALFED in 2000 to protect the fish of the Bay-Delta estuary via changes in the operations of the CVP and SWP, without incurring uncompensated cost to the projects' water users. Evolution of the Clean Water Act over time has also impacted implementation of the COA.

Groundwater Regulations

Groundwater use is subject to limited statewide regulation; however, all water use in California is subject to constitutional provisions that prohibit waste and unreasonable use of water (SWRCB 1999). In general, groundwater is subject to a number of provisions in the Water Code. Assembly Bill 3030, Water Code Section 10750, commonly referred to as the Groundwater Management Act, permits local agencies to develop groundwater management plans (Reclamation and DWR 2003).

Other groundwater regulation is related primarily to water quality issues, which are addressed by several different State agencies, including SWRCB and nine

Regional Water Quality Control Boards, the California Department of Toxic Substances Control, Department of Pesticide Regulation, and Department of Health Services.

The California Legislature and Governor, as well as private citizens, have become increasingly concerned about recent public well closures regarding the detection of chemicals, such as methyl tertiary-butyl ether from gasoline, and various solvents from industrial sources. As a result of increased awareness of groundwater quality, the Supplemental Report of the 1999 Budget Act required SWRCB to develop a comprehensive ambient groundwater monitoring plan. To meet this mandate, SWRCB created the Groundwater Ambient Monitoring and Assessment (GAMA) Program. The primary objective of the GAMA Program is to assess water quality and relative susceptibility of groundwater resources. The GAMA Program has two sampling components: the California Aquifer Susceptibility Assessment for addressing public drinking water wells, and the Voluntary Domestic Well Assessment Project for addressing private drinking water wells.

The GAMA Program is being directed by the SWRCB Division of Water Quality, Land Disposal Section, Groundwater Special Studies Unit. The Voluntary Domestic Well Assessment Project samples domestic wells for various constituents commonly found in domestic well water, and provides that information to domestic well owners. In addition, the Voluntary Domestic Well Assessment Project includes a public education component to aid the public in understanding water quality data and water quality issues affecting domestic water wells. The Voluntary Domestic Well Assessment Project focuses on specific areas, as resources permit. The focus areas are chosen based on existing knowledge of water quality and land use, in coordination with local environmental agencies. SWRCB incurs the costs of sampling and analysis, and results are provided to domestic well owners as quickly as possible.

6.2.3 Regional and Local

The following local laws, regulations, standards, and plans are discussed as part of the regulatory setting:

- Local surface water regulations (water supply master plans, general plans, habitat and conservation plans, land use ordinances)
- Local groundwater regulations (management plans, county ordinances)

Local Surface Water Regulations

Local surface water regulations include goals, objectives, and policies pertaining to the primary and extended study areas, including the following:

- Local water supply master plans
- County general plans

- City general plans
- Local habitat and conservation plans (i.e., Natomas Basin Habitat Conservation Plan)
- Local land-use ordinances

Local Groundwater Regulations

Local regulatory setting documents on groundwater resources in the study areas include local groundwater management plans and county ordinances. Table 6-2 lists current groundwater management plans and county ordinances that apply to agencies in the Redding and Sacramento groundwater basins. Groundwater management plans and county ordinances in the North and South San Joaquin groundwater basins are presented in Table 6-3. These documents typically involve provisions to limit or prevent groundwater overdraft, protect groundwater quality, and regulate transfers.

Table 6-2. Groundwater Management Plans and County Ordinances for Redding and Sacramento Groundwater Basins

Groundwater Basin	Groundwater Management Plans, Agreements, and County Ordinances
Redding	• Shasta County Ordinance No. SCC-98-1 • Tehama County Urgency Ordinance No. 1617 • Tehama County Coordinated GMP (1996) • Redding Basin GMP (1998) • ACID GMP (2006) • El Camino ID GMP (1995)
Sacramento	• Glenn County Ordinance No. 1115 • Colusa County Ordinance No. 615 • Yolo County Export Ordinance No. 615 • Glenn-Colusa Irrigation District GMP (1995) • Feather WD GMP (2005) • Chapter 33 of the Butte County Code • Butte County Well Spacing Ordinance • Glenn County Ordinance No. 1115 and BMOs • Biggs-West Gridley WD GMP (1995) • Richvale ID GMP (1995) • Butte WD GMP (1996) • Western Canal WD GMP (1995) • Sutter Extension GMP (1995) • Yuba County transfer policies • Thermalito ID GMP (1995) • Yuba County Water Agency GMP (2005) • Browns Valley ID transfer policies • Water Forum Agreement • NCMWC GMP (2002) • Sacramento County Water Agency Act, Sections 32-33 • SGA GMP (2003) • Central Sacramento County GMP (2006) • City of Lincoln GMP (2003) • Dunnigan WD GMP (2001) • West Placer GMP (2003) • RD 787 GMP (2005) • RD 2035 GMP (1995) • RD 2068 GMP (2005) • RD 1500 GMP (1997)

Key:
ACID = Anderson-Cottonwood Irrigation District
BMO = basin management objective
GMP = groundwater management plan
ID = irrigation district
NCMWC = Natomas Central Mutual Water Company
RD = Reclamation District
SGA = Sacramento Groundwater Authority
WD = water district

Table 6-3. Groundwater Management Plans and County Ordinances for North and South San Joaquin Groundwater Basins

Groundwater Basin	Groundwater Management Plans, Agreements, and County Ordinances
North San Joaquin	• Merced ID GMP (1997) • Turlock Groundwater Basin GMP (1997) • Camanche Valley Springs GMP (2001) • Tracy Regional GMP (1996) • Eastside WD GMP (1994) • El Nido ID GMP (1997) • Modesto ID GMP (1996) • Oakdale ID GMP (1995) • Eastern San Joaquin Groundwater Basin GMP (2004) • Merced Groundwater Basin GMP (1997) • North San Joaquin WCD GMP (1996) • San Joaquin River Exchange Contractors Water Authority GMP (1997) • Merced County Wellhead Protection Program • Water Supply Plan and Update • South San Joaquin ID GMP (1994) • Southeast Sacramento County Agricultural Water Authority GMP (2002) • Stockton East Water District GMP (1995) • GMP for the Northern Agencies in the Delta-Mendota Canal Service Area and a portion of San Joaquin County (1997)
South San Joaquin	• Chowchilla WD GMP (1997) • Consolidated ID GMP (1995) • Fresno County GMP (1997) • Fresno ID GMP (1996) • Draft Gravelly Ford WD GMP (1998) • Amended GMP for James Irrigation District (2001) • Kaweah Delta Water Conservation District GMP (1995) • Kern Delta WD GMP (1996) • Kings County WD GMP (2001) • GMP for the Kings River Conservation District Area “A” (1995) • GMP for the Kings River Conservation District Area “B” (1996) • GMP for the Kings River Conservation District Area “C” (1998) • Deer Creek and Tule River Authority GMP (1995) • Madera ID GMP (1997) • North Kern Water Storage District GMP (1993) • Orange Cove GMP (1997) • Pleasant Valley WD GMP (2000) • Riverdale ID GMP (2005) • Root Creek WD GMP (1997) • Rosamond CSD GMP (1995)

Table 6-3. Groundwater Management Plans and County Ordinances in North and South San Joaquin Groundwater Basins (contd.)

Groundwater Basin	Groundwater Management Plans, Agreements, and County Ordinances
South San Joaquin (continued)	• Rosedale-Rio Bravo Water Storage District GMP (1997) • Semitropic Water Storage District GMP (2003) • Shafter-Wasco ID GMP (1993) • Tulare Lake Bed Coordinated GMP (1997) • Westside Groundwater Basin GMP (1996) • Westlands WD GMP (1996) • Kern Water Bank MOU • Kern Water Bank Joint Powers Agreement • Kern Water Bank Proposed Monitoring Plan • Pioneer Groundwater Recharge and Recovery Project MOU • Pioneer Project Joint Operating Agreement • Agreement on the Coordinated Operation of Recharge and Recovery Project Kern River Fan • The Pioneer Project Participation Agreement • Berrenda Mesa Project Agreement • Berrenda Mesa Project MOU between Berrenda Mesa WD and KCWA • MOU between Semitropic WSD and the adjoining entities • Agreement between Arvin-Edison WSD and MWDSC for a Water Management Program

Key:
CSD = County Sanitation District
GMP = groundwater management plan
ID = irrigation district
KCWA = Kern County Water Agency
MOU = memorandum of understanding
MWDSC = Metropolitan Water District of Southern California
WCD = Water Conservation District
WD = water district
WSD = water storage district

6.3 Environmental Consequences and Mitigation Measures

The purpose of this chapter is to provide information about the environmental consequences of the SLWRI study alternatives on hydraulics and hydrology, including water management, and impacts on existing facilities. This chapter describes the methods and assumptions, criteria for determining significant impacts, and impacts and mitigation measures associated with the H&H effects of each of the SWLRI alternatives. Implementation of the action alternatives considered in the study would affect the H&H of the Sacramento River, Feather River, American River, and the CVP/SWP systems. Impacts on the H&H of the CVP/SWP systems would translate to potential impacts on related surface and groundwater supplies available for CVP/SWP water users.

6.3.1 Methods and Assumptions

A suite of modeling tools was used to evaluate the potential impacts of the No-Action Alternative and various SLWRI action alternatives on the H&H of the

project, and to quantify potential benefits. CalSim-II was used to simulate CVP and SWP operations, determining the surface water flows, storages, and deliveries associated with each alternative. A detailed description of CalSim-II is included in Chapter 2 of the Modeling Appendix. Delta Simulation Model 2 (DSM2) was used to simulate Delta hydrodynamics, providing the data used to discuss the water-level-related impacts of each alternative. A detailed description of DSM2 and the assumptions used in the SLWRI analysis are included in Chapter 8 of the Modeling Appendix. Analysis and modeling results are summarized below; more detailed results of the CalSim-II output can be found in Attachment A of the *Hydrology, Hydraulics, and Water Management Technical Report*. Attachment B of the *Hydrology, Hydraulics, and Water Management Technical Report* contains detailed results of the DSM2 modeling.

CalSim-II

CalSim-II is the application of the Water Resources Integrated Modeling System software to the CVP/SWP. This application was jointly developed by Reclamation and DWR for planning studies relating to CVP/SWP operations. The primary purpose of CalSim-II is to evaluate the water supply reliability of the CVP and SWP at current and/or future levels of development (e.g., 2005, 2030), with and without various assumed future facilities, and with different modes of facility operations. Geographically, the model covers the drainage basin of the Delta, and CVP/SWP exports to the San Francisco Bay Area, San Joaquin Valley, Central Coast, and Southern California.

CalSim-II typically simulates system operations for an 83-year period using a monthly time step. The model assumes that facilities, land use, water supply contracts, and regulatory requirements are constant over this period, representing a fixed level of development (e.g., 2005, 2030). The historical flow record of October 1921 to September 2003, adjusted for the influences of land use changes and upstream flow regulation, is used to represent the possible range of water supply conditions. Major Central Valley rivers, reservoirs, and CVP/SWP facilities are represented by a network of arcs and nodes. CalSim-II uses a mass balance approach to route water through this network. Simulated flows are mean flows for the month; reservoir storage volumes correspond to end-of-month storage.

CalSim-II models a complex and extensive set of regulatory standards and operations criteria. Descriptions of both are contained in Chapter 2 of the Modeling Appendix. The hydrologic analysis conducted for this PDEIS used the Common Assumptions Common Modeling Package Version 8D CalSim-II models, which are the best available hydrological modeling tools, to approximate system-wide changes in storage, flow, salinity, and reservoir system reoperation associated with the SLWRI alternatives. Although CalSim-II is the best available tool for simulating system-wide operations, the model also contains simplifying assumptions in its representation of the real system. CalSim-II's predictive capability is limited and cannot be readily applied to

analyzing flood flows and hourly, daily, or weekly time steps for hydrologic conditions. The model, however, is useful for comparing the relative effects of alternative facilities and operations within the CVP/SWP system.

A general external review of the methodology, software, and applications of CalSim-II was conducted in 2003 (Close et al. 2003). Recently, an external review of the San Joaquin River Valley CalSim-II model was also conducted (Ford et al. 2006). Several limitations of the CalSim-II models were identified in these external reviews. The main limitations of the CalSim-II models are as follows:

- Model uses a monthly time step
- Accuracy of the inflow hydrology is uncertain
- Model lacks a fully explicit groundwater representation

In addition, Reclamation, DWR, and external reviewers have identified the need for a comprehensive error and uncertainty analysis for various aspects of the CalSim-II model. DWR has issued the CalSim-II Model Sensitivity Analysis Study (DWR 2005) and Reclamation has recently completed a similar sensitivity and uncertainty analysis for the San Joaquin River basin (Reclamation and DWR 2006a). This information will improve understanding of model results.

Despite these limitations, monthly CalSim-II model results remain useful for comparative purposes. It is important to differentiate between "absolute" or "predictive" modeling applications and "comparative" applications. In "absolute" applications, the model is run once to predict a future outcome; errors or assumptions in formulation, system representation, data, operational criteria, etc., all contribute to total error or uncertainty in model results. In "comparative" applications, the model is run twice, once to represent a base condition (no-action) and a second time with a specific change (action) to assess the change in the outcome due to the input change. In the comparative mode (the mode used for this PDEIS), the difference between the two simulations is of principal importance. Most potential errors or uncertainties affecting the "no-action" simulation also affect the "action" simulation in a similar manner; as a result, the effect of errors and uncertainties on the difference between the simulations is reduced. However, not all limitations are fully eliminated by the comparative analysis approach; small differences between the alternatives and the bases of comparison are not considered to be indicative of an effect of the alternative.

DSM2

DSM2 is a branched 1-dimensional model used to simulate hydrodynamics, water quality, and particle tracking in a network of riverine or estuarine channels. The hydrodynamic module can simulate channel stage, flow, and

water velocity. The water quality module can simulate the movement of both conservative and nonconservative constituents. DWR uses the model to perform operational and planning studies of the Delta.

IMpact analysis for PLANning studies of the Delta is typically performed for a 72-year period (1922 to 1994). In model simulations, EC is typically used as a surrogate for salinity. Results from CalSim-II are used to define Delta boundary inflows. CalSim-II-derived boundary inflows include the Sacramento River flow at Hood, the San Joaquin River flow at Vernalis, inflow from the Yolo Bypass, and inflow from the eastside streams. In addition, Net Delta Outflow from CalSim-II is used to calculate the salinity boundary at Martinez.

Details of the model, including source codes and model performance, are available from the DWR Bay-Delta Office, Modeling Support Branch, Web site. Documentation on model development is discussed in annual reports to SWRCB (*Methodology for Flow and Salinity Estimates in the Sacramento-San Joaquin Delta and Suisun Marsh*, by the Delta Modeling Section of DWR) (DWR 2009).

6.3.2 Criteria for Determining Significance of Effects

An environmental document prepared to comply with NEPA must consider the context and intensity of the environmental effects that would be caused by, or result from, the proposed action. Under NEPA, the significance of an effect is used solely to determine whether an environmental impact statement must be prepared. An environmental document prepared to comply with CEQA must identify the potentially significant environmental effects of a proposed project. A "[s]ignificant effect on the environment means a substantial, or potentially substantial, adverse change in any of the physical conditions within the area affected by the project" (State CEQA Guidelines, Section 15382). CEQA also requires that the environmental document propose feasible measures to avoid or substantially reduce significant environmental effects (State CEQA Guidelines, Section 15126.4(a)).

The significance criteria were developed based on the guidance provided by the State CEQA Guidelines, and consider the context and intensity of the environmental effects as required under NEPA. Impacts of an alternative on hydraulics, hydrology, and water management would be significant if project implementation would cause the results in the second column of Table 6-4 to occur. Simulated stream flow and reservoir storage data, generated as part of the hydrology, hydraulics and water management impact assessment, were used in the impact assessments for groundwater, hydropower, flood control, water quality, fisheries, terrestrial biology, recreation, and cultural resources. Accordingly, a detailed description of changes in flow and storage resulting from each of the SLWRI alternatives is included in addition to the impact analysis.

Table 6-4. Impact Indicators and Significance Criteria for Water Management

Impact Indicator	Significance Criterion
Flood management	Increase frequency or severity of damaging flood flows, as indicated by the following: • Increase frequency of daily flows above 100,000 cfs on the Sacramento River below Bend Bridge • Place housing or other structures within a 100-year flood hazard area as mapped on a Federal flood hazard boundary or Flood Insurance Rate Map or other flood hazard delineation map • Place within a 100-year flood hazard area structures that would impede or redirect flood flows
Water Supply Reliability	Reduce water supply reliability to the following CVP/SWP contractors: • North-of-Delta CVP Water Service Contractors or Refuges • South-of-Delta CVP Water Service Contractors or Refuges • SWP Table A Contractors south of the Delta
Water levels in the south Delta [1]	Reduce water surface elevation, relative to the basis of comparison, with sufficient frequency and magnitude to adversely affect south Delta water users' abilities to divert water during the irrigation season.
X2 location	Increase in X2 that adversely affects CCWD's ability to fill Los Vaqueros Reservoir: • Movement of X2 location to west of Chipps Island from February through May • Movement of X2 location to west of Collinsville during December, January, and June
Delta excess water conditions	Reduction in the duration of Delta excess conditions during the November-to-June period that adversely affects CCWD's ability to fill Los Vaqueros Reservoir.
Groundwater resources	A change in groundwater level or quality that would adversely affect users, as indicated by the following: • A change in groundwater level resulting in long-term overdraft conditions for the groundwater basins • A change groundwater quality resulting in substantially adverse effects to designated beneficial uses of groundwater.

Note:
[1] Changes in south Delta water levels are estimated using the DSM2 Model.

Key
CCWD = Contra Costa Water District
cfs = cubic feet per second
Delta = Sacramento-San Joaquin Delta

Significance statements are relative to both existing conditions (2005) and future conditions (2030) unless stated otherwise.

Flood Management

To prevent an increase in flood damages in the study area, the SLWRI must not cause a significant increase in the frequency or magnitude of flood flows on the Sacramento River. The current regulation of Shasta Dam for flood control requires that releases be restricted to quantities that will not cause downstream flows or stages to exceed, insofar as possible, (1) a flow of 79,000 cfs at the tailwater of Keswick Dam, and (2) a stage of 39.2 feet at the Sacramento River Bend Bridge gaging station near Red Bluff (corresponding roughly to a flow of 100,000 cfs). Because of the uncontrolled nature of the inflows between Keswick Dam and Bend Bridge, the 100,000 cfs flow objective at Bend Bridge

is the critical objective for minimizing flood damage. It is also important to ensure that the project does not increase potential flood damages by locating any new facilities within the 100-year floodplain or in a location that could impede or redirect flood flows, thereby potentially increasing damage to other property.

Water Supply Reliability

To prevent a decrease in water supply, the SLWRI must not cause a significant reduction in water supply reliability to CVP and SWP contractors. A significant reduction in reliability would be a reduction in average annual or average dry and critical year reliability of a magnitude and frequency that could not reliably be replaced from other sources, such as groundwater pumping or water transfers. Also, it is recognized that there is limited flexibility to change water usage between months, so monthly reliability is considered in addition to average annual delivery volumes.

The CVP provides water to a range of contract types; Settlement and Exchange contractors have the highest degree of reliability due to water rights senior to the CVP. Due to their high priority, these contractors would not be affected by any of the SLWRI alternatives. Water service contractors and refuges are subject to shortages according to water availability and their geographic location; due to conveyance constraints, south-of-Delta water service contractors and refuges have a lower degree of reliability than north-of-Delta water service contractors and refuges. While the SWP has several contractors north of the Delta, the vast majority of recipients of SWP water supplies are south of the Delta. SWP contractors have several types of water in their contract; the Table A contracts (DWR 2003a) are most susceptible to variability of supply.

South Delta Water Levels

Water levels in the south Delta are influenced to varying degrees by natural tidal fluctuations, San Joaquin River flows, barrier operations, CVP and SWP export pumping, local agricultural diversions and drainage return flows, channel capacities, siltation, and dredging. When the CVP and SWP are exporting water, water levels in local channels can be drawn down, particularly during low water years. The South Delta Water Agency and local farmers in the south and central Delta have interests in maintaining the water levels so that their siphons and pumps, which are installed at fixed locations in the Delta, can continue to be used for irrigation diversions. The SLWRI alternatives could affect the ability of the South Delta Water Agency to divert water if changes in Delta operations reduce Delta channel water levels during the irrigation season, from April to October.

The South Delta Temporary Barriers Program was initiated by DWR in 1991 to improve water conditions in the south Delta and to provide design data for permanent gates. Since 1991, DWR has seasonally installed four barriers. Three barriers, located on the Middle River, Grant Line Canal, and Old River,

ensure adequate water levels and water quality for agricultural diversions. The barriers are constructed from rock fill and incorporate overflow weirs and gated culverts. These barriers are installed in spring and removed in fall. A fourth barrier is seasonally installed at the Head of the Old River for fish control. The existing seasonal barriers (and proposed permanent tidal gates) significantly affect water levels in the south Delta. In October 2005, Reclamation and DWR released a DEIS for the South Delta Improvements Program (Reclamation 2005). This DEIS discusses the proposed operation and evaluates the impacts of the proposed permanent tidal and fish control gates in the south Delta. The Final Environmental Impact Statement/Environmental Impact Report for the South Delta Improvements Program was released in December 2006 (Reclamation and DWR 2006b) but the document has not yet been certified.

To evaluate water level effects, modeling results were examined for sites in the vicinity of three monitoring locations. South Delta agricultural irrigation users are primarily concerned with the water level at low-low tide because this is the minimum water surface elevation they experience. The impact analysis considers the maximum change in water elevation at the low-low tide for each day of each month. Channel tidal levels at three south Delta locations have been selected to describe the possible impacts of the SWLRI alternatives on south Delta tidal hydraulics. The three locations are as follows:

- **Old River at Tracy Boulevard Bridge (Road Bridge).** This station is a tidal level and EC monitoring location, and is upstream from the temporary barrier and proposed permanent barrier just east (upstream) from the Delta-Mendota Canal intake and fish facility.

- **Grant Line Canal Above the Grant Line Canal Barrier.** This station is upstream from the temporary barrier on Grant Line Canal and upstream from the proposed permanent tidal gate.

- **Middle River near the Howard Road Bridge.** This station is located just upstream from the temporary barrier near Victoria Canal and the proposed permanent tidal gate.

A change in water level of greater than 0.1 foot during the irrigation season of April to October, at a level of recurrence substantially adversely affecting south Delta water users, is considered to be significant.

X2 Location

CCWD depends almost entirely on the Delta for water supply. CCWD's raw water system consists of three Delta pumping plants (Mallard Slough, Rock Slough, and Old River), and a 100 TAF reservoir (Los Vaqueros). The pumping plants on Rock Slough and on the Old River are the primary source for CCWD. The third intake at Mallard Slough is used only when water quality conditions in the western Delta permit, usually following a prolonged period of surplus Delta outflow. Water diverted at the Old River Pumping Plant is either

used directly or stored in Los Vaqueros Reservoir for later use. CCWD's current operational priority is to fill Los Vaqueros Reservoir with high quality water whenever possible.

CCWD diversions to fill Los Vaqueros Reservoir are constrained by the Delta Smelt BO (NMFS 2004; USFWS 2005), as subsequently modified by agreements among CCWD, USFWS, DFG, and SWRCB. From February through May, the BO precondition for filling the reservoir is that the X2 location is west of Chipps Island. In December, January, and June, the X2 location must be west of Collinsville. Filling Los Vaqueros Reservoir is unconstrained in December if no delta smelt are present at the diversion location. Through agreement with DFG and USFWS, the X2 restrictions on filling Los Vaqueros Reservoir have subsequently been modified for a temporary trial period through 2010 to conform with X2 requirements specified in RD-1641.

For the impact analysis, it is assumed that from February to June, the X2 requirement for filling Los Vaqueros Reservoir will be met by Reclamation and DWR as part of their responsibilities under RD-1641.[2] Changes in simulated Delta conditions are considered to be potentially significant only for the months of December and January, and only when all of the following conditions are met:

- The Delta is not in balanced condition[3]
- Under the basis of comparison, X2 is west of Collinsville
- Under the SLWRI alternatives, X2 is east of Collinsville

It is noted that Reclamation and DWR are not authorized to use the JPOD when the Delta is in excess conditions, and when such diversions would cause the location of X2 to shift upstream and prevent CCWD from filling Los Vaqueros Reservoir under its water right permits.

Delta Excess Water Conditions

Changes from Delta excess water conditions to balanced conditions could adversely affect CCWD's ability to fill Los Vaqueros Reservoir. Under SWRCB Water Right Decision 1629, filling Los Vaqueros Reservoir is restricted to the parts of the period from November 1 to June 30 when the Delta is in excess water conditions. Changes in simulated Delta conditions are

[2] When the Eight River Index is less than 8.1 MAF, the RD-1641 X2 requirements for May and June are relaxed, potentially impacting filling of Los Vaqueros Reservoir. Model simulations show that this would occur eight times during the historical record for water years 1922 to 1994, but in these circumstances the Delta would be in balanced water conditions.

[3] Balanced water conditions are periods when it is agreed by Reclamation and DWR that releases from upstream reservoirs plus unregulated flows approximately equal the water supply needed to meet Sacramento Valley in-basin uses plus required Delta outflows and exports (Reclamation and DWR 1986).

considered to be potentially significant if during this period the following conditions are met:

- Under the basis of comparison, the Delta is in excess conditions
- Under the SLWRI alternatives, the Delta is in balanced conditions

Groundwater Resources

Impacts on groundwater resources would be considered significant if actions related to the SLWRI alternatives would cause the groundwater resources impacts described in Table 6-4. Improvements in water supply reliability under the SLWRI alternatives may affect groundwater levels, budget, and quality in the primary and extended study areas. In general, potential impacts of the SLWRI in the primary and extended study areas would result from a reduction in water extraction due to increased surface water supply reliability. Currently, CVP and SWP water users in the primary and extended study areas pump groundwater to supplement surface water supply.

Potential impacts on groundwater resources, particularly groundwater levels, budget, and water quality, are evaluated qualitatively based on changes in surface water supply. This approach is based on the assumption that the actual reduction in groundwater extraction would be proportional to the increase in surface water supply reliability that would occur in the study areas under the SLWRI alternatives. Changes in groundwater pumping in the study areas would be relatively small compared to the estimated millions of acre-feet of annual groundwater pumping. Nevertheless, the SLWRI alternatives would have a positive, albeit limited, impact by reducing reliance on groundwater in the study areas. Because effects on groundwater basins would be limited and positive, groundwater impacts are discussed qualitatively.

6.3.3 Direct and Indirect Effects

This section describes the environmental consequences of the SLWRI alternatives, and proposed mitigation measures for any impacts determined to be significant or potentially significant. All alternatives are compared to a basis of comparison. For the existing condition (2005 level of development), a CalSim-II simulation for the existing condition is used. Similarly, the future condition (2030 level of development) uses a CalSim-II simulation of the No-Action/No-Project Alternative as a basis of comparison. Each of the alternatives is simulated using the same level of development so that any changes from the basis of comparison in H&H can be attributed to the alternative.

Alternatives Description

The six SLWRI alternatives are described in the following subsections.

No-Action Alternative NEPA and CEQA require the analysis of a baseline alternative, representing a scenario in which the project is not implemented. For

all Federal feasibility studies of potential water resources projects, the NEPA No-Action Alternative is intended to account for existing facilities, conditions, land uses, and reasonably foreseeable actions expected to occur in the study area by 2030. Reasonably foreseeable actions include actions with current authorization, complete funding for design and construction, and complete environmental permitting and compliance.

Under CEQA, the No-Project Alternative is similar to NEPA's No-Action Alternative, but it involves the review of two scenarios: the Existing Condition baseline, which represents only current conditions at the time the Notice of Preparation is published, and "reasonably foreseeable" future conditions without the project (which is equivalent to the NEPA No-Action Alternative). Table 2-1 of the Modeling Appendix describes the Existing Condition, and shows what actions were assumed to be part of the Future Condition (or No-Project/No-Action Alternative).

For the SLWRI, under the No-Action Alternative, the Federal Government would take reasonably foreseeable actions, as defined above, but would take no additional action toward implementing a specific plan to help increase anadromous fish survival in the upper Sacramento River, nor help address the growing water reliability issues in California. This alternative is used as a basis of comparison to determine effects of the action alternatives under future conditions.

CP1 – 6.5-Foot Dam Raise, Anadromous Fish Survival and Water Supply Reliability CP1 focuses on increasing water supply reliability while contributing to increased anadromous fish survival, actions that are consistent with the 2000 CALFED ROD (CALFED 2000b). In addition to the common features above, CP1 primarily consists of raising Shasta Dam 6.5 feet, an elevation change that increases the reservoir's full pool by 8.5 feet, and enlarges the total storage space in the reservoir by 256,000 acre-feet. Under this plan, Shasta Dam normal operational guidelines would continue essentially unchanged, with the additional storage retained for water supply reliability. This scenario helps to reduce future water shortages through increasing drought and average year water supply reliability. This plan would also include the potential to revise the operational rules for flood control for Shasta Dam and Reservoir, which could benefit flood damage reduction and recreation. Reservoir reoperation would likely include increasing the bottom of the flood control pool elevation based on increased dam height and reservoir capacity. The increased Shasta Reservoir pool depth and volume would also contribute to maintaining lower seasonal water temperatures for anadromous fish on the upper Sacramento River.

CP2 – 12.5-Foot Dam Raise, Anadromous Fish Survival and Water Supply Reliability As with CP1, this comprehensive plan focuses on enlargement of Shasta Dam and Lake consistent with the goals of the 2000 CALFED ROD, and was formulated for the primary purposes of increased water supply reliability

and increased anadromous fish survival. In addition to the common features above, CP2 consists of raising Shasta Dam 12.5 feet, an elevation change that increases the full pool by 14.5 feet, and enlarges the total storage space in the reservoir by 443,000 acre-feet. This alternative would help reduce future shortages by increasing drought and average year water supply reliability. The increased cold-water pool also would contribute to improved seasonal water temperatures for anadromous fish on the upper Sacramento River.

CP3 – 18.5-Foot Dam Raise, Anadromous Fish Survival and Water Supply Reliability CP3 is similar to CP1 and CP2. It focuses on the greatest practical enlargement of Shasta Dam and Lake consistent with the goals of the 2000 CALFED ROD, and was formulated for the primary purposes of increased water supply reliability and increased anadromous fish survival. In addition to the common features above, CP3 consists of raising Shasta Dam 18.5 feet, an elevation change that increases the full pool by 20.5 feet, and enlarges the total storage space in the reservoir by 634,000 acre-feet to 5.19 MAF. This comprehensive plan would help reduce future shortages by increasing water supply reliability in relatively dry years. The increased pool depth and volume would also contribute to improving seasonal water temperatures for anadromous fish on the upper Sacramento River.

CP4 – 18.5-Foot Dam Raise, Anadromous Fish Focus With Water Supply Reliability The primary function of CP4 is to address anadromous fish survival, while still improving water supply reliability. It focuses on increasing the volume of cold water available to the Shasta Lake TCD through reservoir reoperations, and on raising Shasta Dam by 18.5 feet. As with CP3 and the common features above, this raise would increase the full pool by 20.5 feet and enlarge total reservoir storage space by 634,000 acre-feet. This additional storage space would expand Shasta Reservoirs cold-water supply available to the TCD by 378,000 acre-feet, a feature that would help improve cooler water temperatures in the upper Sacramento River.

CP5 – 18.5-Foot Dam Raise, Combination Plan CP5 would address both the primary and secondary planning objectives. CP5 includes enlarging Shasta Dam 18.5 feet, which is consistent with the objectives of the 2000 CALFED ROD, and also includes the common features above. In addition, CP5 includes (1) implementing environmental restoration features along the lower reaches of major tributaries to Shasta Lake, (2) constructing shoreline fish habitat around Shasta Lake, and (3) constructing either additional or improved recreation features at various locations around Shasta Lake to increase the value of the recreational experience. Specific environmental restoration features and increased recreation components are presented in the Alternatives Description portion of the PDEIS and the Draft Feasibility Report.

Changes to CVP/SWP Operations

Each of the SWLRI alternatives would have similar impacts on CVP and SWP operations compared to either the existing condition or the No-Action

Alternative. However, the magnitude of the impacts would vary according to the alternative. Detailed tables of the estimated monthly flows and storages associated with each alternative, in addition to changes from the bases of comparison, are included in Attachment A of the *Hydrology, Hydraulics, and Water Management Technical Report*. Results are summarized below.

The analysis assumed that the SLWRI alternatives would not alter existing operational rules or protocols; no formal changes to CVP or SWP operating criteria and associated with the SLWRI. At a base level, each action alternative would store some additional flows behind Shasta Dam during periods when the flows would have otherwise been released downstream. The resulting increase in storage would then be used to both create an expanded cold-water pool, thus benefiting fisheries, and for subsequent release downstream when there are opportunities to put the water to beneficial use.

Reductions in Shasta releases under the various SLWRI alternatives would typically occur during winter (November through March) in relatively wet years, and increases in releases would typically occur in the late spring and summer (June through September) of drier years. Shasta Dam typically makes releases for one of six purposes:

- Flood management
- Sacramento River flow requirements both below Keswick and at Wilkins Slough
- Sacramento River water temperature requirements at Bend Bridge
- Delta water quality requirements
- Senior water rights along the Sacramento River
- CVP water supply contracts needs both north and south of the Delta

However, release for one purpose may also be sufficient for meeting another; for instance, releases for Sacramento River water temperatures may also be used to both meet Delta water quality requirements and for export to south-of-Delta contractors. While releases for flood management purposes typically occur in winter, water temperature and water quality requirements exist year-around. Releases for water supply purposes primarily occur in late spring, summer, and early fall.

For the SLWRI alternatives, existing water quality and temperature requirements would typically be met in most years; therefore, additional water in storage would primarily be released for water supply purposes. Accordingly, minimal increases in flow would be expected in months when Delta exports are constrained, or when flow is not usable for water supply purposes.

Table 6-5 summarizes monthly flows and changes below Shasta Dam. Releases from Shasta Dam would typically be increased in the summer months, corresponding with the periods of greatest agricultural demands. Similarly, releases would be reduced in the winter months, when the increased storage would be used to capture additional runoff rather than releasing to the downstream river.

Table 6-5. Simulated Monthly Average Sacramento River Flows Below Shasta Dam

Month	Existing Condition (2005)				Future Condition (2030)			
	Existing Condition (cfs)	Change from Base			No-Action Alt (cfs)	Change from Base		
		CP1 and CP4 (cfs)	CP2 (cfs)	CP3 and CP5 (cfs)		CP1 and CP4 (cfs)	CP2 (cfs)	CP3 and CP5 (cfs)
Oct	5,529	-27 (0%)	-9 (0%)	1 (0%)	5,194	-60 (-1%)	6 (0%)	49 (1%)
Nov	5,304	-70 (-1%)	-32 (-1%)	51 (1%)	5,077	-81 (-2%)	-50 (-1%)	4 (0%)
Dec	6,770	-210 (-3%)	-318 (-5%)	-409 (-6%)	6,585	-193 (-3%)	-377 (-6%)	-510 (-8%)
Jan	7,558	-77 (-1%)	-74 (-1%)	-134 (-2%)	7,591	-129 (-2%)	-131 (-2%)	-195 (-3%)
Feb	10,242	-184 (-2%)	-197 (-2%)	-421 (-4%)	10,111	4 (0%)	-192 (-2%)	-283 (-3%)
Mar	8,054	-1 (0%)	-39 (0%)	-63 (-1%)	8,061	-146 (-2%)	-173 (-2%)	-120 (-1%)
Apr	6,419	76 (1%)	92 (1%)	116 (2%)	6,463	56 (1%)	70 (1%)	87 (1%)
May	7,519	-19 (0%)	-11 (0%)	13 (0%)	7,590	-28 (0%)	-12 (0%)	1 (0%)
Jun	10,267	23 (0%)	29 (0%)	80 (1%)	10,186	33 (0%)	162 (2%)	140 (1%)
Jul	10,900	105 (1%)	159 (1%)	164 (2%)	11,028	210 (2%)	273 (3%)	199 (2%)
Aug	8,187	177 (2%)	160 (2%)	243 (3%)	8,453	191 (2%)	222 (3%)	308 (4%)
Sep	4,939	75 (2%)	18 (0%)	43 (1%)	5,355	29 (1%)	-18 (0%)	7 (0%)
Total (TAF)	5,523	-7 (0%)	-13 (0%)	-18 (0%)	5,524	-7 (0%)	-13 (0%)	-18 (0%)

Source: Common Assumptions Common Modeling Package Version 8D CalSim-II 2005 and 2030 simulations (Node C4)

Note:
Simulation period: 1922-2003
(%) indicates percent change from either existing condition or No-Action Alternative
Key:
Alt = alternative
cfs = cubic feet per second
CP = Comprehensive Plan
TAF = thousand acre-feet

Storage in Shasta Reservoir fluctuates greatly throughout a year; storage is typically highest at the end of winter, in April and May, as the need for flood control reservation space in the reservoir is reduced. Storage is typically at its lowest in September and October, after the irrigation season and before the winter refill begins. As a result of the increased storage capacity attributed to each alternative, and the flow reductions described above, Shasta Reservoir storage would be generally higher under the SLWRI alternatives than under the existing condition or the No-Action Alternative (future condition). This additional storage would typically be greatest in the winter (February or March), and would be lowest at the end of summer (September or October), as shown in Table 6-6, consistent with Shasta Reservoir's current operation. Additional runoff captured by the increased storage increment would typically remain in

storage until it could be used to meet one of the purposes described above. Conversely, under either of the bases of comparison, if water in storage were insufficient to meet all of the project purposes, the first increment to be reduced would be deliveries to water service contractors. Therefore, increased releases would typically be made on a schedule providing increased reliability of deliveries to water service contractors, typically in July through October of relatively dry years.

Table 6-6. Simulated Average End-of-Month Shasta Reservoir Storage

Month	Existing Condition (2005)					Future Condition (2030)				
	Existing Condition (TAF)	Change from Base				No-Action Alt (TAF)	Change from Base			
		CP1 (TAF)	CP2 (TAF)	CP3 and CP5 (TAF)	CP4 (TAF)		CP1 (TAF)	CP2 (TAF)	CP3 and CP5 (TAF)	CP4 (TAF)
Oct	2,671	144	263	377	522	2,635	142	258	386	520
Nov	2,690	148	265	374	526	2,667	147	261	385	525
Dec	2,815	160	284	399	538	2,804	158	284	416	536
Jan	3,067	165	288	407	543	3,054	166	292	428	544
Feb	3,291	175	299	430	553	3,284	166	302	443	544
Mar	3,624	175	301	434	553	3,617	174	313	450	552
Apr	3,919	170	295	426	548	3,910	171	308	444	549
May	3,950	171	295	424	549	3,936	172	308	443	550
Jun	3,642	169	293	418	547	3,634	170	297	434	548
Jul	3,187	162	282	407	540	3,171	156	279	420	534
Aug	2,879	150	271	390	528	2,846	144	265	399	522
Sep	2,782	145	269	386	523	2,725	141	265	397	519

Source: Common Assumptions Common Modeling Package Version 8D CalSim-II 2005 and 2030 simulations (Node S4+S44)
Notes:
Simulation period: 1922-2003
Key:
Alt = alternative
CP = Comprehensive Plan
TAF = thousand acre-feet

A key indicator of water temperature benefits of the SLWRI alternatives to the Sacramento River between Keswick Dam and Red Bluff is the amount of cold water available in Shasta Reservoir before the water temperature operation season, about May through October. As previously described, Shasta Reservoir generally reaches its maximum storage during late April or early May. Also, the cold-water pool volume in the lake accumulates during the winter and early spring and is not likely to increase after April. Therefore, the expected increase in spring storage for each dam raise alternative should also result in an incremental increase in the cold-water pool volume.

Reclamation operates the Shasta Dam TCD to manage water temperatures in the Sacramento River to (1) improve habitat for the endangered winter-run Chinook salmon and other threatened runs, (2) withdraw warmer surface water in the

winter and spring to preserve cold-water storage for release during the temperature operation season, and (3) enable power generation to continue while controlling release temperatures, which eliminates the need to bypass the powerplant penstocks via the low-level river outlets. Generally, to accomplish these temperature objectives during the temperature operation season, the TCD functions to select water temperatures in the 47 degrees Fahrenheit (˚F) to 52˚F range. Therefore, a good index of the temperature-related benefits of the alternative is the volume of the cold-water pool less than 52˚F at the end of April. In the context of historical project operation, reservoir storage and cold-water pool conditions in mid-spring represent the available cold-water "bank" managed throughout the temperature operation season (July through October), as prescribed by the SRTTG. The simulated end-of-April volume of water less than 52˚F for the two bases of comparison, and the change in cold-water pool volume for each of the SLWRI alternatives, are shown by Sacramento Valley Index in Table 6-7. As expected, the higher dam raise alternatives generally reflect a larger cold-water pool volume.

Table 6-7. Simulated Average Volume of Water Less than 52˚F in Shasta Reservoir at the End of April

SVI Year Type	Existing Condition (2005)					Future Condition (2030)				
	Existing Condition (TAF)	Change from Base				No-Action Alt (TAF)	Change from Base			
		CP1 (TAF)	CP2 (TAF)	CP3 and CP5 (TAF)	CP4 (TAF)		CP1 (TAF)	CP2 (TAF)	CP3 and CP5 (TAF)	CP4 (TAF)
Average of All Years	1,577	90	152	220	348	1,570	103	169	240	362
Wet	1,807	137	237	349	437	1,799	156	255	374	457
Above Normal	1,721	110	182	284	324	1,722	131	203	270	350
Below Normal	1,743	72	130	214	341	1,723	86	153	223	352
Dry	1,451	71	111	130	310	1,450	80	120	152	314
Critical	928	16	22	17	241	920	15	41	69	251

Source: Common Assumptions Common Modeling Package Version 8D SRWQM 2005 and 2030 simulations

Notes:

Simulation period: 1922-2003

Year types as defined by the Sacramento Valley Index

Key:

ºF = degrees Fahrenheit

Alt =Alternative

CP = Comprehensive Plan

SVI = Sacramento Valley Index

TAF = thousand acre-feet

Downstream from Shasta Dam, the Sacramento River combines with releases from Trinity Reservoir through Whiskeytown Reservoir and the Spring Creek Tunnel above Keswick Dam. Because of the connected nature of Shasta Reservoir and Trinity Reservoir for meeting instream flow requirements and water supply demands below Keswick Dam, changes in Shasta Reservoir operations would possibly result in changes to operations of Trinity Reservoir. Table 6-8 shows changes in Trinity Reservoir storage that would result from SLWRI alternatives. These changes are very small relative to the reservoir storage and should not result in noticeable changes at Trinity Reservoir. To limit the effect of the enlarged Shasta Reservoir on Trinity Reservoir operations, the relationship in CalSim-II between Shasta Reservoir storage and Trinity Reservoir exports to the Sacramento River was modified through interpolation to approximately maintain the export level of the basis of comparison in the action alternatives.

Table 6-8. Simulated Average End-of-Month Trinity Lake Storage

Month	Existing Condition (2005)				Future Condition (2030)			
	Existing Condition (TAF)	Change from Base			No-Action Alt (TAF)	Change from Base		
		CP1 and CP4 (TAF)	CP2 (TAF)	CP3 and CP5 (TAF)		CP1 and CP4 (TAF)	CP2 (TAF)	CP3 and CP5 (TAF)
Oct	1,344	12	18	19	1,333	13	13	15
Nov	1,356	10	16	20	1,347	11	13	17
Dec	1,405	7	13	17	1,399	7	8	12
Jan	1,466	10	18	22	1,463	9	12	15
Feb	1,574	10	18	21	1,572	10	12	15
Mar	1,698	7	14	16	1,696	7	9	12
Apr	1,845	11	19	21	1,844	11	14	17
May	1,841	11	19	21	1,840	11	15	18
Jun	1,800	9	16	18	1,799	8	14	15
Jul	1,658	7	14	14	1,657	8	11	10
Aug	1,520	8	15	16	1,513	12	12	11
Sep	1,402	13	18	18	1,392	16	14	13

Source: Common Assumptions Common Modeling Package Version 8D CalSim-II 2005 and 2030 simulations (Node S1)

Note:

Simulation period: 1922-2003

Key:

Alt =Alternative

CP = Comprehensive Plan

TAF = thousand acre-feet

Below Keswick Dam, Sacramento River flows would be increasingly affected by tributary inflows rather than releases from Shasta Lake. Table 6-9 shows the simulated monthly average tributary inflows to the Sacramento River between Keswick Dam and the RBDD. The tributary inflows are consistent between the 2005 and 2030 levels of development simulations and for each alternative. Below the RBDD, flow changes associated with the SLWRI alternatives would be considerably smaller relative to total flow in the river. Comparing the flows in Table 6-5 and Table 6-10 for the existing condition and No-Action Alternative, the tributary influence on river flow becomes apparent. Similarly, with increases in flow for the existing condition and No-Action Alternative, the influence of the SLWRI alternatives on the flow in the river would be reduced.

Table 6-9. Simulated Monthly Average Tributary Inflow to the Sacramento River Between Keswick Dam and the Red Bluff Diversion Dam

Month	Cottonwood Creek (cfs)	Paynes Creek (cfs)
October	109	23
November	335	77
December	1,073	145
January	1,848	179
February	2,252	174
March	1,803	128
April	1,139	70
May	619	37
June	298	23
July	108	10
August	64	7
September	70	13
Total (AF)	584,937	53,402

Source: Common Assumptions Common Modeling Package Version 8D CalSim-II 2005 and 2030 simulations (Node I108 and I110)

Notes:

Simulation period: 1922-2003

Key:

AF = acre-feet

Alt = alternative

cfs = cubic feet per second

Table 6-10. Simulated Monthly Average Sacramento River Flows Below the Red Bluff Diversion Dam

Month	Existing Condition (2005)				Future Condition (2030)			
	Existing Condition (cfs)	Change from Base			No-Action Alts (cfs)	Change from Base		
		CP1 and CP4 (cfs)	CP2 (cfs)	CP3 and CP5 (cfs)		CP1 and CP4 (cfs)	CP2 (cfs)	CP3 and CP5 (cfs)
Oct	7,341	-20 (0%)	-20 (0%)	-16 (0%)	7,057	-39 (-1%)	-11 (0%)	41 (1%)
Nov	8,012	-7 (0%)	11 (0%)	57 (1%)	7,848	-39 (0%)	-44 (-1%)	-61 (-1%)
Dec	12,049	-190 (-2%)	-297 (-2%)	-391 (-3%)	11,877	-147 (-1%)	-314 (-3%)	-642 (-5%)
Jan	15,414	-137 (-1%)	-164 (-1%)	-234 (-2%)	15,436	-186 (-1%)	-200 (-1%)	-331 (-2%)
Feb	18,866	-192 (-1%)	-210 (-1%)	-428 (-2%)	18,738	-11 (0%)	-189 (-1%)	-92 (0%)
Mar	14,868	27 (0%)	-24 (0%)	-48 (0%)	14,915	-116 (-1%)	-161 (-1%)	-130 (-1%)
Apr	10,416	-15 (0%)	-9 (0%)	8 (0%)	10,480	-20 (0%)	-22 (0%)	53 (1%)
May	9,385	-48 (-1%)	-50 (-1%)	-40 (0%)	9,468	-47 (-1%)	-59 (-1%)	5 (0%)
Jun	11,020	25 (0%)	41 (0%)	73 (1%)	10,923	60 (1%)	140 (1%)	22 (0%)
Jul	12,006	98 (1%)	141 (1%)	178 (1%)	12,111	197 (2%)	271 (2%)	176 (1%)
Aug	9,356	118 (1%)	108 (1%)	156 (2%)	9,690	120 (1%)	187 (2%)	345 (4%)
Sep	6,755	-23 (0%)	-34 (-1%)	-18 (0%)	7,246	-46 (-1%)	-63 (-1%)	-68 (-1%)
Total (TAF)	8,147	-21 (0%)	-30 (0%)	-41 (-1%)	8,166	-17 (0%)	-27 (0%)	-41 (-1%)

Source: Common Assumptions Common Modeling Package Version 8D CalSim-II 2005 and 2030 simulations (Node C112)

Notes:

Simulation period: 1922-2003

(%) indicates percent change from either existing condition or No-Action Alternative

Key:

Alt = alternative

cfs = cubic feet per second

CP = Comprehensive Plan

TAF = thousand acre-feet

In addition to the multiple tributary inflows between Keswick Dam and Red Bluff, downstream flows on the Sacramento River would be affected by diversions above the RBDD. Specifically, contractors off the Tehama-Colusa Canal receive supplies from above the RBDD. Since contractors off the Tehama-Colusa Canal are all water service contractors, and thus would be subject to delivery shortages when CVP storage is low, the SLWRI alternatives would result in increased deliveries to the Tehama-Colusa Canal contractors in relatively dry years. Table 6-11 shows simulated diversions from the RBDD to the Tehama-Colusa Canal in dry and critical years. Agricultural diversions typically occur between April and September, with some additional diversions in March and October; accordingly, deliveries on the Tehama-Colusa Canal increase in the agricultural diversion months, but see no changes in months with little or no irrigation.

Table 6-11. Simulated Monthly Average Diversions to the Tehama-Colusa Canal in Dry and Critical Years

Month	Existing Condition (2005)				Future Condition (2030)			
	Existing Condition (cfs)	Change from Base			No-Action Alt (cfs)	Change from Base		
		CP1 and CP4 (cfs)	CP2 (cfs)	CP3 and CP5 (cfs)		CP1 and CP4 (cfs)	CP2 (cfs)	CP3 and CP5 (cfs)
Oct	115	3	4	5	114	1	3	5
Nov	10	0	0	0	10	0	0	0
Dec	0	0	0	0	0	0	0	0
Jan	0	0	0	0	0	0	0	0
Feb	7	0	0	0	6	0	0	0
Mar	20	4	5	7	19	1	4	7
Apr	148	25	27	32	151	7	10	25
May	289	33	43	55	285	24	44	65
Jun	437	47	53	68	428	29	51	80
Jul	519	53	60	77	516	34	57	91
Aug	468	42	48	61	465	27	45	72
Sep	125	15	14	18	119	5	12	23
Total (TAF)	130	13	15	20	129	8	14	22

Source: Common Assumptions Common Modeling Package Version 8D CalSim-II 2005 and 2030 simulations (Node C112)

Notes:

Simulation period: 1922-2003

Dry and critical years as defined by the Sacramento Valley Index

Key:

Alt = alternative

cfs = cubic feet per second

CP = Comprehensive Plan

TAF = thousand acre-feet

While Tehama-Colusa Canal water users are the primary recipient of CVP water service contract deliveries north of the Delta, other north-of-the-Delta users are subject to changes in water supply, including wildlife refuges. Average monthly deliveries to CVP water service contractors and refuges north of the Delta are included in Table 6-12.

Table 6-12. Simulated Monthly Average Deliveries to North-of-Delta CVP Water Service Contractors and Refuges

Month	Existing Condition (2005)				Future Condition (2030)			
	Existing Condition (cfs)	Change from Base			No-Action Alt (cfs)	Change from Base		
		CP1 and CP4 (cfs)	CP2 (cfs)	CP3 and CP5 (cfs)		CP1 and CP4 (cfs)	CP2 (cfs)	CP3 and CP5 (cfs)
Oct	286	4 (1%)	4 (1%)	5 (2%)	339	2 (1%)	4 (1%)	6 (2%)
Nov	173	0 (%)	0 (%)	0 (%)	220	0 (0%)	0 (0%)	0 (0%)
Dec	109	0 (%)	0 (%)	0 (%)	137	0 (0%)	0 (0%)	0 (0%)
Jan	54	0 (%)	0 (%)	0 (%)	67	0 (0%)	0 (0%)	0 (0%)
Feb	50	0 (%)	0 (%)	0 (%)	62	0 (0%)	0 (0%)	0 (0%)
Mar	35	3 (8%)	3 (9%)	5 (13%)	37	1 (3%)	3 (8%)	5 (12%)
Apr	371	22 (6%)	23 (6%)	30 (8%)	356	11 (3%)	20 (6%)	32 (9%)
May	657	29 (4%)	31 (5%)	40 (6%)	680	15 (2%)	29 (4%)	45 (7%)
Jun	923	36 (4%)	38 (4%)	49 (5%)	967	19 (2%)	37 (4%)	57 (6%)
Jul	1,076	40 (4%)	42 (4%)	55 (5%)	1,136	22 (2%)	42 (4%)	65 (6%)
Aug	914	32 (4%)	33 (4%)	44 (5%)	978	17 (2%)	33 (3%)	52 (5%)
Sep	544	14 (3%)	15 (3%)	20 (4%)	601	8 (1%)	15 (2%)	23 (4%)
Total (TAF)	315	11 (3%)	12 (4%)	15 (5%)	339	6 (2%)	11 (3%)	17 (5%)

Source: Common Assumptions Common Modeling Package Version 8D CalSim-II 2005 and 2030 simulations (Nodes DEL_CVP_PAG_N and DEL_CVP_PRF_N)

Notes:

Simulation period: 1922-2003

(%) indicates percent change from either existing condition or No-Action Alternative

Key:

Alt = alternative

cfs = cubic feet per second

CP = Comprehensive Plan

TAF = thousand acre-feet

As would be expected, the change in deliveries increases with the greater enlargement volumes, and increases in deliveries are much greater in the dry and critical years than in average years, corresponding to the increased likelihood of shortages during drier periods. Table 6-13 shows average deliveries in dry and critical years.

Table 6-13. Simulated Monthly Average Deliveries to North-of-Delta CVP Water Service Contractors and Refuges in Dry and Critical Years

Month	Existing Condition (2005)				Future Condition (2030)			
	Existing Condition (cfs)	Change from Base			No-Action Alt (cfs)	Change from Base		
		CP1 and CP4 (cfs)	CP2 (cfs)	CP3 and CP5 (cfs)		CP1 and CP4 (cfs)	CP2 (cfs)	CP3 and CP5 (cfs)
Oct	280	4 (2%)	5 (2%)	7 (2%)	332	2 (1%)	4 (1%)	6 (2%)
Nov	170	0 (%)	0 (%)	0 (%)	217	0 (0%)	0 (0%)	0 (0%)
Dec	108	0 (%)	0 (%)	0 (%)	135	0 (0%)	0 (0%)	0 (0%)
Jan	53	0 (%)	0 (%)	0 (%)	66	0 (0%)	0 (0%)	0 (0%)
Feb	54	0 (%)	0 (%)	0 (%)	64	0 (0%)	0 (0%)	0 (0%)
Mar	33	4 (13%)	5 (16%)	8 (23%)	36	2 (4%)	5 (13%)	7 (21%)
Apr	249	33 (13%)	36 (14%)	47 (19%)	236	17 (7%)	32 (13%)	52 (22%)
May	382	42 (11%)	47 (12%)	60 (16%)	389	25 (6%)	43 (11%)	69 (18%)
Jun	522	51 (10%)	58 (11%)	75 (14%)	537	32 (6%)	56 (10%)	88 (16%)
Jul	608	58 (10%)	66 (11%)	85 (14%)	631	37 (6%)	63 (10%)	100 (16%)
Aug	541	47 (9%)	53 (10%)	68 (12%)	574	30 (5%)	51 (9%)	80 (14%)
Sep	357	21 (6%)	24 (7%)	31 (9%)	399	13 (3%)	22 (5%)	35 (9%)
Total (TAF)	204	16 (8%)	18 (9%)	23 (11%)	219	10 (4%)	17 (8%)	27 (12%)

Source: Common Assumptions Common Modeling Package Version 8D CalSim-II 2005 and 2030 simulations (Nodes DEL_CVP_PAG_N and DEL_CVP_PRF_N)

Notes:

Simulation period: 1922-2003

(%) indicates percent change from either existing condition or No-Action Alternative

Dry and critical years as defined by the Sacramento Valley Index

Key:

Alt = alternative

cfs = cubic feet per second

CP = Comprehensive Plan

TAF = thousand acre-feet

Table 6-14 shows the simulated monthly average tributary inflows to the Sacramento River below the RBDD. The tributary inflows are the same in the 2005 and 2030 levels of development simulations.

Table 6-14. Simulated Monthly Average Tributary Inflow to the Sacramento River Below the Red Bluff Diversion Dam

Month	Thomes and Elder Creeks (cfs)	Antelope, Mill, and Deer Creeks (cfs)
October	32	397
November	227	712
December	626	1,412
January	881	1,878
February	1,115	2,122
March	976	1,919
April	791	1,699
May	503	1,350
June	172	817
July	36	454
August	8	350
September	10	335
Total (AF)	323,806	811,287

Source: Common Assumptions Common Modeling Package Version 8D CalSim-II 2005 and 2030 simulations (Node I1301 and I1305)

Notes:

Simulation period: 1922-2003

Key:

AF = acre-feet

Alt = alternative

cfs = cubic feet per second

As described in Chapter 1 of the *Hydrology, Hydraulics, and Water Management Technical Report*, during high flow periods, Sacramento River flows below Red Bluff can be diverted into the Sutter Bypass near Ord Ferry, or from the Moulton, Colusa, or Tisdale weirs. Similarly, flows can be diverted into the Yolo Bypass from the Fremont and Sacramento weirs. Table 6-15 shows the recurrence of annual spills over the various Sacramento Valley weirs into the Sutter and Yolo bypasses.

Table 6-15. Simulated Number of Years of Sacramento Valley Weir Spill

Location	Existing Condition (2005)				Future Condition (2030)			
	Existing Condition (cfs)	Change from Base			No-Action Alt (cfs)	Change from Base		
		CP1 and CP4 (cfs)	CP2 (cfs)	CP3 and CP5 (cfs)		CP1 and CP4 (cfs)	CP2 (cfs)	CP3 and CP5 (cfs)
Spill Above Moulton Weir	5	0	-1	-1	5	-1	-1	-1
Moulton Weir	17	0	0	-1	17	0	0	0
Colusa Weir	39	-1	-1	-1	39	-1	-1	-1
Tisdale Weir	57	0	0	0	58	0	0	0
Fremont Weir	29	-1	-1	-1	28	0	0	0
Sacramento Weir	24	-1	-1	-1	23	0	0	0

Source: Common Assumptions Common Modeling Package Version 8D CalSim-II 2005 and 2030 simulations (Node D117, D124, D125, D126, D160, D166A)

Note:

Simulation period: 1922-2003

Key:

Alt = alternative

cfs = cubic feet per second

CP = Comprehensive Plan

As the Sacramento River nears the Delta, the basis-of-comparison flow would increase considerably so that flow changes associated with SLWRI alternatives would be immeasurable in most months. Table 6-16 shows the simulated monthly average Sacramento River flow below Freeport. Flow changes due to each alternative are very small compared to the bases of comparison; average monthly flow changes are typically between 0 percent and 2 percent. Larger flow increases are due to operations specifically for export; since conditions typically only allow for increased exports in July and August, the majority of the benefits are observed during those months.

Table 6-16. Simulated Monthly Average Sacramento River Flows Below Freeport

Month	Existing Condition (2005)				Future Condition (2030)			
	Existing Condition (cfs)	Change from Base			No-Action Alt (cfs)	Change from Base		
		CP1 and CP4 (cfs)	CP2 (cfs)	CP3 and CP5 (cfs)		CP1 and CP4 (cfs)	CP2 (cfs)	CP3 and CP5 (cfs)
Oct	12,719	31 (0%)	19 (0%)	55 (0%)	12,068	-15 (0%)	41 (0%)	56 (0%)
Nov	15,858	-53 (0%)	-29 (0%)	-11 (0%)	15,501	-15 (0%)	0 (0%)	4 (0%)
Dec	26,148	-98 (0%)	-116 (0%)	-134 (-1%)	25,710	-14 (0%)	-139 (-1%)	-200 (-1%)
Jan	34,680	-151 (0%)	-167 (0%)	-184 (-1%)	34,363	-93 (0%)	-126 (0%)	-167 (0%)
Feb	40,650	-272 (-1%)	-198 (0%)	-344 (-1%)	40,345	83 (0%)	-71 (0%)	-115 (0%)
Mar	35,093	5 (0%)	-106 (0%)	-115 (0%)	35,018	-83 (0%)	-117 (0%)	-179 (-1%)
Apr	24,190	-49 (0%)	-33 (0%)	-34 (0%)	24,317	-41 (0%)	-15 (0%)	-10 (0%)
May	20,098	-41 (0%)	-55 (0%)	-56 (0%)	20,119	-59 (0%)	-106 (-1%)	-102 (-1%)
Jun	17,718	50 (0%)	57 (0%)	64 (0%)	18,092	18 (0%)	63 (0%)	31 (0%)
Jul	15,270	327 (2%)	304 (2%)	320 (2%)	16,870	132 (1%)	195 (1%)	277 (2%)
Aug	12,649	232 (2%)	272 (2%)	290 (2%)	13,790	72 (1%)	88 (1%)	97 (1%)
Sep	13,697	6 (0%)	4 (0%)	-5 (0%)	13,863	78 (1%)	114 (1%)	133 (1%)
Total (TAF)	16,142	1 (0%)	-2 (0%)	-7 (0%)	16,223	3 (0%)	-4 (0%)	-10 (0%)

Source: Common Assumptions Common Modeling Package Version 8D CalSim-II 2005 and 2030 simulations (Node C169)

Notes:
Simulation period: 1922-2003
(%) indicates percent change from either existing condition or No-Action Alternative
Key:
Alt = alternative
cfs = cubic feet per second
CP = Comprehensive Plan
TAF = thousand acre-feet

Because of the interconnected nature of CVP and SWP operations for meeting shared Sacramento River flow requirements and Delta water quality obligations, changes in Shasta Reservoir operations could potentially affect operations of both Oroville Reservoir on the Feather River and Folsom Reservoir on the American River. For example, an increase in Shasta Reservoir releases may create opportunities for increased SWP export of releases from Oroville Reservoir by improving Delta water quality. An increase in releases from Oroville Reservoir would result in a decrease in storage. Tables 6-17 and 6-18 show simulated end-of-month storage at Oroville Reservoir and Feather River flow below the Thermalito Afterbay, respectively.

Similarly, an increase in Shasta Reservoir releases in a particular month may result in improved Delta water quality, allowing for a possible reduction in CVP releases from the American River, and a corresponding increase in Folsom Reservoir storage. Tables 6-19 and 6-20 show simulated end-of-month storage at Folsom Reservoir and on the American River near the H-Street Bridge, respectively.

Table 6-17. Simulated Average End-of-Month Oroville Reservoir Storage

Month	Existing Condition (2005)				Future Condition (2030)			
	Existing Condition (TAF)	Change from Base			No-Action Alt (TAF)	Change from Base		
		CP1 and CP4 (TAF)	CP2 (TAF)	CP3 and CP5 (TAF)		CP1 and CP4 (TAF)	CP2 (TAF)	CP3 and CP5 (TAF)
Oct	2,228	-47 (-2%)	-45 (-2%)	-46 (-2%)	2,095	-20 (-1%)	-23 (-1%)	-34 (-2%)
Nov	2,240	-43 (-2%)	-40 (-2%)	-40 (-2%)	2,121	-21 (-1%)	-25 (-1%)	-35 (-2%)
Dec	2,305	-41 (-2%)	-41 (-2%)	-43 (-2%)	2,216	-23 (-1%)	-26 (-1%)	-38 (-2%)
Jan	2,430	-34 (-1%)	-34 (-1%)	-35 (-1%)	2,362	-18 (-1%)	-21 (-1%)	-32 (-1%)
Feb	2,569	-28 (-1%)	-27 (-1%)	-29 (-1%)	2,514	-21 (-1%)	-21 (-1%)	-31 (-1%)
Mar	2,722	-23 (-1%)	-20 (-1%)	-23 (-1%)	2,686	-20 (-1%)	-21 (-1%)	-27 (-1%)
Apr	2,988	-22 (-1%)	-19 (-1%)	-22 (-1%)	2,953	-17 (-1%)	-20 (-1%)	-25 (-1%)
May	3,102	-23 (-1%)	-20 (-1%)	-22 (-1%)	3,068	-17 (-1%)	-18 (-1%)	-23 (-1%)
Jun	2,953	-26 (-1%)	-24 (-1%)	-26 (-1%)	2,898	-18 (-1%)	-18 (-1%)	-22 (-1%)
Jul	2,675	-36 (-1%)	-32 (-1%)	-33 (-1%)	2,565	-17 (-1%)	-18 (-1%)	-25 (-1%)
Aug	2,473	-46 (-2%)	-44 (-2%)	-45 (-2%)	2,329	-15 (-1%)	-14 (-1%)	-21 (-1%)
Sep	2,350	-48 (-2%)	-44 (-2%)	-45 (-2%)	2,196	-20 (-1%)	-21 (-1%)	-31 (-1%)

Source: Common Assumptions Common Modeling Package Version 8D CalSim-II 2005 and 2030 simulations (Node S8)

Note:

Simulation period: 1922-2003

Key:

Alt = alternative

CP = Comprehensive Plan

TAF = thousand acre-feet

Table 6-18. Simulated Monthly Average Feather River Flow Below the Thermalito Afterbay

Month	Existing Condition (2005)				Future Condition (2030)			
	Existing Condition (cfs)	Change from Base			No-Action Alt (cfs)	Change from Base		
		CP1 and CP4 (cfs)	CP2 (cfs)	CP3 and CP5 (cfs)		CP1 and CP4 (cfs)	CP2 (cfs)	CP3 and CP5 (cfs)
Oct	3,687	8 (0%)	18 (0%)	35 (1%)	3,444	17 (0%)	45 (1%)	52 (1%)
Nov	2,986	-82 (-3%)	-84 (-3%)	-106 (-4%)	2,738	14 (0%)	27 (1%)	23 (1%)
Dec	4,704	-20 (0%)	14 (0%)	36 (1%)	4,201	38 (1%)	21 (0%)	38 (1%)
Jan	5,974	-122 (-2%)	-123 (-2%)	-120 (-2%)	5,619	-81 (-1%)	-86 (-1%)	-94 (-2%)
Feb	6,857	-100 (-1%)	-118 (-2%)	-113 (-2%)	6,624	46 (1%)	6 (0%)	-14 (0%)
Mar	6,917	-88 (-1%)	-116 (-2%)	-104 (-1%)	6,560	-10 (0%)	22 (0%)	-53 (-1%)
Apr	3,235	-21 (-1%)	-21 (-1%)	-13 (0%)	3,197	-47 (-1%)	-23 (-1%)	-29 (-1%)
May	4,018	14 (0%)	15 (0%)	2 (0%)	4,006	-8 (0%)	-23 (-1%)	-24 (-1%)
Jun	4,329	50 (1%)	62 (1%)	65 (1%)	4,727	15 (0%)	-4 (0%)	-19 (0%)
Jul	4,352	165 (4%)	138 (3%)	111 (3%)	5,310	0 (0%)	-7 (0%)	50 (1%)
Aug	3,338	171 (5%)	190 (6%)	190 (6%)	3,953	-30 (-1%)	-59 (-2%)	-71 (-2%)
Sep	2,381	27 (1%)	17 (1%)	3 (0%)	2,505	72 (3%)	124 (5%)	180 (8%)
Total (TAF)	3,179	1 (0%)	0 (0%)	0 (0%)	3,186	1 (0%)	2 (0%)	2 (0%)

Source: Common Assumptions Common Modeling Package Version 8D CalSim-II 2005 and 2030 simulations (Node C203)

Notes:
Simulation period: 1922-2003
(%) indicates percent change from either existing condition or No-Action Alternative
Key:
Alt = alternative
cfs = cubic feet per second
CP = Comprehensive Plan
TAF = thousand acre-feet

Table 6-19. Simulated Average End-of-Month Folsom Reservoir Storage

Month	Existing Condition (2005)				Future Condition (2030)			
	Existing Condition (TAF)	Change from Base			No-Action Alt (TAF)	Change from Base		
		CP1 and CP4 (TAF)	CP2 (TAF)	CP3 and CP5 (TAF)		CP1 and CP4 (TAF)	CP2 (TAF)	CP3 and CP5 (TAF)
Oct	514	5 (1%)	12 (2%)	14 (3%)	491	7 (1%)	11 (2%)	13 (2%)
Nov	475	3 (1%)	9 (2%)	12 (3%)	459	7 (1%)	11 (2%)	12 (3%)
Dec	482	1 (0%)	5 (1%)	6 (1%)	468	5 (1%)	7 (1%)	8 (2%)
Jan	494	1 (0%)	4 (1%)	4 (1%)	488	2 (0%)	3 (1%)	5 (1%)
Feb	506	5 (1%)	5 (1%)	6 (1%)	503	4 (1%)	5 (1%)	7 (1%)
Mar	607	3 (0%)	6 (1%)	7 (1%)	604	4 (1%)	5 (1%)	7 (1%)
Apr	725	4 (1%)	6 (1%)	8 (1%)	717	3 (0%)	4 (0%)	5 (1%)
May	834	4 (1%)	7 (1%)	9 (1%)	823	3 (0%)	5 (1%)	6 (1%)
Jun	797	6 (1%)	10 (1%)	13 (2%)	784	6 (1%)	9 (1%)	11 (1%)
Jul	689	2 (0%)	8 (1%)	11 (2%)	657	9 (1%)	13 (2%)	9 (1%)
Aug	623	4 (1%)	11 (2%)	14 (2%)	584	10 (2%)	14 (2%)	14 (2%)
Sep	549	4 (1%)	9 (2%)	13 (2%)	523	6 (1%)	11 (2%)	12 (2%)

Source: Common Assumptions Common Modeling Package Version 8D CalSim-II 2005 and 2030 simulations (Node S6)

Note:
Simulation period: 1922-2003
Key:
Alt = alternative
CP = Comprehensive Plan
TAF = thousand acre-feet

Table 6-20. Simulated Monthly Average American River Flow Near the H Street Bridge

Month	Existing Condition (2005)				Future Condition (2030)			
	Existing Condition (cfs)	Change from Base			No-Action Alt (cfs)	Change from Base		
		CP1 and CP4 (cfs)	CP2 (cfs)	CP3 and CP5 (cfs)		CP1 and CP4 (cfs)	CP2 (cfs)	CP3 and CP5 (cfs)
Oct	1,745	-20 (-1%)	-42 (-2%)	-26 (-2%)	1,534	-10 (-1%)	-12 (-1%)	-19 (-1%)
Nov	2,682	33 (1%)	40 (1%)	36 (1%)	2,457	5 (0%)	12 (0%)	13 (0%)
Dec	3,379	33 (1%)	70 (2%)	95 (3%)	3,237	32 (1%)	57 (2%)	67 (2%)
Jan	4,465	10 (0%)	21 (0%)	33 (1%)	4,232	45 (1%)	70 (2%)	46 (1%)
Feb	5,222	-70 (-1%)	-29 (-1%)	-40 (-1%)	5,046	-41 (-1%)	-38 (-1%)	-34 (-1%)
Mar	3,751	32 (1%)	-2 (0%)	-6 (0%)	3,645	1 (0%)	-4 (0%)	-7 (0%)
Apr	3,359	-22 (-1%)	-15 (0%)	-17 (-1%)	3,188	16 (0%)	20 (1%)	24 (1%)
May	3,672	-7 (0%)	-18 (0%)	-17 (0%)	3,389	-3 (0%)	-22 (-1%)	-18 (-1%)
Jun	3,693	-29 (-1%)	-49 (-1%)	-78 (-2%)	3,318	-58 (-2%)	-74 (-2%)	-78 (-2%)
Jul	3,151	67 (2%)	30 (1%)	33 (1%)	3,012	-50 (-2%)	-60 (-2%)	25 (1%)
Aug	2,246	-44 (-2%)	-36 (-2%)	-43 (-2%)	1,981	-9 (0%)	-37 (-2%)	-85 (-4%)
Sep	2,497	6 (0%)	22 (1%)	14 (1%)	2,005	55 (2%)	57 (2%)	27 (1%)
Total (TAF)	1,745	-20 (-1%)	-42 (-2%)	-26 (-1.5%)	1,534	-10 (-1%)	-12 (-1%)	-19 (-1%)

Source: Common Assumptions Common Modeling Package Version 8D CalSim-II 2005 and 2030 simulations (Node C302)

Notes:
Simulation period: 1922-2003
(%) indicates percent change from either existing condition or No-Action Alternative
Key:
Alt = alternative
cfs = cubic feet per second
CP = Comprehensive Plan
TAF = thousand acre-feet

The Delta is the confluence of the Sacramento, San Joaquin, Cosumnes, Calaveras, and Mokelumne rivers in addition to several other smaller streams and creeks. As the "central hub" of California's water supplies, minor changes in operations in one region could result in other minor changes throughout the system. As previously described, changes in operations associated with the SLWRI alternatives could possibly result in minor changes in operations to other CVP and SWP facilities. While New Melones Reservoir on the Stanislaus River is operated by the CVP to meet water quality requirements in the South Delta and lower San Joaquin River, and could potentially be affected by changes in Sacramento River flow or Delta exports, simulations indicate the SLWRI alternatives would not result in any changes to New Melones operations. (See Attachment A of the *Hydrology, Hydraulics, and Water Management Technical Report*, for details about New Melones Reservoir and Stanislaus River operations.)

Besides potentially changing exports to south-of-Delta water users, changes in Delta inflow could also be reflected in changes in Delta outflow. Changes in Sacramento River flow, as shown above in Table 6-16, are typically reflected as a combination of Delta outflow and export. Table 6-21 shows changes in Delta outflow associated with each alternative.

Table 6-21. Simulated Monthly Average Change in Delta Outflow

Month	Existing Condition (2005)				Future Condition (2030)			
	Existing Condition (cfs)	Change from Base			No-Action Alt (cfs)	Change from Base		
		CP1 and CP4 (cfs)	CP2 (cfs)	CP3 and CP5 (cfs)		CP1 and CP4 (cfs)	CP2 (cfs)	CP3 and CP5 (cfs)
Oct	5,313	-25 (0%)	-29 (-1%)	-38 (-1%)	5,016	-16 (0%)	0 (0%)	7 (0%)
Nov	9,688	-150 (-2%)	-160 (-2%)	-137 (-1%)	9,258	-82 (-1%)	-89 (-1%)	-104 (-1%)
Dec	22,933	-197 (-1%)	-263 (-1%)	-352 (-2%)	22,291	-109 (0%)	-286 (-1%)	-433 (-2%)
Jan	40,954	-299 (-1%)	-320 (-1%)	-363 (-1%)	40,173	-210 (-1%)	-192 (0%)	-283 (-1%)
Feb	52,699	-531 (-1%)	-537 (-1%)	-713 (-1%)	52,325	-95 (0%)	-341 (-1%)	-455 (-1%)
Mar	42,610	-149 (0%)	-202 (0%)	-188 (0%)	42,084	-98 (0%)	-90 (0%)	-167 (0%)
Apr	27,104	-43 (0%)	-32 (0%)	-9 (0%)	27,086	-53 (0%)	-48 (0%)	-39 (0%)
May	20,470	-40 (0%)	-56 (0%)	-43 (0%)	20,307	-94 (0%)	-124 (-1%)	-123 (-1%)
Jun	13,104	-8 (0%)	-41 (0%)	-46 (0%)	13,117	-59 (0%)	-47 (0%)	-67 (-1%)
Jul	7,927	43 (1%)	29 (0%)	42 (1%)	8,262	33 (0%)	47 (1%)	50 (1%)
Aug	4,501	37 (1%)	47 (1%)	48 (1%)	4,473	-7 (0%)	2 (0%)	10 (0%)
Sep	5,595	-19 (0%)	-29 (-1%)	-42 (-1%)	5,259	18 (0%)	11 (0%)	2 (0%)
Total (TAF)	15,127	-81 (-1%)	-94 (-1%)	-109 (-1%)	14,931	-47 (0%)	-69 (0%)	-95 (-1%)

Source: Common Assumptions Common Modeling Package Version 8D CalSim-II 2005 and 2030 simulations (Node C406)

Notes:

Simulation period: 1922-2003

(%) indicates percent change from either existing condition or No-Action Alternative

Key:

Alt = alternative

cfs = cubic feet per second

CP = Comprehensive Plan

TAF = thousand acre-feet

The CVP and SWP divert water via the Jones Pumping Plant and the Banks Pumping Plant, respectively. The increased water supply made available from the SLWRI alternatives would typically be moved through the Jones Pumping Plant; however, under each of the bases of comparison, capacity at Jones is often fully used in the wetter years, leaving little ability to export available water. Accordingly, while unmet CVP demand south of the Delta may exist in some relatively wet years, conveyance restrictions would limit opportunities to export available water in those years. In drier years, however, typically capacity is available for increased exports through the Jones Pumping Plant. Thus, there are greater increases in average annual pumping volumes in those years. Table 6-22 shows the average annual exports through Jones Pumping Plant.

Table 6-22. Simulated Monthly Average Exports Through Jones Pumping Plant

Month	Existing Condition (2005)				Future Condition (2030)			
	Existing Condition (cfs)	Change from Base			No-Action Alt (cfs)	Change from Base		
		CP1 and CP4 (cfs)	CP2 (cfs)	CP3 and CP5 (cfs)		CP1 and CP4 (cfs)	CP2 (cfs)	CP3 and CP5 (cfs)
Oct	4,084	0 (0%)	-17 (0%)	7 (0%)	4,032	5 (0%)	21 (1%)	42 (1%)
Nov	4,019	4 (0%)	14 (0%)	18 (0%)	4,196	23 (1%)	26 (1%)	22 (1%)
Dec	3,922	12 (0%)	17 (0%)	15 (0%)	4,172	4 (0%)	28 (1%)	85 (2%)
Jan	4,034	25 (1%)	27 (1%)	9 (0%)	4,192	-28 (-1%)	-6 (0%)	26 (1%)
Feb	3,705	68 (2%)	56 (2%)	43 (1%)	3,461	21 (1%)	91 (2%)	147 (4%)
Mar	3,147	83 (3%)	42 (1%)	14 (0%)	2,682	40 (1%)	-2 (0%)	14 (0%)
Apr	2,126	-8 (0%)	-8 (0%)	-7 (0%)	2,093	10 (0%)	12 (1%)	-6 (0%)
May	1,857	5 (0%)	9 (1%)	7 (0%)	1,879	17 (1%)	21 (1%)	4 (0%)
Jun	2,536	11 (0%)	37 (1%)	43 (2%)	2,469	-16 (-1%)	16 (1%)	38 (1%)
Jul	3,264	139 (4%)	155 (5%)	190 (6%)	3,572	56 (2%)	102 (3%)	170 (5%)
Aug	3,709	50 (1%)	76 (2%)	112 (3%)	3,589	21 (1%)	68 (2%)	153 (4%)
Sep	4,021	-7 (0%)	6 (0%)	19 (0%)	4,155	39 (1%)	62 (2%)	45 (1%)
Total (TAF)	2,438	23 (1%)	25 (1%)	28 (1%)	2,444	12 (0%)	26 (1%)	44 (2%)

Source: Common Assumptions Common Modeling Package Version 8D CalSim-II 2005 and 2030 simulations (Node D418)

Notes:

Simulation period: 1922-2003

(%) indicates percent change from either existing condition or No-Action Alternative

Key:

Alt = alternative

cfs = cubic feet per second

CP = Comprehensive Plan

TAF = thousand acre-feet

Table 6-23 shows the Sacramento Valley Index (SVI) dry and critical year exports through Jones Pumping Plant. As would be expected, the increased available capacity at Jones results in larger increases in exports.

Table 6-23. Simulated Monthly Average Exports Through Jones Pumping Plant in Dry and Critical Years

Month	Existing Condition (2005)				Future Condition (2030)			
	Existing Condition (cfs)	Change from Base			No-Action Alt (cfs)	Change from Base		
		CP1 and CP4 (cfs)	CP2 (cfs)	CP3 and CP5 (cfs)		CP1 and CP4 (cfs)	CP2 (cfs)	CP3 and CP5 (cfs)
Oct	3,932	15 (0%)	-3 (0%)	7 (0%)	3,874	20 (1%)	36 (1%)	49 (1%)
Nov	3,773	22 (1%)	54 (1%)	61 (2%)	3,884	39 (1%)	75 (2%)	70 (2%)
Dec	3,699	14 (0%)	19 (1%)	13 (0%)	3,887	-4 (0%)	31 (1%)	173 (5%)
Jan	3,866	38 (1%)	45 (1%)	29 (1%)	4,025	-30 (-1%)	14 (0%)	106 (3%)
Feb	3,265	129 (4%)	98 (3%)	117 (4%)	3,079	49 (1%)	199 (6%)	329 (10%)
Mar	2,809	76 (3%)	63 (2%)	44 (2%)	2,474	55 (2%)	10 (0%)	91 (3%)
Apr	1,526	4 (0%)	9 (1%)	24 (2%)	1,521	8 (1%)	13 (1%)	-18 (-1%)
May	1,429	13 (1%)	24 (2%)	21 (1%)	1,446	22 (2%)	33 (2%)	-13 (-1%)
Jun	2,015	31 (2%)	87 (4%)	103 (5%)	1,799	15 (1%)	68 (3%)	96 (5%)
Jul	2,280	268 (12%)	327 (14%)	417 (18%)	2,942	138 (6%)	218 (10%)	309 (14%)
Aug	2,428	161 (7%)	218 (9%)	279 (11%)	2,062	51 (2%)	184 (8%)	399 (16%)
Sep	3,277	-15 (0%)	30 (1%)	63 (2%)	3,482	104 (3%)	153 (5%)	108 (3%)
Total (TAF)	2,069	45 (2%)	59 (3%)	71 (3%)	2,080	28 (1%)	62 (3%)	102 (5%)

Source: Common Assumptions Common Modeling Package Version 8D CalSim-II 2005 and 2030 simulations (Node D418)

Notes:

Simulation period: 1922-2003

Dry and critical years as defined by the Sacramento Valley Index

(%) indicates percent change from either existing condition or No-Action Alternative

Key:

Alt = alternative

cfs = cubic feet per second

CP = Comprehensive Plan

TAF = thousand acre-feet

Recipients of exports through the Jones Pumping Plant include San Joaquin Valley Exchange Contractors, Federal wildlife refuges, and water service contractors. Since the Exchange Contractors have substantially higher levels of reliability of delivery compared to the refuges and water service contractors, their deliveries will not change under any of the SLWRI alternatives. Deliveries to the refuges and water service contractors would increase with an enlargement of Shasta Dam. Table 6-24 shows monthly average deliveries to the CVP south-of-Delta refuges and water service contractors.

Table 6-24. Simulated Monthly Average Deliveries to South-of-Delta CVP Water Service Contractors and Refuges

Month	Existing Condition (2005)				Future Condition (2030)			
	Existing Condition (cfs)	Change from Base			No-Action Alt (cfs)	Change from Base		
		CP1 and CP4 (cfs)	CP2 (cfs)	CP3 and CP5 (cfs)		CP1 and CP4 (cfs)	CP2 (cfs)	CP3 and CP5 (cfs)
Oct	1,694	11 (1%)	11 (1%)	13 (1%)	1,631	3 (0%)	12 (1%)	20 (1%)
Nov	1,157	8 (1%)	9 (1%)	10 (1%)	1,116	5 (0%)	11 (1%)	15 (1%)
Dec	925	11 (1%)	12 (1%)	14 (1%)	916	7 (1%)	15 (2%)	21 (2%)
Jan	1,178	19 (2%)	21 (2%)	24 (2%)	1,208	12 (1%)	26 (2%)	37 (3%)
Feb	1,434	25 (2%)	27 (2%)	31 (2%)	1,478	16 (1%)	33 (2%)	47 (3%)
Mar	853	25 (3%)	28 (3%)	38 (4%)	906	9 (1%)	27 (3%)	45 (5%)
Apr	1,376	26 (2%)	31 (2%)	31 (2%)	1,428	19 (1%)	33 (2%)	45 (3%)
May	2,307	38 (2%)	40 (2%)	46 (2%)	2,344	25 (1%)	50 (2%)	70 (3%)
Jun	3,587	62 (2%)	67 (2%)	77 (2%)	3,674	42 (1%)	83 (2%)	116 (3%)
Jul	3,838	75 (2%)	81 (2%)	92 (2%)	3,980	51 (1%)	100 (3%)	140 (4%)
Aug	2,897	54 (2%)	59 (2%)	67 (2%)	2,987	7 (0%)	50 (2%)	78 (3%)
Sep	1,780	18 (1%)	19 (1%)	22 (1%)	1,743	12 (1%)	24 (1%)	34 (2%)
Total (TAF)	1,392	22 (2%)	24 (2%)	28 (2%)	1,415	13 (1%)	28 (2%)	40 (3%)

Source: Common Assumptions Common Modeling Package Version 8D CalSim-II 2005 and 2030 simulations (Nodes DEL_CVP_PAG_S and DEL_CVP_PRF_S)

Notes:

Simulation period: 1922-2003

(%) indicates percent change from either existing condition or No-Action Alternative

Key:

Alt = alternative

cfs = cubic feet per second

CVP = Central Valley Project

CP = Comprehensive Plan

TAF = thousand acre-feet

As would be expected, while there are some increases in deliveries when all years are averaged, the increases in deliveries in SVI dry and critical years are much greater, as shown in Table 6-25. This is primarily due to several factors, including increased available capacity at the Jones Pumping Plant in dry and critical years, and because of the CVP shortage policies, there is a substantially increased demand in dry and critical years. None of the SLWRI alternatives will provide a noticeable change in deliveries in relatively wet years because contractors are typically already receiving their full contract amount in those years.

Table 6-25. Simulated Monthly Average Deliveries to South-of-Delta CVP Water Service Contractors and Refuges in Dry and Critical Years

Month	Existing Condition (2005)				Future Condition (2030)			
	Existing Condition (cfs)	Change from Base			No-Action Alt (cfs)	Change from Base		
		CP1 and CP4 (cfs)	CP2 (cfs)	CP3 and CP5 (cfs)		CP1 and CP4 (cfs)	CP2 (cfs)	CP3 and CP5 (cfs)
Oct	1,551	16 (1%)	19 (1%)	25 (2%)	1,488	8 (1%)	18 (1%)	26 (2%)
Nov	1,051	12 (1%)	15 (1%)	19 (2%)	1,010	6 (1%)	13 (1%)	19 (2%)
Dec	788	17 (2%)	20 (3%)	26 (3%)	780	8 (1%)	18 (2%)	27 (3%)
Jan	946	29 (3%)	35 (4%)	45 (5%)	974	14 (1%)	32 (3%)	47 (5%)
Feb	1,134	37 (3%)	45 (4%)	59 (5%)	1,176	19 (2%)	42 (4%)	61 (5%)
Mar	500	47 (9%)	59 (12%)	68 (14%)	502	33 (7%)	56 (11%)	78 (16%)
Apr	945	45 (5%)	54 (6%)	52 (6%)	943	43 (5%)	66 (7%)	94 (10%)
May	1,529	70 (5%)	82 (5%)	90 (6%)	1,512	60 (4%)	101 (7%)	147 (10%)
Jun	2,307	116 (5%)	137 (6%)	150 (7%)	2,302	100 (4%)	167 (7%)	245 (11%)
Jul	2,323	139 (6%)	164 (7%)	180 (8%)	2,353	120 (5%)	201 (9%)	294 (13%)
Aug	1,792	102 (6%)	120 (7%)	131 (7%)	1,806	80 (4%)	146 (8%)	213 (12%)
Sep	1,373	33 (2%)	40 (3%)	43 (3%)	1,314	29 (2%)	48 (4%)	71 (5%)
Total (TAF)	980	40 (4%)	48 (5%)	54 (5%)	976	31 (3%)	55 (6%)	80 (8%)

Source: Common Assumptions Common Modeling Package Version 8D CalSim-II 2005 and 2030 simulations (Nodes DEL_CVP_PAG_S and DEL_CVP_PRF_S)

Notes: Simulation period: 1922-2003

Dry and critical years as defined by the Sacramento Valley Index

(%) indicates percent change from either existing condition or No-Action Alternative

Key:

Alt = alternative

cfs = cubic feet per second

CP = comprehensive plan

CVP = Central Valley Project

TAF = thousand acre-feet

When evaluating project effects on water supply reliability, CVP south-of-Delta allocations are a valuable indicator of benefits resulting from each alternative. Tables 6-26 and 6-27 show the simulated annual allocations to south-of-Delta agricultural and M&I refuges and water service contractors for the existing condition and the No-Action Alternative, and the simulated change in allocation for each of the SLWRI alternatives. Simulated allocations are calculated by dividing annual deliveries of each contract type by the demand. The contract period for CVP allocations is assumed to be March through February; the assumed simulated demand for each contract type is as follows:

- **Agricultural water service contractors** – 1,987.2 TAF/year (both 2005 and 2030 level of development).

- **M&I water service contractors** – 164.2 TAF/year (both 2005 and 2030 level of development).

- **Federal refuges** – 304.6 TAF/year (2005 level of development)/281.1 TAF/year (2030 level of development).

Tables 6-26 and 6-27 show that while allocations would typically increase, there could also be years with small decreases in allocations. Simulations of CP2 with a 2030 level of development indicate an average decrease in allocations; however, as indicated in Table 6-24, there would be an average annual increase in deliveries. This apparent contradiction is likely due to differences in averaging methodology for the two tables. More important than the average annual change in allocation is the increase in allocation in years with low allocations under either the existing condition or No-Action Alternative, such as in 1928, 1944, and 1976. Some decreases in allocations would occur in years in the latter parts of prolonged droughts. This is likely due to changes in CalSim-II north-of-Delta reservoir storage–water supply relationships.

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Table 6-26. Simulated Annual Delivery Allocations to South-of-Delta CVP Water Service Contractors and Refuges for a 2005 Level of Development

Year	Existing Conditions (2005)			Change from Existing Conditions								
				Alt CP1 and CP4 (2005)			Alt CP2 (2005)			Alt CP3 and CP5 (2005)		
	Ag	Refuges	M&I	Ag	Refuges	M&I	Ag	Refuges	M&I	Ag	Refuges	M&I
1922	73%	100%	89%	0%	0%	0%	0%	0%	0%	0%	0%	0%
1923	64%	100%	83%	4%	0%	0%	1%	0%	0%	1%	0%	0%
1924	3%	75%	48%	0%	0%	0%	0%	0%	0%	0%	0%	0%
1925	45%	100%	67%	-1%	0%	0%	0%	0%	0%	0%	0%	0%
1926	25%	100%	67%	-4%	0%	0%	-1%	0%	0%	-1%	0%	0%
1927	68%	100%	87%	0%	0%	0%	0%	0%	0%	0%	0%	0%
1928	65%	100%	83%	0%	0%	0%	0%	0%	0%	0%	0%	0%
1929	21%	100%	65%	-6%	0%	0%	-2%	0%	0%	-2%	0%	0%
1930	33%	100%	67%	-2%	0%	0%	-1%	0%	0%	-1%	0%	0%
1931	6%	75%	51%	0%	0%	0%	0%	0%	0%	0%	0%	0%
1932	11%	75%	55%	9%	0%	0%	7%	0%	0%	7%	0%	0%
1933	4%	75%	49%	0%	0%	0%	0%	0%	0%	0%	0%	0%
1934	10%	75%	55%	9%	0%	0%	6%	0%	0%	6%	0%	0%
1935	34%	100%	65%	0%	0%	0%	1%	0%	0%	1%	0%	0%
1936	52%	100%	71%	8%	0%	0%	3%	0%	0%	3%	0%	0%
1937	38%	100%	67%	3%	0%	0%	4%	0%	0%	4%	0%	0%
1938	94%	100%	90%	0%	0%	0%	0%	0%	0%	0%	0%	0%
1939	56%	100%	75%	-3%	0%	0%	-5%	0%	0%	-5%	0%	0%
1940	52%	100%	72%	-1%	0%	0%	-1%	0%	0%	-1%	0%	0%
1941	74%	100%	88%	0%	0%	0%	0%	0%	0%	0%	0%	0%
1942	70%	100%	89%	0%	0%	0%	0%	0%	0%	0%	0%	0%
1943	81%	100%	90%	0%	0%	0%	0%	0%	0%	0%	0%	0%
1944	51%	100%	71%	-2%	0%	0%	0%	0%	0%	0%	0%	0%
1945	66%	100%	84%	0%	0%	0%	0%	0%	0%	0%	0%	0%
1946	59%	100%	78%	-1%	0%	0%	0%	0%	0%	0%	0%	0%
1947	59%	100%	78%	-4%	0%	0%	-4%	0%	0%	-4%	0%	0%
1948	50%	100%	70%	0%	0%	0%	0%	0%	0%	0%	0%	0%
1949	57%	100%	77%	1%	0%	0%	-2%	0%	0%	-2%	0%	0%
1950	51%	100%	71%	-5%	0%	0%	-4%	0%	0%	-4%	0%	0%
1951	67%	100%	85%	0%	0%	0%	0%	0%	0%	0%	0%	0%
1952	92%	100%	90%	0%	0%	0%	0%	0%	0%	0%	0%	0%
1953	60%	100%	79%	0%	0%	0%	0%	0%	0%	0%	0%	0%
1954	63%	100%	82%	0%	0%	0%	0%	0%	0%	0%	0%	0%
1955	46%	100%	68%	-2%	0%	0%	0%	0%	0%	0%	0%	0%
1956	65%	100%	84%	0%	0%	0%	0%	0%	0%	0%	0%	0%
1957	70%	100%	88%	0%	0%	0%	0%	0%	0%	0%	0%	0%
1958	91%	100%	88%	0%	0%	0%	0%	0%	0%	0%	0%	0%
1959	55%	100%	74%	0%	0%	0%	0%	0%	0%	0%	0%	0%
1960	33%	100%	67%	-4%	0%	0%	-2%	0%	0%	-2%	0%	0%
1961	49%	100%	69%	3%	0%	0%	2%	0%	0%	2%	0%	0%
1962	61%	100%	79%	-1%	0%	0%	-1%	0%	0%	-1%	0%	0%
1963	67%	100%	85%	0%	0%	0%	0%	0%	0%	0%	0%	0%
1964	46%	100%	68%	0%	0%	0%	0%	0%	0%	0%	0%	0%
1965	63%	100%	82%	0%	0%	0%	0%	0%	0%	0%	0%	0%
1966	63%	100%	82%	0%	0%	0%	0%	0%	0%	0%	0%	0%
1967	93%	100%	90%	0%	0%	0%	0%	0%	0%	0%	0%	0%
1968	67%	100%	86%	0%	0%	0%	0%	0%	0%	0%	0%	0%
1969	94%	100%	90%	0%	0%	0%	0%	0%	0%	0%	0%	0%
1970	67%	100%	84%	0%	0%	0%	0%	0%	0%	0%	0%	0%
1971	54%	100%	73%	0%	0%	0%	0%	0%	0%	0%	0%	0%
1972	60%	100%	79%	0%	0%	0%	0%	0%	0%	0%	0%	0%
1973	58%	100%	77%	0%	0%	0%	0%	0%	0%	0%	0%	0%
1974	74%	100%	89%	0%	0%	0%	0%	0%	0%	0%	0%	0%
1975	59%	100%	78%	0%	0%	0%	0%	0%	0%	0%	0%	0%
1976	31%	100%	67%	-7%	0%	0%	-5%	0%	0%	-5%	0%	0%
1977	6%	75%	51%	0%	0%	0%	0%	0%	0%	0%	0%	0%
1978	91%	100%	90%	0%	0%	0%	-1%	0%	0%	-1%	0%	0%
1979	58%	100%	77%	0%	0%	0%	0%	0%	0%	0%	0%	0%
1980	79%	100%	90%	0%	0%	0%	0%	0%	0%	0%	0%	0%
1981	67%	100%	85%	0%	0%	0%	0%	0%	0%	0%	0%	0%
1982	92%	100%	90%	0%	0%	0%	0%	0%	0%	0%	0%	0%
1983	95%	100%	90%	0%	0%	0%	0%	0%	0%	0%	0%	0%
1984	62%	100%	82%	0%	0%	0%	0%	0%	0%	0%	0%	0%
1985	62%	100%	81%	0%	0%	0%	0%	0%	0%	0%	0%	0%
1986	86%	100%	90%	-10%	0%	0%	-8%	0%	0%	-8%	0%	0%
1987	53%	100%	73%	1%	0%	0%	-2%	0%	0%	-2%	0%	0%
1988	18%	100%	62%	-11%	0%	0%	-1%	0%	0%	-1%	0%	0%
1989	34%	100%	65%	1%	0%	0%	0%	0%	0%	0%	0%	0%
1990	0%	100%	45%	0%	0%	0%	0%	0%	0%	0%	0%	0%
1991	13%	75%	58%	1%	0%	0%	0%	0%	0%	0%	0%	0%
1992	41%	75%	67%	1%	0%	0%	5%	0%	0%	5%	0%	0%
1993	56%	100%	75%	0%	0%	0%	-1%	0%	0%	-1%	0%	0%
1994	66%	75%	85%	2%	0%	0%	2%	0%	0%	2%	0%	0%
1995	94%	100%	90%	0%	0%	0%	0%	0%	0%	0%	0%	0%
1996	73%	100%	89%	0%	0%	0%	0%	0%	0%	0%	0%	0%
1997	62%	100%	81%	0%	0%	0%	0%	0%	0%	0%	0%	0%
1998	95%	100%	90%	0%	0%	0%	0%	0%	0%	0%	0%	0%
1999	64%	100%	83%	0%	0%	0%	0%	0%	0%	0%	0%	0%
2000	67%	100%	86%	0%	0%	0%	0%	0%	0%	0%	0%	0%
2001	53%	100%	73%	-3%	0%	0%	-3%	0%	0%	-3%	0%	0%
2002	62%	100%	81%	0%	0%	0%	0%	0%	0%	0%	0%	0%
2003	46%	50%	49%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Avg	56%	97%	76%	0%	0%	0%	0%	0%	0%	0%	0%	0%

Source: Common Assumptions Common Modeling Package Version 8D CalSim-II 2005 simulations (Nodes DEL_ CVP_PAG_S, DEL_CVP_PRF_S, and DEL_CVP_PMI_S for delivery information, and CACMP Delivery Specifications for demand information)

Notes:

Simulation period: 1922-2003

(%) indicates change from either existing condition or No-Action Alternative

Key:

Ag = Agricultural Water Service Contractor

Alt = alternative

Avg = average

M&I = Municipal and Industrial contractor

Refuge = Level 2 Federal Refuge

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Table 6-27. Simulated Annual Delivery Allocations to South-of-Delta CVP Water Service Contractors and Refuges for a 2030 Level of Development

Year	No-Action/ No Project Alternative (2030)			Change from No-Action/ No Project Alternative								
				Alt CP1 and CP4 (2030)			Alt CP2 (2030)			Alt CP3 and CP5 (2030)		
	Ag	Refuges	M&I	Ag	Refuges	M&I	Ag	Refuges	M&I	Ag	Refuges	M&I
1922	78%	100%	90%	0%	0%	0%	0%	0%	0%	0%	0%	0%
1923	61%	100%	80%	-1%	0%	-1%	9%	0%	8%	-2%	0%	-2%
1924	3%	75%	48%	0%	0%	0%	0%	0%	0%	0%	0%	0%
1925	46%	100%	68%	1%	0%	0%	-4%	0%	0%	-2%	0%	0%
1926	26%	100%	67%	-1%	0%	0%	-5%	0%	-2%	0%	0%	0%
1927	68%	100%	87%	0%	0%	0%	0%	0%	0%	0%	0%	0%
1928	62%	100%	81%	9%	0%	6%	2%	0%	2%	14%	0%	6%
1929	17%	100%	61%	-4%	0%	-4%	-5%	0%	-5%	0%	0%	0%
1930	30%	100%	67%	0%	0%	0%	-1%	0%	0%	-1%	0%	0%
1931	5%	75%	49%	0%	0%	0%	0%	0%	0%	0%	0%	0%
1932	15%	75%	59%	-2%	0%	-2%	-2%	0%	-2%	0%	0%	0%
1933	3%	75%	48%	0%	0%	0%	0%	0%	0%	0%	0%	0%
1934	11%	75%	55%	-2%	0%	-2%	-1%	0%	-1%	-1%	0%	-1%
1935	30%	100%	64%	0%	0%	0%	0%	0%	0%	-2%	0%	0%
1936	46%	100%	67%	1%	0%	0%	2%	0%	1%	-1%	0%	0%
1937	33%	100%	67%	0%	0%	0%	1%	0%	0%	-1%	0%	0%
1938	95%	100%	90%	0%	0%	0%	0%	0%	0%	0%	0%	0%
1939	51%	100%	71%	8%	0%	7%	-9%	0%	-3%	15%	0%	14%
1940	59%	100%	78%	-3%	0%	-3%	7%	0%	5%	-4%	0%	-4%
1941	79%	100%	89%	0%	0%	0%	0%	0%	0%	0%	0%	0%
1942	75%	100%	90%	0%	0%	0%	0%	0%	0%	0%	0%	0%
1943	86%	100%	90%	0%	0%	0%	0%	0%	0%	0%	0%	0%
1944	48%	100%	68%	4%	0%	4%	-5%	0%	-1%	10%	0%	9%
1945	68%	100%	86%	2%	0%	2%	2%	0%	2%	2%	0%	2%
1946	62%	100%	81%	1%	0%	1%	-2%	0%	-1%	1%	0%	1%
1947	46%	100%	67%	3%	0%	2%	-4%	0%	0%	6%	0%	4%
1948	64%	100%	83%	-1%	0%	-1%	-3%	0%	-3%	-2%	0%	-1%
1949	62%	100%	82%	0%	0%	0%	5%	0%	4%	0%	0%	0%
1950	40%	100%	67%	3%	0%	0%	-3%	0%	0%	3%	0%	0%
1951	71%	100%	89%	0%	0%	0%	0%	0%	0%	0%	0%	0%
1952	94%	99%	90%	0%	0%	0%	0%	0%	0%	0%	0%	0%
1953	66%	100%	85%	0%	0%	0%	0%	0%	0%	0%	0%	0%
1954	68%	100%	87%	0%	0%	0%	0%	0%	0%	0%	0%	0%
1955	43%	100%	67%	4%	0%	0%	-4%	0%	0%	11%	0%	6%
1956	70%	100%	89%	0%	0%	0%	0%	0%	0%	0%	0%	0%
1957	72%	100%	89%	0%	0%	0%	0%	0%	0%	0%	0%	0%
1958	92%	100%	90%	0%	0%	0%	0%	0%	0%	0%	0%	0%
1959	66%	100%	85%	0%	0%	0%	0%	0%	0%	0%	0%	0%
1960	27%	100%	67%	2%	0%	0%	-2%	0%	-1%	2%	0%	1%
1961	61%	100%	80%	3%	0%	2%	-4%	0%	-3%	1%	0%	1%
1962	63%	100%	82%	0%	0%	0%	0%	0%	0%	0%	0%	0%
1963	73%	100%	89%	0%	0%	0%	0%	0%	0%	0%	0%	0%
1964	45%	100%	67%	7%	0%	5%	-3%	0%	0%	13%	0%	10%
1965	72%	100%	87%	0%	0%	2%	-5%	0%	-2%	0%	0%	2%
1966	68%	100%	86%	0%	0%	0%	0%	0%	0%	0%	0%	0%
1967	94%	100%	90%	0%	0%	0%	0%	0%	0%	0%	0%	0%
1968	67%	100%	86%	0%	0%	0%	0%	0%	0%	0%	0%	0%
1969	95%	100%	90%	0%	0%	0%	0%	0%	0%	0%	0%	0%
1970	68%	100%	87%	1%	0%	1%	-2%	0%	-2%	1%	0%	1%
1971	65%	100%	84%	0%	0%	0%	0%	0%	0%	0%	0%	0%
1972	62%	100%	82%	2%	0%	1%	2%	0%	1%	2%	0%	1%
1973	69%	100%	87%	0%	0%	0%	0%	0%	0%	0%	0%	0%
1974	79%	100%	90%	0%	0%	0%	0%	0%	0%	0%	0%	0%
1975	68%	100%	86%	0%	0%	0%	0%	0%	0%	0%	0%	0%
1976	18%	100%	62%	8%	0%	5%	3%	0%	2%	11%	0%	5%
1977	6%	73%	50%	0%	2%	1%	0%	2%	1%	0%	2%	1%
1978	92%	100%	89%	1%	0%	1%	1%	0%	1%	1%	0%	1%
1979	69%	100%	87%	3%	0%	2%	0%	0%	0%	4%	0%	2%
1980	84%	100%	90%	0%	0%	0%	0%	0%	0%	0%	0%	0%
1981	72%	100%	89%	0%	0%	0%	0%	0%	0%	0%	0%	0%
1982	93%	99%	90%	0%	0%	0%	0%	0%	0%	0%	0%	0%
1983	95%	100%	90%	0%	0%	0%	0%	0%	0%	0%	0%	0%
1984	67%	100%	86%	0%	0%	0%	0%	0%	0%	0%	0%	0%
1985	69%	100%	87%	0%	0%	1%	0%	0%	0%	0%	0%	1%
1986	64%	100%	83%	8%	0%	6%	-6%	0%	-6%	21%	0%	7%
1987	43%	100%	67%	3%	0%	0%	1%	0%	0%	7%	0%	3%
1988	21%	100%	65%	0%	0%	0%	-2%	0%	-2%	-1%	0%	-1%
1989	39%	100%	65%	2%	0%	0%	0%	0%	0%	1%	0%	0%
1990	0%	100%	45%	0%	0%	0%	0%	0%	0%	0%	0%	0%
1991	18%	75%	61%	-2%	0%	-2%	-2%	0%	-2%	-2%	0%	-2%
1992	42%	75%	67%	-2%	0%	0%	-1%	0%	0%	1%	0%	0%
1993	64%	100%	82%	0%	0%	0%	-1%	0%	-1%	0%	0%	0%
1994	77%	75%	90%	0%	0%	0%	0%	0%	0%	0%	0%	0%
1995	94%	100%	90%	0%	0%	0%	0%	0%	0%	0%	0%	0%
1996	78%	100%	90%	0%	0%	0%	0%	0%	0%	0%	0%	0%
1997	67%	100%	86%	0%	0%	0%	0%	0%	0%	0%	0%	0%
1998	95%	99%	90%	0%	0%	0%	0%	0%	0%	0%	0%	0%
1999	68%	100%	87%	0%	0%	0%	0%	0%	0%	0%	0%	0%
2000	72%	100%	87%	0%	0%	0%	0%	0%	2%	0%	0%	0%
2001	40%	100%	67%	5%	0%	0%	-6%	0%	0%	7%	0%	0%
2002	68%	100%	86%	0%	0%	0%	-2%	0%	-2%	0%	0%	0%
2003	48%	50%	48%	0%	0%	0%	-3%	0%	0%	0%	0%	0%
Avg	58%	97%	78%	1%	0%	0%	-1%	0%	0%	1%	0%	1%

Source: Common Assumptions Common Modeling Package Version 8D CalSim-II 2030 simulations (Nodes DEL_ CVP_PAG_S, DEL_CVP_PRF_S, and DEL_CVP_PMI_S for delivery information, and CACMP Delivery Specifications for demand information)

Notes:

Simulation period: 1922-2003

(%) indicates change from either existing condition or No-Action Alternative

Key:

Ag = Agricultural Water Service Contractor

Alt = alternative

Avg = average

M&I = Municipal and Industrial contractor

Refuge = Level 2 Federal Refuge

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While the Banks Pumping Plant typically provides water supply to SWP contractors, the SLWRI alternatives may provide opportunities for increased CVP and SWP exports through the Banks Pumping Plant by improving Delta water quality (i.e., salinities). Furthermore, CVP/SWP water rights in the Delta (RD-1641) provide opportunities for the CVP to export its supplies through the Banks Pumping Plant under certain conditions. Accordingly, there would be increases in exports at the Banks Pumping Plant under the SLWRI alternatives, but since the Banks Pumping Plant export capacity would be fully used less often than the Jones Pumping Plant, increases in exports would be relatively similar in average annual and SVI dry and critical years. Table 6-28 shows average annual exports through Banks Pumping Plant for the various SLWRI alternatives.

Table 6-28. Simulated Monthly Average Exports Through the Banks Pumping Plant

Month	Existing Condition (2005)				Future Condition (2030)			
	Existing Condition (cfs)	Change from Base			No-Action Alt (cfs)	Change from Base		
		CP1 and CP4 (cfs)	CP2 (cfs)	CP3 and CP5 (cfs)		CP1 and CP4 (cfs)	CP2 (cfs)	CP3 and CP5 (cfs)
Oct	4,855	4 (0%)	13 (0%)	33 (1%)	4,343	2 (0%)	27 (1%)	-6 (0%)
Nov	4,872	92 (2%)	115 (2%)	109 (2%)	4,745	21 (0%)	39 (1%)	25 (1%)
Dec	6,039	9 (0%)	29 (0%)	75 (1%)	5,947	23 (0%)	16 (0%)	-10 (0%)
Jan	6,547	24 (0%)	29 (0%)	35 (1%)	6,858	11 (0%)	-22 (0%)	-34 (-1%)
Feb	5,686	98 (2%)	120 (2%)	85 (1%)	5,960	84 (1%)	48 (1%)	-4 (0%)
Mar	4,948	36 (1%)	22 (0%)	23 (0%)	5,562	-44 (-1%)	-37 (-1%)	-26 (-1%)
Apr	3,187	-6 (0%)	-5 (0%)	-6 (0%)	3,286	3 (0%)	21 (1%)	-23 (-1%)
May	3,030	-7 (0%)	-9 (0%)	-20 (-1%)	3,098	-4 (0%)	-24 (-1%)	-22 (-1%)
Jun	3,111	45 (1%)	60 (2%)	66 (2%)	3,602	30 (1%)	31 (1%)	-49 (-2%)
Jul	2,970	145 (5%)	120 (4%)	87 (3%)	3,791	72 (2%)	75 (3%)	77 (3%)
Aug	3,905	143 (4%)	148 (4%)	130 (3%)	5,005	42 (1%)	3 (0%)	-38 (-1%)
Sep	5,030	31 (1%)	27 (1%)	18 (0%)	5,206	24 (0%)	43 (1%)	1 (0%)
Total (TAF)	3,265	37 (1%)	40 (1%)	38 (1%)	3,461	16 (0%)	13 (0%)	-7 (0%)

Source: Common Assumptions Common Modeling Package Version 8D CalSim-II 2005 and 2030 simulations (Node D419)

Notes:

Simulation period: 1922-2003

(%) indicates percent change from either existing condition or No–Action Alternative

Key:

Alt = alternative

cfs = cubic feet per second

CP = Comprehensive Plan

TAF = thousand acre-feet

As described in Chapter 1 of the *Hydrology, Hydraulics, and Water Management Technical Report*, the SWP delivers water supplies to contractors both north and south of the Delta, and makes all of its exports through the Banks Pumping Plant. Because of the increased exports described in Table 2-25, it is reasonable to expect a similar increase in deliveries to SWP contractors south of the Delta. Of the approximately 4.2 MAF of Table A contracts, about 4 MAF are held by contractors south of the Delta. Table 6-29 shows the average monthly increases in SWP Table A deliveries to contractors south of the Delta.

Since a large portion of the SWP Table A demands south of the Delta are for M&I use, the monthly pattern of deliveries is fairly even throughout the year, compared to the CVP contractors, who are primarily agricultural, and only require water supply during the irrigation season.

Table 6-29. Simulated Monthly Average Deliveries to SWP Table A Contractors South of the Delta

Month	Existing Condition (2005)				Future Condition (2030)			
	Existing Condition (cfs)	Change from Base			No-Action Alt (cfs)	Change from Base		
		CP1 and CP4 (cfs)	CP2 (cfs)	CP3 and CP5 (cfs)		CP1 and CP4 (cfs)	CP2 (cfs)	CP3 and CP5 (cfs)
Oct	4,101	61 (1%)	73 (2%)	63 (2%)	4,169	26 (1%)	18 (0%)	26 (1%)
Nov	3,408	58 (2%)	69 (2%)	60 (2%)	3,634	27 (1%)	20 (1%)	25 (1%)
Dec	3,109	57 (2%)	72 (2%)	63 (2%)	3,509	54 (2%)	47 (1%)	53 (2%)
Jan	345	10 (3%)	11 (3%)	10 (3%)	1,394	100 (7%)	99 (7%)	95 (7%)
Feb	783	13 (2%)	13 (2%)	13 (2%)	2,576	12 (0%)	9 (0%)	3 (0%)
Mar	2,025	26 (1%)	33 (2%)	31 (2%)	3,044	55 (2%)	39 (1%)	20 (1%)
Apr	5,298	54 (1%)	63 (1%)	54 (1%)	6,019	52 (1%)	44 (1%)	48 (1%)
May	6,586	58 (1%)	67 (1%)	56 (1%)	7,376	28 (0%)	17 (0%)	22 (0%)
Jun	8,721	85 (1%)	95 (1%)	74 (1%)	8,970	-10 (0%)	-23 (0%)	-39 (0%)
Jul	8,466	80 (1%)	83 (1%)	75 (1%)	8,762	-4 (0%)	-18 (0%)	-10 (0%)
Aug	7,889	83 (1%)	86 (1%)	79 (1%)	8,146	10 (0%)	-1 (0%)	2 (0%)
Sep	5,949	65 (1%)	70 (1%)	64 (1%)	6,135	8 (0%)	-1 (0%)	6 (0%)
Total (TAF)	3,434	39 (1%)	45 (1%)	39 (1%)	3,855	22 (1%)	15 (0%)	15 (0%)

Source: Common Assumptions Common Modeling Package Version 8D CalSim-II 2005 and 2030 simulations (Nodes DEL_SWP_PAG and DEL_SWP_PMI)

Notes:

Simulation period: 1922-2003

(%) indicates percent change from either existing condition or No-Action Alternative

Key:

Alt = alternative

cfs = cubic feet per second

CP = Comprehensive Plan

SWP = State Water Project

TAF = thousand acre-feet

In SVI dry and critical years, SWP Table A deliveries are relatively lower because of less available water supply. In these periods, the ability of the SWP to deliver more water under the SLWRI alternatives would be improved because of increased releases from Shasta Reservoir improving Delta water quality. Table 6-30 shows the SWP Table A deliveries to south-of-Delta contractors in SVI dry and critical years.

Differences in timing between exports through the Jones and Banks pumping plants and deliveries to CVP and SWP contractors would be due to the ability of both projects to store water in San Luis Reservoir during winter months, and to use that storage to augment Delta exports in summer months with releases from San Luis Reservoir. (Attachment A of the *Hydrology, Hydraulics, and Water Management Technical Report*, includes information about San Luis Reservoir storage.

Table 6-30. Simulated Monthly Average Deliveries to SWP Table A Contractors South of the Delta in Dry and Critical Years

Month	Existing Condition (2005)				Future Condition (2030)			
	Existing Condition (cfs)	Change from Base			No-Action Alt (cfs)	Change from Base		
		CP1 and CP4 (cfs)	CP2 (cfs)	CP3 and CP5 (cfs)		CP1 and CP4 (cfs)	CP2 (cfs)	CP3 and CP5 (cfs)
Oct	3,598	61 (2%)	70 (2%)	49 (1%)	3,675	45 (1%)	37 (1%)	41 (1%)
Nov	2,876	59 (2%)	67 (2%)	51 (2%)	3,086	45 (1%)	41 (1%)	42 (1%)
Dec	2,605	58 (2%)	67 (3%)	51 (2%)	2,945	82 (3%)	78 (3%)	77 (3%)
Jan	242	7 (3%)	8 (3%)	5 (2%)	643	63 (10%)	58 (9%)	59 (9%)
Feb	490	17 (3%)	17 (3%)	16 (3%)	1,155	54 (5%)	48 (4%)	44 (4%)
Mar	1,116	56 (5%)	70 (6%)	68 (6%)	1,424	52 (4%)	14 (1%)	-18 (-1%)
Apr	4,710	79 (2%)	90 (2%)	67 (1%)	4,836	114 (2%)	105 (2%)	110 (2%)
May	5,625	92 (2%)	91 (2%)	70 (1%)	5,840	55 (1%)	35 (1%)	41 (1%)
Jun	7,507	125 (2%)	116 (2%)	76 (1%)	7,389	-34 (0%)	-65 (-1%)	-112 (-2%)
Jul	7,354	110 (1%)	89 (1%)	74 (1%)	7,256	-27 (0%)	-56 (-1%)	-43 (-1%)
Aug	6,561	119 (2%)	103 (2%)	88 (1%)	6,518	-4 (0%)	-28 (0%)	-17 (0%)
Sep	4,750	95 (2%)	84 (2%)	74 (2%)	4,778	10 (0%)	-7 (0%)	4 (0%)
Total (TAF)	2,874	53 (2%)	53 (2%)	42 (1%)	3,000	27 (1%)	15 (1%)	14 (0%)

Source: Common Assumptions Common Modeling Package Version 8D CalSim-II 2005 and 2030 simulations (Nodes DEL_SWP_PAG and DEL_SWP_PMI)

Notes:
Simulation period: 1922-2003
(%) indicates percent change from either existing condition or No-Action Alternative
Dry and critical years as defined by the Sacramento Valley Index
Key:
Alt = alternative
cfs = cubic feet per second
CP = Comprehensive Plan
SWP = State Water Project
TAF = thousand acre-feet

Changes in Delta export operations could also result in changes in reservoir operations south of the Delta along the San Joaquin River. Any changes in operations of South-of-Delta reservoirs would be reflected in changes in San Joaquin River flows near its confluence with the Delta. The San Joaquin River at Vernalis is commonly used as the downstream end of the San Joaquin River. Table 6-31 shows simulated San Joaquin River flow at Vernalis. According to modeling, the SLWRI alternatives do not affect San Joaquin River flows at Vernalis.

Table 6-31. Simulated Monthly Average San Joaquin River flows at Vernalis

Month	Existing Condition (2005)				Future Condition (2030)			
	Existing Condition (cfs)	Change from Base			No-Action Alt (cfs)	Change from Base		
		CP1 and CP4 (cfs)	CP2 (cfs)	CP3 and CP5 (cfs)		CP1 and CP4 (cfs)	CP2 (cfs)	CP3 and CP5 (cfs)
Oct	2,486	0 (0%)	0 (0%)	0 (0%)	2,472	0 (0%)	0 (0%)	0 (0%)
Nov	2,561	0 (0%)	0 (0%)	0 (0%)	2,533	0 (0%)	0 (0%)	0 (0%)
Dec	3,354	0 (0%)	0 (0%)	0 (0%)	3,313	0 (0%)	0 (0%)	0 (0%)
Jan	4,772	0 (0%)	0 (0%)	0 (0%)	4,737	0 (0%)	0 (0%)	0 (0%)
Feb	6,434	0 (0%)	0 (0%)	0 (0%)	6,340	-1 (0%)	-1 (0%)	-1 (0%)
Mar	6,339	0 (0%)	0 (0%)	-1 (0%)	6,211	0 (0%)	0 (0%)	0 (0%)
Apr	6,006	0 (0%)	0 (0%)	0 (0%)	5,973	0 (0%)	0 (0%)	0 (0%)
May	6,022	0 (0%)	0 (0%)	0 (0%)	5,997	0 (0%)	0 (0%)	0 (0%)
Jun	4,631	0 (0%)	0 (0%)	0 (0%)	4,575	0 (0%)	0 (0%)	0 (0%)
Jul	3,221	1 (0%)	1 (0%)	1 (0%)	3,217	0 (0%)	1 (0%)	1 (0%)
Aug	2,113	0 (0%)	0 (0%)	1 (0%)	2,082	0 (0%)	1 (0%)	1 (0%)
Sep	2,366	0 (0%)	0 (0%)	0 (0%)	2,361	0 (0%)	0 (0%)	0 (0%)
Total (TAF)	3,024	0 (0%)	0 (0%)	0 (0%)	2,994	0 (0%)	0 (0%)	0 (0%)

Source: Common Assumptions Common Modeling Package Version 8D CalSim-II 2005 and 2030 simulations (Nodes DEL_SWP_PAG and DEL_SWP_PMI)

Notes:

Simulation period: 1922-2003

(%) indicates percent change from either existing condition or No-Action Alternative

Key:

Alt = alternative

cfs = cubic feet per second

CP = Comprehensive Plan

SWP = State Water Project

TAF = thousand acre-feet

No-Action Alternative

Under the No-Action Alternative, Shasta Dam would not be modified, and the CVP would continue operating similar to the existing condition. Changes in regulatory conditions and water supply demands would result in differences in flows on the Sacramento River and at the Delta. Possible changes include the following:

- Firm Level 2 Federal refuge needs
- Implementation of the Sacramento Area Water Forum Agreement on the American River
- Increased CCWD contract supply and water rights
- SWP deliveries based on full Table A amounts
- Use of the Delta-Mendota Canal–California Aqueduct Intertie
- Implementation of the San Joaquin River Salinity Management Program
- CVP use of Banks Pumping Plant to move 50,000 acre-feet/year of Level 2 refuge water
- Implementation of permanent operable Delta barriers

For a complete list of the differences between the No-Action Alternative and the existing conditions, see Table 2-1 in the Modeling Appendix.

Each of these changes could result in different operations of Shasta Reservoir, and could result in impacts to the various impact indicators. As described above, modeling indicates that the No-Action Alternative would continue to meet water supply demands at levels of compliance similar to the existing conditions, and would not result in any appreciable changes in water supply reliability.

Shasta Lake and Vicinity The significance criteria for H&H are not expected to apply in the Shasta Lake and Vicinity geographic region; therefore, potential effects in that geographic region are not discussed further in this PDEIS.

Upper Sacramento River (Shasta Dam to Red Bluff)

Impact H&H-1 (No-Action): Change in Frequency of Flows Above 100,000 cfs on the Sacramento River Below Bend Bridge Flood management operations would not change under the No-Action Alternative as compared to the existing condition. There would be no impact.

Flood management operations at Shasta Dam would not be expected to change under the No-Action Alternative as compared to the existing condition.

Therefore, the recurrence of flows above 100,000 cfs on the Sacramento River below Bend Bridge would be expected to be the same.

Therefore, Impact H&H-1 (No-Action) would have no impact. Mitigation is not required for the No-Action Alternative.

Impact H&H-2 (No-Action): Place Housing or Other Structures Within a 100-Year Flood Hazard Area as Mapped on a Federal Flood Hazard Boundary or Flood Insurance Rate Map or Other Flood Hazard Delineation Map No new structures will be built in the 100-year flood plain. Therefore, there would be no impact.

No new structures would be built in the flood plain under the No-Action Alternative, and flood management operations at Shasta Dam would not be expected to change under the No-Action Alternative as compared to the existing condition.

Therefore, Impact H&H-2 (No-Action) would have no impact. Mitigation is not required for the No-Action Alternative.

Impact H&H-3(No-Action): Place Within a 100-Year Flood Hazard Area Structures that Would Impede or Redirect Flood Flows No new structures will be built in the 100-year flood plain. Therefore, there would be no impact.

No new structures would be built in the flood plain under the No-Action Alternative, and flood management operations at Shasta Dam would not be expected to change under the No-Action Alternative compared to the existing condition.

Therefore, Impact H&H-3 (No-Action) would have no impact. Mitigation is not required for the No-Action Alternative.

Lower Sacramento River and Delta

Impact H&H-4 (No-Action): Change in Water Levels in the Old River near Tracy Road Bridge Water levels in the Old River near Tracy Road Bridge could be substantially lower under the No-Action Alternative than the existing condition. Therefore, this impact would be potentially significant.

As shown in Table 6-32, there will be some noticeable differences in water level in the Old River near the Tracy Road Bridge. These differences are due to the construction of permanent operable barriers rather than the temporary barriers included in the existing condition. Specifically, the permanent barriers will use different gate operations than the temporary barriers, resulting in typically decreased water levels under the No-Action Alternative.

Therefore, Impact H&H-4 (No-Action) would be potentially significant. Mitigation is not required for the No-Action Alternative.

Table 6-32. Simulated Monthly Maximum 15-Minute Change in Water Levels at Various Locations in the South Delta at Low-Low Tide

Month	Change from Existing Condition		
	Old River near Tracy Road Bridge (feet)	Grant Line Canal near the Grant Line Canal Barrier (feet)	Middle River near the Howard Road Bridge (feet)
April	-0.38 (11)	-0.79 (14)	-1.26 (30)
May	-2.66 (63)	-2.55 (68)	-1.72 (36)
June	-3.38 (73)	-3.05 (72)	-1.24 (68)
July	-3.06 (73)	-2.72 (73)	-1.10 (72)
August	-2.76 (73)	-2.46 (73)	-1.13 (73)
September	-2.38 (73)	-1.76 (73)	-1.15 (73)
October	-2.09 (73)	-2.14 (73)	-1.16 (73)

Source: Common Assumptions Common Modeling Package Version 8D DSM2 2005 and 2030 simulations (Node 071_0, 206_5533, and 129_0)

Notes:

Simulation period: 1922-1994

Number in parentheses indicates number of months with a maximum decrease in water level exceeding 0.1 foot

Impact H&H-5 (No-Action): Change in Water Levels in the Grant Line Canal near the Grant Line Canal Barrier Water levels in the Grant Line Canal near the Grant Line Canal Barrier could be substantially lower under the No-Action Alternative than the existing condition. Therefore, this impact would be potentially significant.

Similar to Impact H&H-4, as shown in Table 6-32, water levels under the No-Action Alternative will typically be lower than under the existing condition because of differences in operation of south Delta barriers.

Therefore, Impact H&H-5 (No-Action) would be potentially significant. Mitigation is not required for the No-Action Alternative. *Impact H&H-6 (No-Action): Change in Water Levels in the Middle River near the Howard Road Bridge* Water levels in the Middle River near Howard Road Bridge could be substantially lower under the No-Action Alternative than the existing condition. Therefore, this impact would be potentially significant.

Similar to Impact H&H-4, as shown in Table 6-32, water levels under the No-Action Alternative will typically be lower than under the existing condition because of differences in operation of south Delta barriers.

Therefore, Impact H&H-6 (No-Action) would be potentially significant. Mitigation is not required for the No-Action Alternative.

Impact H&H-7 (No-Action): Change in X2 Position X2 Position would not change from west of either Collinsville or Chipps Island, whichever is the controlling location, from the existing condition to the No-Action Alternative. Therefore, there would be no impact.

Examination of simulation output indicates that compared to the existing condition there would be no months when the No-Action Alternative would cause the X2 position to shift westward from either Collinsville or Chipps Island, depending on the applicable standard, to east of the respective location.

Therefore, there would be no impact for Impact H&H-7 (No-Action Alternative). Mitigation is not required for the No-Action Alternative.

Impact H&H-8 (No-Action): Change in Recurrence of Delta Excess Conditions
The No-Action Alternative could result in a change of recurrence of Delta excess conditions at a frequency potentially impacting CCWD's ability to fill Los Vaqueros Reservoir. Therefore, this impact would be potentially significant.

As shown in Table 6-33, the No-Action Alternative would cause many changes from excess to balanced conditions compared to the existing condition.

Because of the large number of occurrences, Impact H&H-8 (No-Action) would be potentially significant. Mitigation is not required for the No-Action Alternative.

Table 6-33. Simulated Number of Years the Delta Changes from Excess to Balanced Condition

Number of Years the Delta Changes from Excess to Balanced Conditions Compared to Existing Condition											
Jan	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
63 (76%)	55 (66%)	49 (59%)	59 (71%)	60 (72%)	26 (31%)	5 (6%)	9 (11%)	22 (27%)	18 (22%)	32 (39%)	46 (55%)

Source: Common Assumptions Common Modeling Package Version 8D CalSim-II 2005 and 2030 simulations
Notes:
Simulation Period: 1922-2003
Number in parentheses indicates percentage of months Delta condition change occurs

CVP/SWP Service Areas

Impact H&H-9 (No-Action): Change in Deliveries to North-of-Delta CVP Water Service Contractors and Refuges Average annual deliveries to north-of-Delta CVP water service contractors and refuges would be greater under the No-Action Alternative relative to the existing condition, but there may be potentially large decreases in certain months. Therefore, this impact would be potentially significant.

As shown in Table 6-34, average annual deliveries under the No-Action Alterative to North-of-Delta CVP water service contractors and refuges would be greater than under existing conditions, but April deliveries could potentially decrease by 5 percent under both average annual and dry and critical years.

Therefore, Impact H&H-9 (No-Action) would be potentially significant. Mitigation is not required for the No-Action Alternative.

Table 6-34. Simulated Monthly Average Deliveries and Percent Change of Deliveries to North-of-Delta CVP Water Service Contractors and Refuges

Month	Change from Existing Conditions	
	Average All Years (cfs (%))	Dry and Critical Years (cfs (%))
October	53 (18%)	52 (19%)
November	47 (17%)	46 (17%)
December	28 (10%)	28 (10%)
January	13 (5%)	13 (5%)
February	12 (4%)	10 (4%)
March	2 (1%)	3 (1%)
April	-15 (-5%)	-13 (-5%)
May	24 (8%)	7 (2%)
June	45 (16%)	15 (5%)
July	60 (21%)	22 (8%)
August	64 (23%)	33 (12%)
September	56 (20%)	42 (15%)
Total (TAF)	24 (8%)	16 (6%)

Source: Common Assumptions Common Modeling Package, version 8D CalSim-II 2005 and 2030 simulations (Nodes DEL_CVP_PAG_N and DEL_CVP_PRF_N)

Notes:

Simulation period: 1922-1994. Change as measured from either existing condition or No-Action Alternative. Dry and critical years as defined by the Sacramento Valley Index

Key:

cfs = cubic feet per second

TAF = Thousand acre-feet

Impact H&H-10 (No-Action): Change in Deliveries to South-of-Delta CVP Water Service Contractors and Refuges Average annual deliveries to south-of-Delta CVP water service contractors and refuges would increase under the No-Action Alternative relative to the existing condition, but there may be potentially large average .decreases in some months. Therefore, this impact would be potentially significant.

As shown in Table 6-35, annual deliveries to South-of-Delta CVP water service contractors and refuges would increase by 8 percent and 6 percent in average annual and dry and critical years, respectively. However, average April deliveries under both average annual and dry and critical years could decrease by 5 percent on average.

Therefore, Impact H&H-10 (No-Action) would be potentially significant. Mitigation is not required for the No-Action Alternative.

Table 6-35. Simulated Monthly Average Deliveries and Percent Change of Deliveries to South-of-Delta CVP Water Service Contractors and Refuges

Month	Change from Existing Conditions	
	Average All Years (cfs (%))	Dry and Critical Years (cfs (%))
October	-63 (-4%)	-63 (-4%)
November	-42 (-2%)	-42 (-3%)
December	-9 (-1%)	-8 (-1%)
January	30 (2%)	29 (2%)
February	45 (3%)	42 (3%)
March	53 (3%)	2 (0%)
April	52 (3%)	-2 (0%)
May	37 (2%)	-18 (-1%)
June	87 (5%)	-4 (0%)
July	142 (8%)	30 (2%)
August	91 (5%)	14 (1%)
September	-37 (-2%)	-60 (-4%)
Total (TAF)	23 (1%)	-5 (0%)

Source: Common Assumptions Common Modeling Package, version 8D CalSim-II 2005 and 2030 simulations (Nodes DEL_CVP_PAG_S and DEL_CVP_PRF_S)

Notes:

Simulation period: 1922-1994. Change as measured from either existing condition or No-Action Alternative. Dry and critical years as defined by the Sacramento Valley Index

Key:

cfs = cubic feet per second

TAF = thousand acre-feet

Impact H&H-11 (No-Action): Change in Deliveries to SWP Table A Contractors South of the Delta Average annual deliveries to SWP Table A contractors south of the Delta would increase, but average deliveries in some month could decrease, therefore, this impact would be potentially significant.

As shown in Table 6-36, average annual and monthly deliveries to SWP Table A contractors south of the Delta would increase under the No-Action Alternative relative to existing conditions when averaging all years. However, when averaging dry and critical years, there are decreases in average deliveries in June, July, and August of 3 percent, 2 percent, and 1 percent, respectively.

Therefore, Impact H&H-11 (No-Action) would be potentially significant. Mitigation is not required for the No-Action Alternative.

Table 6-36. Simulated Monthly Average Deliveries and Percent Change of Deliveries to SWP Table A Contractors South-of-Delta

Month	Change from Existing Conditions	
	Average All Years (cfs (%))	Dry and Critical Years (cfs (%))
October	68 (2%)	76 (2%)
November	226 (6%)	210 (6%)
December	400 (10%)	340 (9%)
January	1,049 (26%)	401 (11%)
February	1,793 (44%)	665 (18%)
March	1,019 (25%)	308 (9%)
April	721 (18%)	126 (4%)
May	790 (19%)	216 (6%)
June	249 (6%)	-118 (-3%)
July	296 (7%)	-98 (-3%)
August	258 (6%)	-43 (-1%)
September	187 (5%)	29 (1%)
Total (TAF)	420 (10%)	125 (3%)

Source: Common Assumptions Common Modeling Package, version 8D CalSim-II 2005 and 2030 simulations (Nodes DEL_SWP_PAG and DEL_SWP_PMI)

Notes:

Simulation period: 1922-1994. Change as measured from either existing condition or No-Action Alternative. Dry and critical years as defined by the Sacramento Valley Index

Key:

cfs = cubic feet per second

TAF = Thousand acre-feet

Impact H&H-12(No-Action): Change in Groundwater Changes in groundwater levels under the No-Action Alternative as compared to the existing condition would not be noticeable. Therefore, this impact would be less than significant.

As shown in Tables 6-12, 6-13, 6-24, 6-25, 6-29, and 6-30, surface water deliveries to CVP and SWP contractors would be expected to increase for the No-Action Alternative compared to the existing condition. However, these increases in deliveries are likely associated with increases in demands rather than increases in water supply. Therefore, while groundwater pumping would still be required, groundwater usage in the CVP/SWP service area would not be expected to change noticeably.

Thus, Impact H&H-12 (No-Action) would be less than significant. Mitigation is not required for the No-Action Alternative.*Impact H&H-13 (No-Action): Change in Groundwater Quality* Changes in groundwater quality under the No-Action Alternative as compared to the existing condition would not be noticeable. Therefore, this impact would be less than significant.

As shown in Tables 6-12, 6-13, 6-24, 6-25, 6-29, and 6-30, surface water deliveries to CVP and SWP contractors would be expected to increase for the No-Action Alternative compared to the existing condition. However, these increases in deliveries are likely associated with increases in demands rather than increases in water supply. Therefore, while groundwater pumping would still be required, groundwater usage in the CVP/SWP service area would not be expected to change noticeably.

Thus, Impact H&H-13 (No-Action) would be less than significant. Mitigation is not required for the No-Action Alternative.

CP1 – 6.5-Foot Dam Raise, Anadromous Fish Survival and Water Supply Reliability

Operations under CP1 would be similar to the bases of comparison, but Shasta Reservoir would be raised by 6.5 feet, and would have 256 TAF increased storage. With the enlarged storage capacity, at Shasta Reservoir, there would be minor changes in operations. This section describes the environmental consequences of CP1.

Shasta Lake and Vicinity The significance criteria for H&H are not expected to apply in the Shasta Lake and Vicinity geographic region; therefore, potential effects in that geographic region are not discussed further in this PDEIS.

Upper Sacramento River (Shasta Dam to Red Bluff)

Impact H&H-1 (CP1): Change in Frequency of Flows Above 100,000 cfs on the Sacramento River Below Bend Bridge CP1 would slightly reduce the frequency of flows greater than 100,000 cfs. Therefore, this impact would be beneficial.

SLWRI modeling uses a monthly time step, which is inappropriate for flood control analysis. However, flood management operations for downstream objectives would not change with an increase in reservoir storage. While a slight decrease in recurrence of high flows would be possible, CP1 would not increase the frequency of flows above 100,000 cfs.

Therefore, Impact H&H-1 (CP1) would be beneficial. Mitigation for this impact is not needed, and thus not proposed.

Impact H&H-2 (CP1): Place Housing or Other Structures Within a 100-Year Flood Hazard Area as Mapped on a Federal Flood Hazard Boundary or Flood Insurance Rate Map or Other Flood Hazard Delineation Map No new structures would be built downstream from Shasta Dam. Therefore, there would be no impact.

All project construction would be done at the Shasta Dam site, and while the reservoir area would be expanded, any structures located within the reservoir area would be removed. Since reservoir operations for downstream objectives would not change, no additional structures downstream from the dam would be located within the 100-year flood hazard area.

Therefore, there would be no impact for Impact H&H-2 (CP1). Mitigation for this impact is not needed, and thus not proposed.

Impact H&H-3 (CP1): Place Within a 100-Year Flood Hazard Area Structures that Would Impede or Redirect Flood Flows No new structures would be built downstream from Shasta Dam. Therefore, there would be no impact.

All project construction would be done at the Shasta Dam site, and while the reservoir area would be expanded, any structures located within the reservoir area would be removed. Since reservoir operations for downstream objectives would not change, no additional structures downstream from the dam would be located within the 100-year flood hazard area which would impede or redirect flood flows.

Therefore, there would be no impact for Impact H&H-3 (CP1). Mitigation for this impact is not needed, and thus not proposed.

Lower Sacramento River and Delta

Impact H&H-4 (CP1): Change in Water Levels in the Old River near Tracy Road Bridge Delta export operations associated with CP1 would result in increased Delta exports during some months. Accordingly, there would be a possibility of changes in south Delta water levels at times. This impact would be less than significant.

During the agricultural season (April through October), the maximum change in water level at low-low tide compared to the existing condition exceeds 0.1 foot in 2 months, May and June, 1954. As shown in Table 6-37, compared to the No-Action Alternative, CP1 would result in water level changes in excess of 0.1 foot in 15 months during the agricultural season, representing 3 percent of months in the irrigation season. The greatest decrease would be 0.27 foot in July 1930.

Because of the rare incidence of maximum water level changes exceeding 0.1 foot, Impact H&H-4 (CP1) would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Table 6-37. Simulated Monthly Maximum 15-Minute Change in Old River Water Levels near Tracy Road Bridge at Low-Low Tide

Month	Change from Existing Condition	Change from No-Action Alternative
	CP1 (2005) Change (feet)	CP1 (2030) Change (feet)
April	-0.06 (0)	-0.13 (2)
May	-0.14 (1)	-0.13 (1)
June	-0.13 (1)	-0.16 (2)
July	-0.09 (0)	-0.27 (5)
August	-0.06 (0)	-0.13 (2)
September	-0.04 (0)	-0.18 (2)
October	-0.04 (0)	-0.13 (1)

Source: Common Assumptions Common Modeling Package Version 8D DSM2 2005 and 2030 simulations (Node 071_0)

Notes:

Simulation period: 1922-1994

Number in parentheses indicates number of months with a maximum decrease in water level exceeding 0.1 foot

Key:

CP = Comprehensive Plan

Impact H&H-5 (CP1): Change in Water Levels in the Grant Line Canal near the Grant Line Canal Barrier Similar to Impact H&H-4 (CP1), CP1 would have the potential to affect water levels in the Grant Line Canal above the Grant Line Canal Barrier. This impact would be less than significant.

As shown in Table 6-38, maximum monthly changes in minimum daily water level associated with CP1 would exceed 0.1 foot in 2 months during the irrigation season, June 1987 and July 1955, compared to the existing condition. When compared to the No-Action Alternative, maximum monthly changes in excess of 0.1 foot occur in 10 months during the irrigation season, representing 2 percent of months.

Because of the low incidence of changes in water level greater than 0.1 foot, this impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Table 6-38. Simulated Monthly Maximum 15-Minute Change in the Grant Line Canal Water Levels near the Grant Line Canal Barrier at Low-Low Tide

Month	Change from Existing Condition	Change from No-Action Alternative
	CP1 (2005) Change (feet)	CP1 (2030) Change (feet)
April	-0.05 (0)	-0.12 (1)
May	-0.11 (1)	-0.13 (1)
June	-0.11 (1)	-0.15 (1)
July	-0.09 (0)	-0.21 (3)
August	-0.07 (0)	-0.13 (1)
September	-0.04 (0)	-0.16 (2)
October	-0.05 (0)	-0.11 (1)

Source: Common Assumptions Common Modeling Package Version 8D DSM2 2005 and 2030 simulations (Node 206_5533)

Notes:

Simulation period: 1922-1994

Number in parentheses indicates number of months with a maximum decrease in water level exceeding 0.1 foot

Key:

CP = Comprehensive Plan

Impact H&H-6 (CP1): Change in Water Levels in the Middle River near the Howard Road Bridge This impact is similar to both Impacts H&H-4 (CP1) and H&H-5 (CP1), and would be less than significant.

As shown in Table 6-39, maximum monthly changes in minimum daily water levels in the Middle River near the Howard Road Bridge would exceed 0.1 foot in 2 months compared to the existing condition, and in 16 months compared to the No-Action Alternative. A change in 16 months out of the 73 year period of record represents 3 percent of the months during the irrigation season.

Because of the low incidence of changes in water level greater than 0.1 foot, this impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Table 6-39. Simulated Monthly Maximum 15-Minute Change in Middle River Water Levels near the Howard Road Bridge at Low-Low Tide

Month	Change from Existing Condition	Change from No-Action Alternative
	CP1 (2005) Change (feet)	CP1 (2030) Change (feet)
April	-0.04 (0)	-0.13 (2)
May	-0.08 (0)	-0.12 (1)
June	-0.12 (1)	-0.13 (2)
July	-0.10 (1)	-0.24 (5)
August	-0.04 (0)	-0.15 (3)
September	-0.02 (0)	-0.17 (2)
October	-0.02 (0)	-0.12 (1)

Source: Common Assumptions Common Modeling Package Version 8D DSM2 2005 and 2030 simulations (Node 129_0)

Notes:

Simulation period: 1922-1994

Number in parentheses indicates number of months with a maximum decrease in water level exceeding 0.1 foot

Key:

CP = Comprehensive Plan

Impact H&H-7 (CP1): Change in X2 Position Changes in X2 position from west of either Collinsville or Chipps Island, depending on the applicable standard, would be extremely rare, so this impact would be less than significant.

Examination of simulation output indicates that compared to the existing condition, there would be no months when the No-Action Alternative would cause the X2 position to shift from either west of Collinsville or Chipps Island, depending on the applicable standard, to east of the respective location.

Compared to the No-Action Alternative, there would be 1 month, December 1929, when the X2 position would change from west to east of Collinsville. Under the No-Action Alternative, the X2 position would be at 80.97 kilometers (km), and under CP1, it would be at 81.05 km, a 0.08 km shift.

Because of the extremely rare occurrence and the very low magnitude of change, this impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact H&H-8 (CP1): Change in Recurrence of Delta Excess Conditions Changes from excess to balance Delta conditions would be very rare, so this impact would be less than significant.

As shown in Table 6-40, CP1 would cause one February, one March and one September to switch from excess to balanced Delta conditions when compared to the existing condition, and three Julys, two Augusts, and one each of January, June, September, November, and December when compared to the No-Action Alternative.

Because of the low number of occurrences, this impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Table 6-40. Simulated Number of Years the Delta Changes from Excess to Balanced Condition

	Number of Years the Delta Changes from Excess to Balanced Conditions Compared to Existing Condition or No-Action Alternative											
	Jan	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
CP1 (2005)	0 (0%)	1 (1%)	1 (1%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	1 (1%)	0 (0%)	0 (0%)	0 (0%)
CP1 (2030)	1 (1%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	1 (1%)	3 (4%)	2 (2%)	1 (1%)	0 (0%)	1 (1%)	0 (0%)

Source: Common Assumptions Common Modeling Package Version 8D CalSim-II 2005 and 2030 simulations

Notes:

Simulation Period: 1922-2003

Number in parentheses indicates percentage of months Delta condition change occurs

Key:

CP = Comprehensive Plan

CVP/SWP Service Areas

Impact H&H-9 (CP1): Change in Deliveries to North-of-Delta CVP Water Service Contractors and Refuges Average annual and monthly deliveries would increase under both existing and future conditions. Therefore, this impact would be beneficial.

As shown in Table 6-41, average annual and average monthly deliveries under both existing and future conditions would increase relative to the basis of comparison when averaging all years, and dry and critical years.

Therefore, Impact H&H-9 (CP1) would be beneficial. Mitigation for this impact is not needed, and thus not proposed.

Table 6-41. Simulated Monthly Average Deliveries and Percent Change of Deliveries to North-of-Delta CVP Water Service Contractors and Refuges

Month	Existing Condition (2005)				Future Condition (2030)			
	Average All Years		Dry and Critical Years		Average All Years		Dry and Critical Years	
	Existing Condition (cfs)	CP1 Change (cfs (%))	Existing Condition (cfs)	CP1 Change (cfs (%))	No-Action Alternative (cfs)	CP1 Change (cfs (%))	No-Action Alternative (cfs)	CP1 Change (cfs (%))
Oct	286	4 (1%)	280	4 (2%)	339	2 (1%)	332	2 (1%)
Nov	173	0 (0%)	170	0 (0%)	220	0 (0%)	217	0 (0%)
Dec	109	0 (0%)	108	0 (0%)	137	0 (0%)	135	0 (0%)
Jan	54	0 (0%)	53	0 (0%)	67	0 (0%)	66	0 (0%)
Feb	50	0 (0%)	54	0 (0%)	62	0 (0%)	64	0 (0%)
Mar	35	3 (8%)	33	4 (13%)	37	1 (3%)	36	2 (5%)
Apr	371	22 (6%)	249	33 (13%)	356	11 (3%)	236	17 (7%)
May	657	29 (4%)	382	42 (11%)	680	15 (2%)	389	25 (6%)
Jun	923	36 (4%)	522	51 (10%)	967	19 (2%)	537	32 (6%)
Jul	1,076	40 (4%)	608	58 (10%)	1,136	22 (2%)	631	37 (6%)
Aug	914	32 (4%)	541	47 (9%)	978	17 (2%)	574	30 (6%)
Sep	544	14 (3%)	357	21 (6%)	601	8 (1%)	399	13 (4%)
Total (TAF)	315	11 (3%)	204	16 (8%)	339	6 (2%)	219	10 (5%)

Source: Common Assumptions Common Modeling Package, version 8D CalSim-II 2005 and 2030 simulations (Nodes DEL_CVP_PAG_N and DEL_CVP_PRF_N)

Notes:

Simulation period: 1922-1994. Change as measured from either existing condition or No-Action Alternative. Dry and critical years as defined by the Sacramento Valley Index.

Key:

cfs = cubic feet per second

CP = Comprehensive Plan

TAF = Thousand acre-feet

Impact H&H-10 (CP1): Change in Deliveries to South-of-Delta CVP Water Service Contractors and Refuges Average annual and monthly deliveries would increase under both existing and future conditions. Therefore, this impact would be beneficial.

As shown in Table 6-42, average annual and average monthly deliveries under both existing and future conditions would increase relative to the basis of comparison when averaging all years, and dry and critical years.

Therefore, Impact H&H-10 (CP1) would be beneficial. Mitigation for this impact is not needed, and thus not proposed.

Table 6-42. Simulated Monthly Average Deliveries and Percent Change of Deliveries to South-of-Delta CVP Water Service Contractors and Refuges

Month	Existing Condition (2005)				Future Condition (2030)			
	Average All Years		Dry and Critical Years		Average All Years		Dry and Critical Years	
	Existing Condition (cfs)	CP1 Change (cfs (%))	Existing Condition (cfs)	CP1 Change (cfs (%))	No-Action Alternative (cfs)	CP1 Change (cfs (%))	No-Action Alternative (cfs)	CP1 Change (cfs (%))
Oct	1,694	11 (1%)	1,551	16 (1%)	1,631	3 (0%)	1,488	8 (1%)
Nov	1,157	8 (1%)	1,051	12 (1%)	1,116	5 (0%)	1,010	6 (1%)
Dec	925	11 (1%)	788	17 (2%)	916	7 (1%)	780	8 (1%)
Jan	1,178	19 (2%)	946	29 (3%)	1,208	12 (1%)	974	14 (2%)
Feb	1,434	25 (2%)	1,134	37 (3%)	1,478	16 (1%)	1,176	19 (2%)
Mar	853	25 (3%)	500	47 (9%)	906	9 (1%)	502	33 (7%)
Apr	1,376	26 (2%)	945	45 (5%)	1,428	19 (1%)	943	43 (5%)
May	2,307	38 (2%)	1,529	70 (5%)	2,344	25 (1%)	1,512	60 (4%)
Jun	3,587	62 (2%)	2,307	116 (5%)	3,674	42 (1%)	2,302	100 (4%)
Jul	3,838	75 (2%)	2,323	139 (6%)	3,980	51 (1%)	2,353	120 (5%)
Aug	2,897	54 (2%)	1,792	102 (6%)	2,987	7 (0%)	1,806	80 (4%)
Sep	1,780	18 (1%)	1,373	33 (2%)	1,743	12 (1%)	1,314	29 (2%)
Total (TAF)	1,392	22 (2%)	980	40 (4%)	1,415	13 (1%)	976	31 (3%)

Source: Common Assumptions Common Modeling Package, version 8D CalSim-II 2005 and 2030 simulations (Nodes DEL_CVP_PAG_S and DEL_CVP_PRF_S)

Notes:

Simulation period: 1922-1994. Change as measured from either existing condition or No-Action Alternative. Dry and critical years as defined by the Sacramento Valley Index.

Key:

cfs = cubic feet per second

CP = Comprehensive Plan

TAF = Thousand acre-feet

Impact H&H-11 (CP1): Change in Deliveries to SWP Table A Contractors South of the Delta Average annual deliveries would increase under both existing and future conditions, but there could be some less than significant decreases in monthly deliveries under future conditions. Therefore, this impact would be less than significant.

As shown in Table 6-43, average annual deliveries to SWP Table A contractors south of the Delta would increase under Alternative CP1 in both existing and future conditions relative to the bases of comparison in both average years and in dry and critical years. Under existing conditions, the average monthly deliveries would increase in all months, but there could be some decreases in deliveries under Alternative CP1 relative to the No-Action Alternative under Future Conditions in both average annual and dry and critical years. These decreases would be less than 1 percent, and would therefore not be significant.

Therefore, Impact H&H-11 (CP1) would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Table 6-43. Simulated Monthly Average Deliveries and Percent Change of Deliveries to SWP Table A Contractors South-of-Delta

Month	Existing Condition (2005)				Future Condition (2030)			
	Average All Years		Dry and Critical Years		Average All Years		Dry and Critical Years	
	Existing Condition (cfs)	CP1 Change (cfs (%))	Existing Condition (cfs)	CP1 Change (cfs (%))	No-Action Alternative (cfs)	CP1 Change (cfs (%))	No-Action Alternative (cfs)	CP1 Change (cfs (%))
Oct	4,101	61 (1%)	3,598	61 (2%)	4,169	26 (1%)	3,675	45 (1%)
Nov	3,408	58 (2%)	2,876	59 (2%)	3,634	27 (1%)	3,086	45 (1%)
Dec	3,109	57 (2%)	2,605	58 (2%)	3,509	54 (2%)	2,945	82 (3%)
Jan	345	10 (3%)	242	7 (3%)	1,394	100 (7%)	643	63 (10%)
Feb	783	13 (2%)	490	17 (3%)	2,576	12 (0%)	1,155	54 (5%)
Mar	2,025	26 (1%)	1,116	56 (5%)	3,044	55 (2%)	1,424	52 (4%)
Apr	5,298	54 (1%)	4,710	79 (2%)	6,019	52 (1%)	4,836	114 (2%)
May	6,586	58 (1%)	5,625	92 (2%)	7,376	28 (0%)	5,840	55 (1%)
Jun	8,721	85 (1%)	7,507	125 (2%)	8,970	-10 (0%)	7,389	-34 (0%)
Jul	8,466	80 (1%)	7,354	110 (1%)	8,762	-4 (0%)	7,256	-27 (0%)
Aug	7,889	83 (1%)	6,561	119 (2%)	8,146	10 (0%)	6,518	-4 (0%)
Sep	5,949	65 (1%)	4,750	95 (2%)	6,135	8 (0%)	4,778	10 (0%)
Total (TAF)	3,434	39 (1%)	2,874	53 (2%)	3,855	22 (1%)	3,000	27 (1%)

Source: Common Assumptions Common Modeling Package, version 8D CalSim-II 2005 and 2030 simulations (Nodes DEL_SWP_PAG and DEL_SWP_PMI)

Notes:

Simulation period: 1922-1994. Change as measured from either existing condition or No-Action Alternative. Dry and critical years as defined by the Sacramento Valley Index.

Key:

cfs = cubic feet per second

CP = Comprehensive Plan

TAF = Thousand acre-feet

Impact H&H-12 (CP1): Change in Groundwater Levels CP1 would deliver additional surface water to CVP and SWP water contractors, reducing their need to pump groundwater. The reduction in groundwater pumping would result in increased groundwater levels. Therefore, this impact would be beneficial for groundwater levels.

With increased water supply deliveries to CVP and SWP water contractors, and an associated increase in surface water supply reliability to those contractors, shortages in deliveries would decrease under CP1. Contractor responses to shortages in surface water deliveries would vary; some may elect to fallow their land, others may buy water on the transfer market, and some may pump groundwater. An increase in surface water deliveries would result in a decrease in groundwater pumping. With less groundwater pumping, groundwater basins that are in overdraft conditions would be anticipated to recover as a result of increasing groundwater levels.

Accordingly, this impact would be beneficial. Mitigation for this impact is not needed, and thus not proposed.

Impact H&H-13 (CP1): Change in Groundwater Quality CP1 would deliver additional surface water to CVP and SWP water contractors, reducing their need to pump groundwater. The reduction in groundwater pumping could improve groundwater quality. Therefore, this impact would be less than significant for groundwater quality.

This impact would be beneficial for groundwater levels and less than significant for groundwater quality. With increased water supply deliveries to CVP and SWP water contractors, and an associated increase in surface water supply reliability to those contractors, shortages in deliveries would decrease under CP1. Contractor responses to shortages in surface water deliveries would vary; some may elect to fallow their land, others may buy water on the transfer market, and some may pump groundwater. An increase in surface water deliveries would result in a decrease in groundwater pumping. Because CP1 would have a positive, albeit limited, impact by reducing reliance on groundwater, it is anticipated that the impacts of CP1 on groundwater quality would be also limited.

Accordingly, this impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

CP2 – 12.5-Foot Dam Raise, Anadromous Fish Survival and Water Supply Reliability

Operations under CP2 would be similar to CP1, except the Shasta Dam and Reservoir enlargement would be 12.5 feet and 443 TAF, respectively, rather than 6.5 feet and 256 TAF, respectively. With the increased storage capacity at Shasta Reservoir, there would be minor changes in operations. However, all impacts would be similar to those observed under CP1. This section describes the environmental consequences of CP2.

Shasta Lake and Vicinity The significance criteria for H&H are not expected to apply in the Shasta Lake and Vicinity geographic region; therefore, potential effects in that geographic region are not discussed further in this PDEIS.

Upper Sacramento River (Shasta Dam to Red Bluff)

Impact H&H-1 (CP2): Change in Frequency of Flows Above 100,000 cfs on the Sacramento River Below Bend Bridge This impact would be similar to Impact H&H-1 (CP1) and would be beneficial. Mitigation for this impact is not needed, and thus not proposed.

Impact H&H-2 (CP2): Place Housing or Other Structures Within a 100-Year Flood Hazard Area as Mapped on a Federal Flood Hazard Boundary or Flood Insurance Rate Map or Other Flood Hazard Delineation Map This impact would be the same as Impact H&H-2 (CP1) and there would be no impact. Mitigation for this impact is not needed, and thus not proposed.

Impact H&H-3 (CP2): Place Within a 100-Year Flood Hazard Area Structures that Would Impede or Redirect Flood Flows This impact would be the same as Impact H&H-3 (CP1) and there would be no impact. Mitigation for this impact is not needed, and thus not proposed.

Lower Sacramento River and Delta

Impact H&H-4 (CP2): Change in Water Levels in Old River near Tracy Road Bridge Impact H&H-4 (CP2) would be very similar to Impact H&H-4 (CP1), except the amount of annual exports would be slightly greater under CP2. This impact would be less than significant.

Table 6-44, shows maximum monthly changes in minimum daily Old River water levels near Tracy Road Bridge. Under the existing condition, CP2 would result in 3 months during the irrigation season when the maximum change in water level at low-low tide would exceed 0.1 foot. Compared to the No-Action Alternative, there would be 24 months with maximum changes in water levels exceeding 0.1 foot. A change of 24 months represents less than 5 percent of the irrigation season during the period of record.

Because of the low incidence of changes in minimum daily water level exceeding 0.1 foot, this impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Table 6-44. Simulated Monthly Maximum 15-Minute Change in Old River Water Levels near Tracy Road Bridge at Low-Low Tide

Month	Change from Existing Condition	Change from No-Action Alternative
	CP2 (2005) Change (feet)	CP2 (2030) Change (feet)
April	-0.06 (0)	-0.30 (3)
May	-0.14 (1)	-0.13 (2)
June	-0.13 (1)	-0.16 (2)
July	-0.11 (1)	-0.30 (9)
August	-0.06 (0)	-0.20 (3)
September	-0.07 (0)	-0.18 (2)
October	-0.07 (0)	-0.13 (3)

Source: Common Assumptions Common Modeling Package Version 8D DSM2 2005 and 2030 simulations (Node 071_0)

Notes:

Simulation period: 1922-1994

Number in parentheses indicates number of months with a maximum decrease in water level exceeding 0.1 foot

Key:

CP = Comprehensive Plan

Impact H&H-5 (CP2): Change in Water Levels in the Grant Line Canal near the Grant Line Canal Barrier Impact H&H-5 (CP2) would be very similar to Impact H&H-5 (CP1), except the amount of Delta exports would be slightly greater under CP2. This impact would be less than significant.

Table 6-45 shows maximum monthly changes in minimum daily Grant Line Canal water levels above the Grant Line Canal Barrier. Under existing condition, CP2 would result in 4 months during the irrigation season when the maximum change in water level at low-low tide would exceed 0.1 foot. Compared to the No-Action Alternative, there would be 15 months with maximum changes in water levels exceeding 0.1 foot. A change of 15 months represents less than 3 percent of the irrigation season during the period of record.

Because of the low incidence of changes in minimum daily water level exceeding 0.1 foot, this impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Table 6-45. Simulated Monthly Maximum 15-Minute Change in Grant Line Canal Water Levels near the Grant Line Canal Barrier at Low-Low Tide

Month	Change from Existing Condition	Change from No-Action Alternative
	CP2 (2005) Change (feet)	CP2 (2030) Change (feet)
April	-0.05 (0)	-0.24 (2)
May	-0.11 (1)	-0.13 (1)
June	-0.11 (1)	-0.10 (0)
July	-0.11 (2)	-0.25 (7)
August	-0.07 (0)	-0.19 (1)
September	-0.07 (0)	-0.17 (2)
October	-0.08 (0)	-0.11 (2)

Source: Common Assumptions Common Modeling Package Version 8D DSM2 2005 and 2030 simulations (Node 206_5533)

Notes:

Simulation period: 1922-1994

Number in parentheses indicates number of months with a maximum decrease in water level exceeding 0.1 foot

Key:

CP = Comprehensive Plan

Impact H&H-6 (CP2): Change in Water Levels in the Middle River near the Howard Road Bridge Impact H&H-6 (CP2) would be very similar to Impact H&H-6 (CP1), except the amount of Delta export would be slightly greater under CP2, resulting in slightly different south Delta water levels. This impact would be less than significant.

Table 6-46 shows maximum monthly changes in minimum daily Middle River water levels near the Howard Road Bridge. Under the existing condition, CP2 would result in 2 months during the irrigation season when the maximum change in water level at low-low tide would exceed 0.1 foot. Compared to the No-Action Alternative, there would be 21 months with maximum changes in water levels exceeding 0.1 foot. A change of 21 months represents 4 percent of the irrigation season during the period of record.

Because of the low incidence of changes in minimum daily water level exceeding 0.1 foot, this impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Table 6-46. Simulated Monthly Maximum 15-Minute Change in Middle River Water Levels near the Howard Road Bridge at Low-Low Tide

Month	Change from Existing Condition	Change from No-Action Alternative
	CP2 (2005) Change (feet)	CP2 (2030) Change (feet)
April	-0.04 (0)	-0.30 (3)
May	-0.08 (0)	-0.12 (1)
June	-0.12 (1)	-0.10 (1)
July	-0.10 (1)	-0.26 (9)
August	-0.04 (0)	-0.21 (2)
September	-0.02 (0)	-0.17 (2)
October	-0.02 (0)	-0.12 (3)

Source: Common Assumptions Common Modeling Package Version 8D DSM2 2005 and 2030 simulations (Node 129_0)

Notes:

Simulation period: 1922-1994

Number in parentheses indicates number of months with a maximum decrease in water level exceeding 0.1 foot

Key:

CP = Comprehensive Plan

Impact H&H-7 (CP2): Change in X2 Position Changes in X2 position from west of either Collinsville or Chipps Island, depending on the applicable standard, would be extremely rare, so this impact would be less than significant.

Similar to Impact H&H-7 (CP1) examination of simulation output indicates that compared to the existing condition, there would be no months when the No-Action Alternative would cause the X2 position to shift from either west of Collinsville or Chipps Island, depending on the applicable standard, to east of the respective location. Compared to the No-Action Alternative, there would be 1 month, December 1929, when the X2 position would change from west to east of Collinsville. Under the No-Action Alternative, the X2 position would be at 80.97 km, and under CP2, it would be at 81.04 km, a 0.07 km shift.

Because of the extremely rare occurrence and the very low magnitude of change, this impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact H&H-8 (CP2): Change in Recurrence of Delta Excess Conditions Changes from excess to balance Delta conditions would be very rare, so this impact would be less than significant.

As shown in Table 6-47, CP2 would cause one February and one September to change from excess to balanced Delta conditions when compared to the existing condition, and three Julys, two Augusts, and one each of January, June, September, and November when compared to the No-Action Alternative.

Because of the low number of occurrences, this impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Table 6-47. Simulated Number of Years the Delta Changes from Excess to Balanced Condition

	Number of Years the Delta Changes from Excess to Balanced Conditions Compared to Existing Condition or No-Action Alternative											
	Jan	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
CP1 (2005)	0 (0%)	1 (1%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	1 (1%)	0 (0%)	0 (0%)	0 (0%)
CP1 (2030)	1 (1%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	1 (1%)	3 (4%)	2 (2%)	1 (1%)	0 (0%)	1 (1%)	0 (0%)

Source: Common Assumptions Common Modeling Package Version 8D CalSim-II 2005 and 2030 simulations
Notes:
Simulation Period: 1922-2003
Number in parentheses indicates percentage of months Delta condition change occurs
Key:
CP = Comprehensive Plan

CVP/SWP Service Areas

Impact H&H-9 (CP2): Change in Deliveries to North-of-Delta CVP Water Service Contractors and Refuges Impact H&H-9 (CP2) would be similar to Impact H&H-9 (CP1) except the increase in deliveries would be greater under CP2. Therefore, this impact would be beneficial.

As shown in Table 6-48, average annual and average monthly deliveries under both existing and future conditions would increase relative to the basis of comparison when averaging all years, and dry and critical years.

Therefore, Impact H&H-9 (CP2) would be beneficial. Mitigation for this impact is not needed, and thus not proposed.

Table 6-48. Simulated Monthly Average Deliveries and Percent Change of Deliveries to North-of-Delta CVP Water Service Contractors and Refuges

Month	Existing Condition (2005)				Future Condition (2030)			
	Average All Years		Dry and Critical Years		Average All Years		Dry and Critical Years	
	Existing Condition (cfs)	CP2 Change (cfs (%))	Existing Condition (cfs)	CP2 Change (cfs (%))	No-Action Alternative (cfs)	CP2 Change (cfs (%))	No-Action Alternative (cfs)	CP2 Change (cfs (%))
Oct	286	4 (1%)	280	5 (2%)	339	4 (1%)	332	4 (1%)
Nov	173	0 (0%)	170	0 (0%)	220	0 (0%)	217	0 (0%)
Dec	109	0 (0%)	108	0 (0%)	137	0 (0%)	135	0 (0%)
Jan	54	0 (0%)	53	0 (0%)	67	0 (0%)	66	0 (0%)
Feb	50	0 (0%)	54	0 (0%)	62	0 (0%)	64	0 (0%)
Mar	35	3 (9%)	33	5 (16%)	37	3 (8%)	36	5 (14%)
Apr	371	23 (6%)	249	36 (14%)	356	20 (6%)	236	32 (13%)
May	657	31 (5%)	382	47 (12%)	680	29 (4%)	389	43 (11%)
Jun	923	38 (4%)	522	58 (11%)	967	37 (4%)	537	56 (11%)
Jul	1,076	42 (4%)	608	66 (11%)	1,136	42 (4%)	631	63 (10%)
Aug	914	33 (4%)	541	53 (10%)	978	33 (4%)	574	51 (9%)
Sep	544	15 (3%)	357	24 (7%)	601	15 (3%)	399	22 (6%)
Total (TAF)	315	12 (4%)	204	18 (9%)	339	11 (4%)	219	17 (8%)

Source: Common Assumptions Common Modeling Package, version 8D CalSim-II 2005 and 2030 simulations (Nodes DEL_CVP_PAG_N and DEL_CVP_PRF_N)

Notes:

Simulation period: 1922-1994. Change as measured from either existing condition or No-Action Alternative. Dry and critical years as defined by the Sacramento Valley Index.

Key:

cfs = cubic feet per second

CP = Comprehensive Plan

TAF = Thousand acre-feet

Impact H&H-10 (CP2): Change in Deliveries to South-of-Delta CVP Water Service Contractors and Refuges Impact H&H-10 (CP2) would be similar to Impact H&H-10 (CP1) except the increase in deliveries would be greater under CP2. Therefore, this impact would be beneficial.

As shown in Table 6-49, average annual and average monthly deliveries under both existing and future conditions would increase relative to the basis of comparison when averaging all years, and dry and critical years.

Therefore, Impact H&H-10 (CP2) would be beneficial. Mitigation for this impact is not needed, and thus not proposed.

Table 6-49. Simulated Monthly Average Deliveries and Percent Change of Deliveries to South-of-Delta CVP Water Service Contractors and Refuges

Month	Existing Condition (2005)				Future Condition (2030)			
	Average All Years		Dry and Critical Years		Average All Years		Dry and Critical Years	
	Existing Condition (cfs)	CP2 Change (cfs (%))	Existing Condition (cfs)	CP2 Change (cfs (%))	No-Action Alternative (cfs)	CP2 Change (cfs (%))	No-Action Alternative (cfs)	CP2 Change (cfs (%))
Oct	1,694	11 (1%)	1,551	19 (1%)	1,631	12 (1%)	1,488	18 (1%)
Nov	1,157	9 (1%)	1,051	15 (1%)	1,116	11 (1%)	1,010	13 (1%)
Dec	925	12 (1%)	788	20 (3%)	916	15 (2%)	780	18 (2%)
Jan	1,178	21 (2%)	946	35 (4%)	1,208	26 (2%)	974	32 (3%)
Feb	1,434	27 (2%)	1,134	45 (4%)	1,478	33 (2%)	1,176	42 (4%)
Mar	853	28 (3%)	500	59 (12%)	906	27 (3%)	502	56 (11%)
Apr	1,376	31 (2%)	945	54 (6%)	1,428	33 (2%)	943	66 (7%)
May	2,307	40 (2%)	1,529	82 (5%)	2,344	50 (2%)	1,512	101 (7%)
Jun	3,587	67 (2%)	2,307	137 (6%)	3,674	83 (2%)	2,302	167 (7%)
Jul	3,838	81 (2%)	2,323	164 (7%)	3,980	100 (3%)	2,353	201 (9%)
Aug	2,897	59 (2%)	1,792	120 (7%)	2,987	50 (2%)	1,806	146 (8%)
Sep	1,780	19 (1%)	1,373	40 (3%)	1,743	24 (1%)	1,314	48 (4%)
Total (TAF)	1,392	24 (2%)	980	48 (5%)	1,415	28 (2%)	976	55 (6%)

Source: Common Assumptions Common Modeling Package, version 8D CalSim-II 2005 and 2030 simulations (Nodes DEL_CVP_PAG_S and DEL_CVP_PRF_S)

Notes:

Simulation period: 1922-1994. Change as measured from either existing condition or No-Action Alternative. Dry and critical years as defined by the Sacramento Valley Index.

Key:

cfs = cubic feet per second

CP = Comprehensive Plan

TAF = Thousand acre-feet

As shown in Table 6-50, average annual deliveries to SWP Table A contractors south of the Delta would increase under Alternative CP2 in both existing and future conditions relative to the bases of comparison in both average years and in dry and critical years. Under existing conditions, the average monthly deliveries would increase in all months, but there could be some decreases in deliveries under Alternative CP2 relative to the No-Action Alternative under

future conditions in both average annual and dry and critical years. These decreases would be less than 1 percent, and would therefore not be significant.

Therefore, Impact H&H-11 (CP2) would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Table 6-50. Simulated Monthly Average Deliveries and Percent Change of Deliveries to SWP Table A Contractors South-of-Delta

Month	Existing Condition (2005)				Future Condition (2030)			
	Average All Years		Dry and Critical Years		Average All Years		Dry and Critical Years	
	Existing Condition (cfs)	CP2 Change (cfs (%))	Existing Condition (cfs)	CP2 Change (cfs (%))	No-Action Alternative (cfs)	CP2 Change (cfs (%))	No-Action Alternative (cfs)	CP2 Change (cfs (%))
Oct	4,101	73 (2%)	3,598	70 (2%)	4,169	18 (0%)	3,675	37 (1%)
Nov	3,408	69 (2%)	2,876	67 (2%)	3,634	20 (1%)	3,086	41 (1%)
Dec	3,109	72 (2%)	2,605	67 (3%)	3,509	47 (1%)	2,945	78 (3%)
Jan	345	11 (3%)	242	8 (3%)	1,394	99 (7%)	643	58 (9%)
Feb	783	13 (2%)	490	17 (3%)	2,576	9 (0%)	1,155	48 (4%)
Mar	2,025	33 (2%)	1,116	70 (6%)	3,044	39 (1%)	1,424	14 (1%)
Apr	5,298	63 (1%)	4,710	90 (2%)	6,019	44 (1%)	4,836	105 (2%)
May	6,586	67 (1%)	5,625	91 (2%)	7,376	17 (0%)	5,840	35 (1%)
Jun	8,721	95 (1%)	7,507	116 (2%)	8,970	-23 (0%)	7,389	-65 (-1%)
Jul	8,466	83 (1%)	7,354	89 (1%)	8,762	-18 (0%)	7,256	-56 (-1%)
Aug	7,889	86 (1%)	6,561	103 (2%)	8,146	-1 (0%)	6,518	-28 (0%)
Sep	5,949	70 (1%)	4,750	84 (2%)	6,135	-1 (0%)	4,778	-7 (0%)
Total (TAF)	3,434	45 (1%)	2,874	53 (2%)	3,855	15 (0%)	3,000	15 (1%)

Source: Common Assumptions Common Modeling Package, version 8D CalSim-II 2005 and 2030 simulations (Nodes DEL_SWP_PAG and DEL_SWP_PMI)

Notes:

Simulation period: 1922-1994. Change as measured from either existing condition or No-Action Alternative. Dry and critical years as defined by the Sacramento Valley Index.

Key:

cfs = cubic feet per second

CP = Comprehensive Plan

TAF = Thousand acre-feet

Impact H&H-12 (CP2): Change in Groundwater Levels CP2 would deliver additional surface water to CVP and SWP water contractors, reducing their need to pump groundwater. The reduction in groundwater pumping would result in increased groundwater levels. Therefore, this impact would be beneficial for groundwater levels.

With increased water supply deliveries to CVP and SWP water contractors, and an associated increase in surface water supply reliability to those contractors, shortages in deliveries would decrease under CP2. Contractor responses to shortages in surface water deliveries would vary; some may elect to fallow their land, others may buy water on the transfer market, and some may pump groundwater. An increase in surface water deliveries would result in a decrease in groundwater pumping. With less groundwater pumping, groundwater basins

that are in overdraft conditions would be anticipated to recover as a result of increasing groundwater levels.

Accordingly, this impact would be beneficial. Mitigation for this impact is not needed, and thus not proposed.

Impact H&H-13 (CP2): Change in Groundwater Quality CP2 would deliver additional surface water to CVP and SWP water contractors, reducing their need to pump groundwater. The reduction in groundwater pumping could improve groundwater quality. Therefore, this impact would be less than significant for groundwater quality.

With increased water supply deliveries to CVP and SWP water contractors, and an associated increase in surface water supply reliability to those contractors, shortages in deliveries would decrease under CP2. Contractor responses to shortages in surface water deliveries would vary; some may elect to fallow their land, others may buy water on the transfer market, and some may pump groundwater. An increase in surface water deliveries would result in a decrease in groundwater pumping. Because CP2 would have a positive, albeit limited, impact by reducing reliance on groundwater, it is anticipated that the impacts of CP2 on groundwater quality would be also limited.

Accordingly, this impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

CP3 – 18.5-Foot Dam Raise, Anadromous Fish Survival and Water Supply Reliability

Operations under CP3 would be similar to CP1, except the Shasta Dam and Reservoir enlargement would be 18.5 feet and 634 TAF, respectively, rather than 6.5 feet and 256 TAF, respectively. With the increased storage capacity of Shasta Reservoir, there would be minor changes in operations. However, all impacts would be similar to those observed under CP1. This section describes the environmental consequences of CP3.

Shasta Lake and Vicinity The significance criteria for H&H are not expected to apply in the Shasta Lake and Vicinity geographic region; therefore, potential effects in that geographic region are not discussed further in this PDEIS.

Upper Sacramento River (Shasta Dam to Red Bluff)

Impact H&H-1 (CP3): Change in Frequency of Flows Above 100,000 cfs on the Sacramento River Below Bend Bridge This impact would be similar to Impact H&H-1 (CP1) and would be beneficial. Mitigation for this impact is not needed, and thus not proposed.

Impact H&H-2 (CP3): Place Housing or Other Structures Within a 100-Year Flood Hazard Area as Mapped on a Federal Flood Hazard Boundary or Flood Insurance Rate Map or Other Flood Hazard Delineation Map This impact

would be the same as Impact H&H-2 (CP1) and there would be no impact. Mitigation for this impact is not needed, and thus not proposed.

Impact H&H-3 (CP3): Place Within a 100-Year Flood Hazard Area Structures that Would Impede or Redirect Flood Flows This impact would be the same as Impact H&H-3 (CP1) and there would be no impact. Mitigation for this impact is not needed, and thus not proposed.

Lower Sacramento River and Delta

Impact H&H-4 (CP3): Change in Water Levels in Old River near Tracy Road Bridge Impact H&H-4 (CP3) would be very similar to Impact H&H-1 (CP1), except export amounts would be slightly higher under CP3, resulting in slightly different water levels. This impact would be less than significant.

Table 6-51 shows the maximum monthly change in minimum daily Old River water levels near Tracy Road Bridge. Under existing condition, Alternative CP3 would result in 4 months during the irrigation season when the maximum change in water level at low-low tide would exceed 0.1 foot. Compared to the No-Action Alternative, there would be 33 months with maximum changes in water levels exceeding 0.1 foot. A change of 33 months represents 6 percent of the irrigation season during the period of record.

Because of the low incidence of changes in minimum daily water level exceeding 0.1 foot, this impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Table 6-51. Simulated Monthly Maximum 15-Minute Change in Old River Water Levels near Tracy Road Bridge at Low-Low Tide

Month	Change from Existing Condition	Change from No-Action Alternative
	CP3 (2005) Change (feet)	CP3 (2030) Change (feet)
April	-0.07 (0)	-0.32 (4)
May	-0.14 (1)	-0.14 (2)
June	-0.13 (2)	-0.16 (2)
July	-0.11 (1)	-0.26 (10)
August	-0.08 (0)	-0.26 (6)
September	-0.06 (0)	-0.18 (6)
October	-0.07 (0)	-0.14 (3)

Source: Common Assumptions Common Modeling Package Version 8D DSM2 2005 and 2030 simulations (Node 071_0)

Notes:

Simulation period: 1922-1994

Number in parentheses indicates number of months with a maximum decrease in water level exceeding 0.1 foot

Key:

CP = Comprehensive Plan

Impact H&H-5 (CP3): Change in Water Levels in the Grant Line Canal near the Grant Line Canal Barrier Impact H&H-2 (CP3) would be very similar to Impact H&H-5 (CP1), except Delta export amounts would be slightly higher under CP3. This impact would be less than significant.

Table 6-52 shows the maximum monthly change in minimum daily Grant Line Canal water levels above the Grant Line Canal Barrier. Under the existing condition, CP3 would result in 6 months during the irrigation season when the maximum change in water level at low-low tide would exceed 0.1 foot. Compared to the No-Action Alternative, there would be 26 months with maximum changes in water levels exceeding 0.1 foot. A change of 26 months represents 5 percent of the irrigation season during the period of record.

Because of the low incidence of changes in minimum daily water level exceeding 0.1 foot, this impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Table 6-52. Simulated Monthly Maximum 15-Minute Change in Tyrant Line Canal Water Levels near the Grant Line Canal Barrier at Low-Low Tide

Month	Change from Existing Condition	Change from No-Action Alternative
	CP3 (2005) Change (feet)	CP3 (2030) Change (feet)
April	-0.07 (0)	-0.25 (3)
May	-0.11 (1)	-0.13 (1)
June	-0.11 (2)	-0.10 (0)
July	-0.11 (3)	-0.25 (11)
August	-0.09 (0)	-0.25 (5)
September	-0.06 (0)	-0.17 (4)
October	-0.08 (0)	-0.13 (2)

Source: Common Assumptions Common Modeling Package Version 8D DSM2 2005 and 2030 simulations (Node 206_5533)

Notes:

Simulation period: 1922-1994

Number in parentheses indicates number of months with a maximum decrease in water level exceeding 0.1 foot

Key:

CP = Comprehensive Plan

Impact H&H-6 (CP3): Change in Water Levels in the Middle River near the Howard Road Bridge Impact H&H-6 (CP3) would be very similar to Impact H&H-6 (CP1), except Delta export amounts would be slightly higher under CP3, resulting in slightly different south Delta water levels. Changes in water levels would be very rare; therefore, this impact would be less than significant.

Table 6-53 shows maximum monthly changes in minimum daily Middle River water levels near the Howard Road Bridge. Under the existing condition, CP3 would result in 4 months during the irrigation season when the maximum change in water level at low-low tide would exceed 0.1 foot. Compared to the No-Action Alternative, there would be 30 months with maximum changes in water levels exceeding 0.1 foot. A change of 30 months represents less than 6 percent of the irrigation season during the period of record.

Because of the low incidence of changes in minimum daily water level exceeding 0.1 foot, this impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Table 6-53. Simulated Monthly Maximum 15-Minute Change in Middle River Water Levels near the Howard Road Bridge at Low-Low Tide

Month	Change from Existing Condition	Change from No-Action Alternative
	CP3 (2005) Change (feet)	CP3 (2030) Change (feet)
April	-0.05 (0)	-0.31 (3)
May	-0.09 (0)	-0.12 (1)
June	-0.17 (1)	-0.10 (1)
July	-0.13 (3)	-0.26 (11)
August	-0.07 (0)	-0.27 (5)
September	-0.03 (0)	-0.17 (6)
October	-0.04 (0)	-0.14 (3)

Source: Common Assumptions Common Modeling Package Version 8D DSM2 2005 and 2030 simulations (Node 129_0)

Notes:

Simulation period: 1922-1994

Number in parentheses indicates number of months with a maximum decrease in water level exceeding 0.1 foot

Key:

CP = Comprehensive Plan

Impact H&H-7 (CP3): Change in X2 Position Changes in X2 position from west of either Collinsville or Chipps Island, depending on the applicable standard, would be extremely rare, so this impact would be less than significant.

Similar to Impact H&H-7 (CP1), examination of simulation output indicates that compared to the existing condition there would be no months when the No-Action Alternative would cause the X2 position to shift from either west of Collinsville or Chipps Island, depending on the applicable standard, to east of the respective location. Compared to the No-Action Alternative, there would be 1 month, December 1929, when the X2 position would change from west to east of Collinsville. Under the No-Action Alternative, the X2 position would be at 80.97 km, and under CP3, it would be at 81.05 km, a 0.08 km shift.

Because of the extremely rare occurrence and the very low magnitude of change, this impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact H&H-8 (CP3): Change in Recurrence of Delta Excess Condition Changes from excess to balance Delta conditions would be very rare, so this impact would be less than significant.

As shown in Table 6-54, CP3 would cause three Februarys and one September to change from excess to balanced Delta conditions when compared to the existing condition, and three Julys, two Augusts, and one each of January, June, September, and November when compared to the No-Action Alternative.

Because of the low number of occurrences, this impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Table 6-54. Simulated Number of Years the Delta Changes from Excess to Balanced Condition

	Number of Years the Delta Changes from Excess to Balanced Conditions Compared to Existing Condition or No-Action Alternative											
	Jan	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
CP1 (2005)	0 (0%)	3 (4%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	1 (1%)	0 (0%)	0 (0%)	0 (0%)
CP1 (2030)	1 (1%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	1 (1%)	3 (4%)	2 (2%)	1 (1%)	0 (0%)	1 (1%)	0 (0%)

Source: Common Assumptions Common Modeling Package Version 8D CalSim-II 2005 and 2030 simulations
Notes:
Simulation Period: 1922-2003
Number in parentheses indicates percentage of months Delta condition change occurs
Key:
CP = Comprehensive Plan

CVP/SWP Service Areas

Impact H&H-9 (CP3): Change in Deliveries to North-of-Delta CVP Water Service Contractors and Refuges Impact H&H-9 (CP3) would be similar to Impact H&H-9 (CP1) except the increase in deliveries would be greater under CP3. Therefore, this impact would be beneficial.

As shown in Table 6-55, average annual and average monthly deliveries under both existing and future conditions would increase relative to the basis of comparison when averaging all years, and dry and critical years.

Therefore, Impact H&H-9 (CP3) would be beneficial. Mitigation for this impact is not needed, and thus not proposed.

Table 6-55. Simulated Monthly Average Deliveries and Percent Change of Deliveries to North-of-Delta CVP Water Service Contractors and Refuges

Month	Existing Condition (2005)				Future Condition (2030)			
	Average All Years		Dry and Critical Years		Average All Years		Dry and Critical Years	
	Existing Condition (cfs)	CP3 Change (cfs (%))	Existing Condition (cfs)	CP3 Change (cfs (%))	No-Action Alternative (cfs)	CP3 Change (cfs (%))	No-Action Alternative (cfs)	CP3 Change (cfs (%))
Oct	286	5 (2%)	280	7 (2%)	339	6 (2%)	332	6 (2%)
Nov	173	0 (0%)	170	0 (0%)	220	0 (0%)	217	0 (0%)
Dec	109	0 (0%)	108	0 (0%)	137	0 (0%)	135	0 (0%)
Jan	54	0 (0%)	53	0 (0%)	67	0 (0%)	66	0 (0%)
Feb	50	0 (0%)	54	0 (0%)	62	0 (0%)	64	0 (0%)
Mar	35	5 (13%)	33	8 (23%)	37	5 (13%)	36	7 (22%)
Apr	371	30 (8%)	249	47 (19%)	356	32 (9%)	236	52 (21%)
May	657	40 (6%)	382	60 (16%)	680	45 (7%)	389	69 (18%)
Jun	923	49 (5%)	522	75 (14%)	967	57 (6%)	537	88 (17%)
Jul	1,076	55 (5%)	608	85 (14%)	1,136	65 (6%)	631	100 (16%)
Aug	914	44 (5%)	541	68 (12%)	978	52 (6%)	574	80 (15%)
Sep	544	20 (4%)	357	31 (9%)	601	23 (4%)	399	35 (10%)
Total (TAF)	315	15 (5%)	204	23 (11%)	339	17 (5%)	219	27 (13%)

Source: Common Assumptions Common Modeling Package, version 8D CalSim-II 2005 and 2030 simulations (Nodes DEL_CVP_PAG_N and DEL_CVP_PRF_N)

Notes:

Simulation period: 1922-1994. Change as measured from either existing condition or No-Action Alternative. Dry and critical years as defined by the Sacramento Valley Index.

Key:

cfs = cubic feet per second

CP = Comprehensive Plan

TAF = Thousand acre-feet

Impact H&H-10 (CP3): Change in Deliveries to South-of-Delta CVP Water Service Contractors and Refuges Impact H&H-10 (CP3) would be similar to Impact H&H-10 (CP1) except the increase in deliveries would be greater under CP3. Therefore, this impact would be beneficial.

As shown in Table 6-56, average annual and average monthly deliveries under both existing and future conditions would increase relative to the basis of comparison when averaging all years, and dry and critical years.

Therefore, Impact H&H-10 (CP3) would be beneficial. Mitigation for this impact is not needed, and thus not proposed.

Table 6-56. Simulated Monthly Average Deliveries and Percent Change of Deliveries to South-of-Delta CVP Water Service Contractors and Refuges

Month	Existing Condition (2005)				Future Condition (2030)			
	Average All Years		Dry and Critical Years		Average All Years		Dry and Critical Years	
	Existing Condition (cfs)	CP3 Change (cfs (%))	Existing Condition (cfs)	CP3 Change (cfs (%))	No-Action Alternative (cfs)	CP3 Change (cfs (%))	No-Action Alternative (cfs)	CP3 Change (cfs (%))
Oct	1,694	13 (1%)	1,551	25 (2%)	1,631	20 (1%)	1,488	26 (2%)
Nov	1,157	10 (1%)	1,051	19 (2%)	1,116	15 (1%)	1,010	19 (2%)
Dec	925	14 (1%)	788	26 (3%)	916	21 (2%)	780	27 (3%)
Jan	1,178	24 (2%)	946	45 (5%)	1,208	37 (3%)	974	47 (5%)
Feb	1,434	31 (2%)	1,134	59 (5%)	1,478	47 (3%)	1,176	61 (5%)
Mar	853	38 (4%)	500	68 (14%)	906	45 (5%)	502	78 (16%)
Apr	1,376	31 (2%)	945	52 (6%)	1,428	45 (3%)	943	94 (10%)
May	2,307	46 (2%)	1,529	90 (6%)	2,344	70 (3%)	1,512	147 (10%)
Jun	3,587	77 (2%)	2,307	150 (7%)	3,674	116 (3%)	2,302	245 (11%)
Jul	3,838	92 (2%)	2,323	180 (8%)	3,980	140 (4%)	2,353	294 (13%)
Aug	2,897	67 (2%)	1,792	131 (7%)	2,987	78 (3%)	1,806	213 (12%)
Sep	1,780	22 (1%)	1,373	43 (3%)	1,743	34 (2%)	1,314	71 (5%)
Total (TAF)	1,392	28 (2%)	980	54 (5%)	1,415	40 (3%)	976	80 (8%)

Source: Common Assumptions Common Modeling Package, version 8D CalSim-II 2005 and 2030 simulations (Nodes DEL_CVP_PAG_S and DEL_CVP_PRF_S)

Notes:

Simulation period: 1922-1994.

Change as measured from either existing condition or No-Action Alternative.

Dry and critical years as defined by the Sacramento Valley Index.

Key:

cfs = cubic feet per second

CP = Comprehensive Plan

TAF = Thousand acre-feet

Impact H&H-11 (CP3): Change in Deliveries to SWP Table A Contractors South of the Delta Impact H&H-11 (CP3) would be similar to Impact H&H-11 (CP1) except the increase in average annual deliveries would be greater, and potential decreases in average monthly deliveries in some months could be slightly larger under CP3. Therefore, this impact would be less than significant.

As shown in Table 6-57, average annual deliveries to SWP Table A contractors south of the Delta would increase under Alternative CP2 in both existing and future conditions relative to the bases of comparison in both average years and in dry and critical years. Under existing conditions, the average monthly deliveries would increase in all months, but there could be some decreases in deliveries under Alternative CP3 relative to the No-Action Alternative under future conditions in both average annual and dry and critical years. These decreases would be around 1 percent, and would therefore not be significant.

Therefore, Impact H&H-11 (CP3) would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Table 6-57. Simulated Monthly Average Deliveries and Percent Change of Deliveries to SWP Table A Contractors South-of-Delta

Month	Existing Condition (2005)				Future Condition (2030)			
	Average All Years		Dry and Critical Years		Average All Years		Dry and Critical Years	
	Existing Condition (cfs)	CP3 Change (cfs (%))	Existing Condition (cfs)	CP3 Change (cfs (%))	No-Action Alternative (cfs)	CP3 Change (cfs (%))	No-Action Alternative (cfs)	CP3 Change (cfs (%))
Oct	4,101	63 (2%)	3,598	49 (1%)	4,169	26 (1%)	3,675	41 (1%)
Nov	3,408	60 (2%)	2,876	51 (2%)	3,634	25 (1%)	3,086	42 (1%)
Dec	3,109	63 (2%)	2,605	51 (2%)	3,509	53 (2%)	2,945	77 (3%)
Jan	345	10 (3%)	242	5 (2%)	1,394	95 (7%)	643	59 (9%)
Feb	783	13 (2%)	490	16 (3%)	2,576	3 (0%)	1,155	44 (4%)
Mar	2,025	31 (2%)	1,116	68 (6%)	3,044	20 (1%)	1,424	-18 (-1%)
Apr	5,298	54 (1%)	4,710	67 (1%)	6,019	48 (1%)	4,836	110 (2%)
May	6,586	56 (1%)	5,625	70 (1%)	7,376	22 (0%)	5,840	41 (1%)
Jun	8,721	74 (1%)	7,507	76 (1%)	8,970	-39 (0%)	7,389	-112 (-2%)
Jul	8,466	75 (1%)	7,354	74 (1%)	8,762	-10 (0%)	7,256	-43 (-1%)
Aug	7,889	79 (1%)	6,561	88 (1%)	8,146	2 (0%)	6,518	-17 (0%)
Sep	5,949	64 (1%)	4,750	74 (2%)	6,135	6 (0%)	4,778	4 (0%)
Total (TAF)	3,434	39 (1%)	2,874	42 (1%)	3,855	15 (0%)	3,000	14 (0%)

Source: Common Assumptions Common Modeling Package, version 8D CalSim-II 2005 and 2030 simulations (Nodes DEL_SWP_PAG and DEL_SWP_PMI)

Notes:

Simulation period: 1922-1994.

Change as measured from either existing condition or No-Action Alternative.

Dry and critical years as defined by the Sacramento Valley Index.

Key:

cfs = cubic feet per second

CP = Comprehensive Plan

TAF = Thousand acre-feet

Impact H&H-12 (CP3): Change in Groundwater Levels CP3 would deliver additional surface water to CVP and SWP water contractors, reducing their need to pump groundwater. The reduction in groundwater pumping would result in increased groundwater levels. Therefore, this impact would be beneficial for groundwater levels.

With increased water supply deliveries to CVP and SWP water contractors, and an associated increase in surface water supply reliability to those contractors, shortages in deliveries would decrease under CP3. Contractor responses to shortages in surface water deliveries would vary; some may elect to fallow their land, others may buy water on the transfer market, and some may pump groundwater. An increase in surface water deliveries would result in a decrease in groundwater pumping. With less groundwater pumping, groundwater basins that are in overdraft conditions would be anticipated to recover as a result of increasing groundwater levels.

Therefore, this impact would be beneficial. Mitigation for this impact is not needed, and thus not proposed.

Impact H&H-13 (CP3): Change in Groundwater Quality CP3 would deliver additional surface water to CVP and SWP water contractors, reducing their need to pump groundwater. The reduction in groundwater pumping could improve groundwater quality. Therefore, this impact would less than significant for groundwater quality.

With increased water supply deliveries to CVP and SWP water contractors, and an associated increase in surface water supply reliability to those contractors, shortages in deliveries would decrease under CP3. Contractor responses to shortages in surface water deliveries would vary; some may elect to fallow their land, others may buy water on the transfer market, and some may pump groundwater. An increase in surface water deliveries would result in a decrease in groundwater pumping. Because CP3 would have a positive, albeit limited, impact by reducing reliance on groundwater, it is anticipated that the impacts of CP3 on groundwater quality would be also limited.

Therefore, this impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

CP4 – 18.5-Foot Dam Raise, Anadromous Fish Focus With Water Supply Reliability

CP4 would differ from the No-Action Alternative primarily through a 634 TAF enlargement of Shasta Reservoir, with 256 TAF operated for water supply reliability, and 378 TAF of the storage dedicated to anadromous fish survivability, through an increase in available cold water for release to the Sacramento River. This section describes the environmental consequences of CP4.

Shasta Lake and Vicinity The significance criteria for H&H are not expected to apply in the Shasta Lake and Vicinity geographic region; therefore, potential effects in that geographic region are not discussed further in this PDEIS.

Upper Sacramento River (Shasta Dam to Red Bluff)
Impact H&H-1 (CP4). Change in Frequency of Flows Above 100,000 cfs on the Sacramento River Below Bend Bridge This impact would be similar to Impact H&H-1 (CP1) and would be beneficial. Mitigation for this impact is not needed, and thus not proposed.

Impact H&H-2 (CP4). Place Housing or Other Structures Within a 100-Year Flood Hazard Area as Mapped on a Federal Flood Hazard Boundary or Flood Insurance Rate Map or Other Flood Hazard Delineation Map This impact would be the same as Impact H&H-2 (CP1) and there would be no impact. Mitigation for this impact is not needed, and thus not proposed.

Impact H&H-3 (CP4). Place Within a 100-Year Flood Hazard Area Structures that Would Impede or Redirect Flood Flows This impact would be the same as Impact H&H-3 (CP1) and there would be no impact. Mitigation for this impact is not needed, and thus not proposed.

Lower Sacramento River and Delta
Impact H&H-4 (CP4). Change in Water Levels in Old River near Tracy Road Bridge This impact would be the same as Impact H&H-4 (CP1) and would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact H&H-5 (CP4). Change in Water Levels in the Grant Line Canal near the Grant Line Canal Barrier This impact would be the same as Impact H&H-5 (CP1) and would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact H&H-6 (CP4). Change in Water Levels in Middle River near the Howard Road Bridge This impact would be the same as Impact H&H-6 (CP1) and would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact H&H-7 (CP4): Change in X2 Position This impact would be the same as Impact H&H-7 (CP1) and would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact H&H-8 (CP4): Change in Recurrence of Delta Excess Conditions
This impact would be the same as Impact H&H-8 (CP1) and would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

CVP/SWP Service Areas
Impact H&H-9 (CP4): Change in Deliveries to North-of-Delta CVP Water Service Contractors and Refuges This impact would be the same as Impact

H&H-9 (CP1) and would be beneficial. Mitigation for this impact is not needed, and thus not proposed.

Impact H&H-10 (CP4): Change in Deliveries to South-of-Delta CVP Water Service Contractors and Refuges This impact would be the same as Impact H&H-10 (CP1) and would be beneficial. Mitigation for this impact is not needed, and thus not proposed.

Impact H&H-11 (CP4): Change in Deliveries to SWP Table A Contractors South of the Delta This impact would be the same as Impact H&H-11 (CP1) and would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact H&H-12 (CP4). Change in Groundwater Levels This impact would be the same as Impact H&H-12 (CP1) and would be beneficial. Mitigation for this impact is not needed, and thus not proposed.

Impact H&H-13 (CP4). Change in Groundwater Quality This impact would be the same as Impact H&H-13 (CP1) and would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

CP5 – 18.5-Foot Dam Raise Combination Plan

CP5 would differ from the No-Action Alternative primarily through a 634 TAF enlargement of Shasta Reservoir with additional recreation facilities at Shasta Lake and environmental restoration to the lower ends of the Shasta Lake tributaries. This section describes the environmental consequences of CP5.

Shasta Lake and Vicinity The significance criteria for H&H are not expected to apply in the Shasta Lake and Vicinity geographic region; therefore, potential effects in that geographic region are not discussed further in this PDEIS.

Upper Sacramento River (Shasta Dam to Red Bluff)

Impact H&H-1 (CP5). Change in Frequency of Flows Above 100,000 cfs on the Sacramento River Below Bend Bridge This impact would be similar to Impact H&H-1 (CP1) and would be beneficial. Mitigation for this impact is not needed, and thus not proposed.

Impact H&H-2 (CP5): Place Housing or Other Structures Within a 100-year Flood Hazard Area as Mapped on a Federal Flood Hazard Boundary or Flood Insurance Rate Map or Other Flood Hazard Delineation Map This impact would be the same as Impact H&H-2 (CP1) and there would be no impact. Mitigation for this impact is not needed, and thus not proposed.

Impact H&H-3 (CP5): Place Within a 100-Year Flood Hazard Area Structures that Would Impede or Redirect Flood Flows This impact would be the same as Impact H&H-3 (CP1) and there would be no impact. Mitigation for this impact is not needed, and thus not proposed.

Lower Sacramento River and Delta

Impact H&H-4 (CP5). Change in Water Levels in Old River near Tracy Road Bridge This impact would be the same as Impact H&H-4 (CP3) and would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact H&H-5 (CP5): Change in Water Levels in the Grant Line Canal near the Grant Line Canal Barrier This impact would be the same as Impact H&H-5 (CP3) and would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact H&H-6 (CP5): Change in water levels in Middle River near the Howard Road Bridge This impact would be the same as Impact H&H-6 (CP3) and would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact H&H-7 (CP5): Change in X2 Position This impact would be the same as Impact H&H-7 (CP3) and would be less than significant. Mitigation for this impact is not needed, and thus not proposed..

Impact H&H-8 (CP5): Change in Recurrence of Delta Excess Conditions This impact would be the same as Impact H&H-8 (CP3) and would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

CVP/SWP Service Areas

Impact H&H-9 (CP5): Change in Deliveries to North-of-Delta CVP Water Service Contractors and Refuges This impact would be the same as Impact H&H-9 (CP3) and would be beneficial. Mitigation for this impact is not needed, and thus not proposed.

Impact H&H-10 (CP5): Change in Deliveries to South-of-Delta CVP Water Service Contractors and Refuges This impact would be the same as Impact H&H-10 (CP3) and would be beneficial. Mitigation for this impact is not needed, and thus not proposed.

Impact H&H-11 (CP5): Change in Deliveries to SWP Table A Contractors South of the Delta This impact would be the same as Impact H&H-11 (CP3) and would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact H&H-12 (CP5): Change in Groundwater Levels This impact would be the same as Impact H&H-12 (CP3) and would be beneficial. Mitigation for this impact is not needed, and thus not proposed.

Impact H&H-13 (CP5): Change in Groundwater Quality This impact would be the same as Impact H&H-13 (CP3) and would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

6.3.4 Mitigation Measures

Table 6-58 presents a summary of the impacts related to hydrology, hydraulics, and water management. No significant impacts have been identified, and therefore no mitigation measures are proposed.

No-Action Alternative

No feasible mitigation is available to reduce the impacts of changes in level of development or new facility construction. Therefore, these potential impacts would remain significant and unavoidable.

CP1 – 6.5-Foot Dam Raise, Anadromous Fish Survival and Water Supply Reliability

No mitigation measures are required for this alternative.

CP2 – 12.5-Foot Dam Raise, Anadromous Fish Survival and Water Supply Reliability

No mitigation measures are required for this alternative.

CP3 – 18.5-Foot Dam Raise, Anadromous Fish Survival and Water Supply Reliability

No mitigation measures are required for this alternative.

CP4 – 18.5-Foot Dam Raise, Anadromous Fish Focus With Water Supply Reliability

No mitigation measures are required for this alternative.

CP5 – 18.5-Foot Dam Raise, Combination Plan

No mitigation measures are required for this alternative.

Table 6-58. Summary of Mitigation Measures for Hydrology, Hydraulics, and Water Management

Impact		No-Action Alternative	CP1	CP2	CP3	CP4	CP5
Impact H&H-1: Change in Frequency of Flows Above 100,000 cfs on the Sacramento River Below Bend Bridge	LOS before Mitigation	NI	B	B	B	B	B
	Mitigation Measure	None required.	No mitigation needed; thus, none proposed.				
	LOS after Mitigation	NI	B	B	B	B	B
Impact H&H-2: Place Housing or Other Structures Within a 100-Year Flood Hazard Area as Mapped on a Federal Flood Hazard Boundary or Flood Insurance Rate Map or Other Flood Hazard Delineation Map	LOS before Mitigation	NI	NI	NI	NI	NI	NI
	Mitigation Measure	None required.	No mitigation needed; thus, none proposed.				
	LOS after Mitigation	NI	NI	NI	NI	NI	NI
Impact H&H-3: Place Within a 100-Year Flood Hazard Area Structures that Would Impede or Redirect Flood Flows	LOS before Mitigation	NI	NI	NI	NI	NI	NI
	Mitigation Measure	None required.	No mitigation needed; thus, none proposed.				
	LOS after Mitigation	NI	NI	NI	NI	NI	NI
Impact H&H-4: Change in Water Levels in the Old River near Tracy Road Bridge	LOS before Mitigation	PS	LTS	LTS	LTS	LTS	LTS
	Mitigation Measure	None required	No mitigation needed; thus, none proposed.				
	LOS after Mitigation	PS	LTS	LTS	LTS	LTS	LTS
Impact H&H-5: Change in Water Levels in the Grant Line Canal near the Grant Line Canal Barrier	LOS before Mitigation	PS	LTS	LTS	LTS	LTS	LTS
	Mitigation Measure	None required	No mitigation needed; thus, none proposed.				
	LOS after Mitigation	PS	LTS	LTS	LTS	LTS	LTS
Impact H&H-6: Change in Water Levels in the Middle River near the Howard Road Bridge	LOS before Mitigation	PS	LTS	LTS	LTS	LTS	LTS
	Mitigation Measure	None required	No mitigation needed; thus, none proposed.				
	LOS after Mitigation	PS	LTS	LTS	LTS	LTS	LTS
Impact H&H-7: Change in X2 Position	LOS before Mitigation	NI	LTS	LTS	LTS	LTS	LTS
	Mitigation Measure	None required	No mitigation needed; thus, none proposed.				
	LOS after Mitigation	NI	LTS	LTS	LTS	LTS	LTS

Table 6-58. Summary of Mitigation Measures for Hydrology, Hydraulics, and Water Management (contd.)

Impact		No-Action Alternative	CP1	CP2	CP3	CP4	CP5
Impact H&H-8: Change in Recurrence of Delta Excess Conditions	LOS before Mitigation	PS	LTS	LTS	LTS	LTS	LTS
	Mitigation Measure	None required.	No mitigation needed; thus, none proposed.				
	LOS after Mitigation	PS	LTS	LTS	LTS	LTS	LTS
Impact H&H-9: Change in Deliveries to North-of-Delta CVP Water Service Contractors and Refuges	LOS before Mitigation	PS	B	B	B	B	B
	Mitigation Measure	None required.	No mitigation needed; thus, none proposed.				
	LOS after Mitigation	PS	B	B	B	B	B
Impact H&H-10: Change in Deliveries to South-of-Delta CVP Water Service Contractors and Refuges	LOS before Mitigation	PS	B	B	B	B	B
	Mitigation Measure	None required.	No mitigation needed; thus, none proposed.				
	LOS after Mitigation	PS	B	B	B	B	B
Impact H&H-11: Change in Deliveries to SWP Table A, Contractors South of the Delta	LOS before Mitigation	PS	LTS	LTS	LTS	LTS	LTS
	Mitigation Measure	None required.	No mitigation needed; thus, none proposed.				
	LOS after Mitigation	PS	LTS	LTS	LTS	LTS	LTS
Impact H&H-12: Change in Groundwater	LOS before Mitigation	LTS	B	B	B	B	B
	Mitigation Measure	None required.	No mitigation needed; thus, none proposed.				
	LOS after Mitigation	LTS	B	B	B	B	B
Impact H&H-13: Change in Groundwater Quality	LOS before Mitigation	LTS	LTS	LTS	LTS	LTS	LTS
	Mitigation Measure	None required.	No mitigation needed; thus, none proposed.				
	LOS after Mitigation	LTS	LTS	LTS	LTS	LTS	LTS

Notes:
B = beneficial
LOS = level of significance
LTS = less than significant
NI = No Impact
PS = potentially significant

6.3.5 Cumulative Effects

Chapter 3, "Considerations for Describing the Affected Environment and Environmental Consequences" discusses overall cumulative impacts of the project alternatives and, including the relationship to CALFED Programmatic Cumulative Impacts Analysis, qualitative and quantitative assessment, past and future actions in the study area, and significance criteria.

This section provides an analysis of overall cumulative impacts of the project alternatives with other past, present, and reasonably foreseeable future projects producing related impacts.

The projects listed in the quantitative analysis section of Chapter 3, "Considerations for Describing the Affected Environment and Environmental Consequences" are included in the 2030 level of development alternatives above. Accordingly, quantitative effects of the projects combined with the SLWRI alternatives are described in the Environmental Consequences section. The discussion below focuses on the qualitative effect of the SLWRI alternatives and the other past, present, and reasonably foreseeable future projects.

The effects of climate change on operations at Shasta Lake could potentially result in changes to hydrology, hydraulics, and water management. As described in the Climate Change Projection Appendix, climate change could result in higher reservoir releases in the winter and early spring due to an increase in runoff during these times. The change in winter and early spring releases could necessitate managing flood events resulting from potentially larger storms. Similarly, climate change could result in lower reservoir inflows and Sacramento tributary flows during the late spring and summer due to a decreased snow pack. This reduction in inflow and tributary flow could result in Shasta Lake storage being reduced due to both a reduced ability to capture flows, and an increased need to make releases to meet downstream requirements.

CP1 – 6.5-Foot Dam Raise, Anadromous Fish Survival and Water Supply Reliability

As described in Section 6.3.3 above, CP1 would not result in potentially significant impacts.

When combined with other past, present, and reasonably foreseeable future projects, it is likely there would be a change in flows in the Sacramento River. Since Shasta Reservoir is operated to meet flow and water quality requirements in the Sacramento River and Delta, a new project or program along the Sacramento River and in the Delta could potentially affect the hydraulics, hydrology, and water resources of CP1. For instance, if the Shasta River Water Reliability Study (SRWRS) were implemented, Shasta Reservoir would be reoperated, resulting in changes to the Sacramento River flow regime and Delta inflow. However, with the implementation of the other past, present, and

reasonably foreseeable future projects, it is reasonable to assume there would not be a reduction in flow requirements, or a reduction in the level of protection from current water quality requirements. Therefore, during periods when the CVP and SWP are operated to meet regulatory constraints, the effects of the implementation of the projects described above would be limited.

Water levels in the south Delta could be affected by changes in Delta inflow and export pumping. Even though regulatory requirements restrict export pumping when water levels in the south Delta reach certain levels, CP1 combined with other projects could result in changes to water levels during the irrigation season at a magnitude and frequency that would affect south Delta water users. Accordingly, it is possible that CP1 combined with a number of other projects could result in potentially significant and unavoidable impacts to south Delta water levels.

Both the X2 position and Delta outflow are primarily products of Delta inflow and export pumping. A previously mentioned, CP1 combined with other projects could result in changes to Delta inflow and export pumping. While CP1 results in very rare changes to either the X2 position or Delta outflow of a magnitude affecting CCWD's ability to fill Los Vaqueros Reservoir, and result in less than significant impacts to the X2 position, it is possible CP1 combined with other projects could result in potentially significant and unavoidable impacts.

As previously described, CP1 would have a beneficial impact on groundwater resources in the CVP/SWP service areas. Similarly, it is extremely unlikely that CP1, when combined with other projects, would result in a decrease in surface water deliveries and an increased reliance on groundwater pumping relative to the bases of comparison. Accordingly, there would not be an effect on groundwater levels or groundwater quality. Therefore, CP1, combined with other projects, would likely have a beneficial effect.

None of the other past, present, and reasonably foreseeable future projects would negatively affect Shasta Reservoir's ability to fill its flood management obligations. Consequently, when combined with CP1, the cumulative effect would be no impact or a beneficial effect on flood management.

As stated previously, effects of climate change on operations of Shasta Lake could include increased inflows and releases at certain times of the year, and decreased inflows at other times. The additional storage associated with CP1 would potentially diminish these effects and allow Shasta Lake to capture some of the increased runoff in the winter and early spring for release in late spring and summer. Potential impacts associated with flood management, water supply, south Delta water levels, and groundwater management would be less than significant under CP1. Therefore, even with the addition of anticipated effects of climate change, CP1 would not have a significant cumulative effect, and could be potentially beneficial.

CP2 – 12.5-Foot Dam Raise, Anadromous Fish Survival and Water Supply Reliability

As described in Section 6.3.3 above, CP2 would not result in potentially significant impacts.

When combined with the other past, present, and reasonably foreseeable future projects, it is likely there would be a change in flows in the Sacramento River. Since Shasta Reservoir is operated to meet flow and water quality requirements in the Sacramento River and Delta, a new project or program along the Sacramento River and in the Delta could potentially affect the hydraulics, hydrology, and water resources of CP2. For instance, if the SRWRS were implemented, Shasta Reservoir would be reoperated, resulting in changes to the Sacramento River flow regime and Delta inflow. However, with the implementation of the other past, present, and reasonably foreseeable future projects, it is reasonable to assume there would not be a reduction in flow requirements, or a reduction in the level of protection from current water quality requirements. Therefore, during periods when the CVP and SWP are operated to meet regulatory constraints, the effects of the implementation of the projects described above would be limited.

Water levels in the south Delta could be affected by changes in Delta inflow and export pumping. Even though regulatory requirements restrict export pumping when water levels in the south Delta reach certain levels, CP2 combined with other projects could result in changes to water levels during the irrigation season at a magnitude and frequency that would affect south Delta water users. Accordingly, it is possible that CP2 combined with other projects could result in potentially significant and unavoidable impacts to south Delta water levels.

Both the X2 position and Delta outflow are primarily products of Delta inflow and export pumping. A previously mentioned, CP2 combined with other projects could result in changes to Delta inflow and export pumping. While CP2 results in very rare changes to either the X2 position or Delta outflow of a magnitude affecting CCWD's ability to fill Los Vaqueros Reservoir, and result in less–than-significant impacts to the X2 position, it is possible CP2 combined with other projects could result in potentially significant and unavoidable impacts.

As previously described, CP2 would have a beneficial impact on groundwater resources in the CVP/SWP service areas. Similarly, it is extremely unlikely that CP2, when combined with other projects, would result in a decrease in surface water deliveries and an increased reliance on groundwater pumping relative to the bases of comparison. Accordingly, there would not be an effect on groundwater levels or groundwater quality. Therefore, CP2, combined with other projects, would likely have a beneficial effect.

None of the other past, present, and reasonably foreseeable future projects would negatively affect Shasta Reservoir's ability to fill its flood management

obligations. Consequently, when combined with CP2, the cumulative effect would be no impact or a beneficial effect on flood management.

As stated previously, effects of climate change on operations of Shasta Lake could include increased inflows and releases at certain times of the year, and decreased inflows at other times. The additional storage associated with CP2 would potentially diminish these effects and allow Shasta Lake to capture some of the increased runoff in the winter and early spring for release in late spring and summer. Potential impacts associated with flood management, water supply, south Delta water levels, and groundwater management would be less than significant under CP2. Therefore, even with the addition of anticipated effects of climate change, CP2 would not have a significant cumulative effect, and could be potentially beneficial.

CP3 – 18.5-Foot Dam Raise, Anadromous Fish Survival and Water Supply

As described in Section 6.3.3 above, CP3 would not result in potentially significant impacts.

When combined with the other past, present, and reasonably foreseeable future projects, it is likely there would be a change in flows in the Sacramento River. Since Shasta Reservoir is operated to meet flow and water quality requirements in the Sacramento River and Delta, a new project or program along the Sacramento River and in the Delta could potentially affect the hydraulics, hydrology, and water resources of CP3. For instance, if the SRWRS were implemented, Shasta Reservoir would be reoperated, resulting in changes to the Sacramento River flow regime and Delta inflow. However, with the implementation of the other past, present, and reasonably foreseeable future projects, it is reasonable to assume there would not be a reduction in flow requirements, or a reduction in the level of protection from current water quality requirements. Therefore, during periods when the CVP and SWP are operated to meet regulatory constraints, the effects of the implementation of the projects described above would be limited.

Water levels in the south Delta could be affected by changes in Delta inflow and export pumping. Even though regulatory requirements restrict export pumping when water levels in the south Delta reach certain levels, CP3 combined with other projects could result in changes to water levels during the irrigation season at a magnitude and frequency that would affect south Delta water users. Accordingly, it is possible that CP3 combined with other projects could result in potentially significant and unavoidable impacts to south Delta water levels.

Both the X2 position and Delta outflow are primarily products of Delta inflow and export pumping. A previously mentioned, CP3 combined with other projects could result in changes to Delta inflow and export pumping. While CP3 results in very rare changes to either the X2 position or Delta outflow of a magnitude affecting CCWD's ability to fill Los Vaqueros Reservoir, and result in less than significant impacts to the X2 position, it is possible CP3 combined

with other projects could result in potentially significant and unavoidable impacts.

As previously described, CP3 would have a beneficial impact on groundwater resources in the CVP/SWP service areas. Similarly, it is extremely unlikely that CP3, when combined with a number of other projects, would result in a decrease in surface water deliveries and an increased reliance on groundwater pumping relative to the bases of comparison. Accordingly, there would not be an effect on groundwater levels or groundwater quality. Therefore, CP3, combined with a number of other projects, would likely have a beneficial effect.

None of the other past, present, and reasonably foreseeable future projects would negatively affect Shasta Reservoir's ability to fill its flood management obligations. Consequently, when combined with CP3, the cumulative effect would be no impact or a beneficial effect on flood management.

As stated previously, effects of climate change on operations of Shasta Lake could include increased inflows and releases at certain times of the year, and decreased inflows at other times. The additional storage associated with CP3 would potentially diminish these effects and allow Shasta Lake to capture some of the increased runoff in the winter and early spring for release in late spring and summer. Potential impacts associated with flood management, water supply, south Delta Water levels, and groundwater management would be less than significant under CP3. Therefore, even with the addition of anticipated effects of climate change, CP3 would not have a significant cumulative effect, and could be potentially beneficial.

CP4 – 18.5-Foot Dam Raise, Anadromous Fish Focus With Water Supply Reliability

As described in Section 6.3.3 above, CP4 would not result in potentially significant impacts.

When combined with the other past, present, and reasonably foreseeable future projects, it is likely there would be a change in flows in the Sacramento River. Since Shasta Reservoir is operated to meet flow and water quality requirements in the Sacramento River and Delta, a new project or program along the Sacramento River and in the Delta could potentially affect the hydraulics, hydrology, and water resources of CP4. For instance, if the SRWRS were implemented, Shasta Reservoir would be reoperated, resulting in changes to the Sacramento River flow regime and Delta inflow. However, with the implementation of the other past, present, and reasonably foreseeable future projects, it is reasonable to assume there would not be a reduction in flow requirements, or a reduction in the level of protection from current water quality requirements. Therefore, during periods when the CVP and SWP are operated to meet regulatory constraints, the effects of the implementation of the projects described above would be limited.

Water levels in the south Delta could be affected by changes in Delta inflow and export pumping. Even though regulatory requirements restrict export pumping when water levels in the south Delta reach certain levels, CP4 combined with other projects could result in changes to water levels during the irrigation season at a magnitude and frequency that would affect south Delta water users. Accordingly, it is possible that CP4 combined with other projects could result in potentially significant and unavoidable impacts to south Delta water levels.

Both the X2 position and Delta outflow are primarily products of Delta inflow and export pumping. A previously mentioned, CP4 combined with other projects could result in changes to Delta inflow and export pumping. While CP4 results in very rare changes to either the X2 position or Delta outflow of a magnitude affecting CCWD's ability to fill Los Vaqueros Reservoir, and result in less than significant impacts to the X2 position, it is possible CP4 combined with other projects could result in potentially significant and unavoidable impacts.

As previously described, CP4 would have a beneficial impact on groundwater resources in the CVP/SWP service areas. Similarly, it is extremely unlikely that CP4, when combined with other projects, would result in a decrease in surface water deliveries and an increased reliance on groundwater pumping relative to the bases of comparison. Accordingly, there would not be an effect on groundwater levels or groundwater quality. Therefore, CP4, combined with other projects, would likely have a beneficial effect.

None of the other past, present, and reasonably foreseeable future projects would negatively affect Shasta Reservoir's ability to fill its flood management obligations. Consequently, when combined with CP4, the cumulative effect would be no impact or a beneficial effect on flood management.

As stated previously, effects of climate change on operations of Shasta Lake could include increased inflows and releases at certain times of the year, and decreased inflows at other times. The additional storage associated with CP4 would potentially diminish these effects and allow Shasta Lake to capture some of the increased runoff in the winter and early spring for release in late spring and summer. Potential impacts associated with flood management, water supply, south Delta water levels, and groundwater management would be less than significant under CP4. Therefore, even with the addition of anticipated effects of climate change, CP4 would not have a significant cumulative effect, and could be potentially beneficial.

CP5 – 18.5-Foot Dam Raise, Combination Plan

As described in Section 6.3.3 above, CP5 would not result in potentially significant impacts.

When combined with the other past, present, and reasonably foreseeable future projects, it is likely there would be a change in flows in the Sacramento River.

Since Shasta Reservoir is operated to meet flow and water quality requirements in the Sacramento River and Delta, a new project or program along the Sacramento River and in the Delta could potentially affect the hydraulics, hydrology, and water resources of CP5. For instance, if the SRWRS were implemented, Shasta Reservoir would be reoperated, resulting in changes to the Sacramento River flow regime and Delta inflow. However, with the implementation of the other past, present, and reasonably foreseeable future projects, it is reasonable to assume there would not be a reduction in flow requirements, or a reduction in the level of protection from current water quality requirements. Therefore, during periods when the CVP and SWP are operated to meet regulatory constraints, the effects of the implementation of the projects described above would be limited.

Water levels in the south Delta could be affected by changes in Delta inflow and export pumping. Even though regulatory requirements restrict export pumping when water levels in the south Delta reach certain levels, CP5 combined with other projects could result in changes to water levels during the irrigation season at a magnitude and frequency that would affect south Delta water users. Accordingly, it is possible that CP5 combined with other projects could result in potentially significant and unavoidable impacts to south Delta water levels.

Both the X2 position and Delta outflow are primarily products of Delta inflow and export pumping. A previously mentioned, CP5 combined with other projects could result in changes to Delta inflow and export pumping. While CP5 results in very rare changes to either the X2 position or Delta outflow of a magnitude affecting CCWD's ability to fill Los Vaqueros Reservoir, and result in less than significant impacts to the X2 position, it is possible CP5 combined with other projects could result in potentially significant and unavoidable impacts.

As previously described, CP5 would have a beneficial impact on groundwater resources in the CVP/SWP service areas. Similarly, it is extremely unlikely that CP5, when combined with other projects, would result in a decrease in surface water deliveries and an increased reliance on groundwater pumping relative to the bases of comparison. Accordingly, there would not be an effect on groundwater levels or groundwater quality. Therefore, CP5, combined with other projects, would likely have a beneficial effect.

None of the other past, present, and reasonably foreseeable future projects would negatively affect Shasta Reservoir's ability to fill its flood management obligations. Consequently, when combined with CP5, the cumulative effect would be no impact or a beneficial effect on flood management.

As stated previously, effects of climate change on operations of Shasta Lake could include increased inflows and releases at certain times of the year, and decreased inflows at other times. The additional storage associated with CP5 would potentially diminish these effects and allow Shasta Lake to capture some

of the increased runoff in the winter and early spring for release in late spring and summer. Potential impacts associated with flood management, water supply, south Delta water levels, and groundwater management would be less than significant under CP5. Therefore, even with the addition of anticipated effects of climate change, CP5 would not have a significant cumulative effect, and could be potentially beneficial.

Chapter 7
Water Quality

7.1 Affected Environment

This section describes the affected environment related to water quality for the dam and reservoir modifications proposed under the SLWRI. For more detail, please see the *Water Quality Technical Report*.

7.1.1 Overview of Water Quality Conditions

Surface water quality in the study area is affected by natural runoff, agricultural return flows, abandoned mines, construction, logging, grazing, operations of flow-regulating facilities, urbanization, and recreation. This section discusses key water quality constituents of concern (temperature, sediments, and metals), the factors influencing their concentrations, and the regulatory objectives associated with maintaining beneficial uses.

The following discussion provides an overview of water quality and its relationship to beneficial uses throughout the primary and secondary study areas. This section is followed by discussions of key water quality parameters that influence beneficial uses to varying degrees within the study areas; temperature, sediment and metals.

Shasta Lake and Vicinity

This section addresses water quality in the Shasta Lake and vicinity portion of the primary study area. It focuses on the six arms of Shasta Lake and tributaries that enter into Shasta Lake from the surrounding watersheds.

Water quality in this portion of the primary study area generally meets the standards for beneficial uses identified in the *Water Quality Control Plan for the Sacramento River and San Joaquin River Basins* (Basin Plan) (CVRWQCB 2009). The quality of surface waters in Shasta County is generally considered good, although some water bodies are affected by nonpoint pollution sources that influence surface water quality: high turbidity from controllable sediment discharge sources (e.g., land development and roads); high concentrations of nitrates and dissolved solids from range and agricultural runoff or septic tank failures; contaminated street and lawn runoff from urban areas, roads, and railroads; acid mine drainage and heavy metal discharges from historic mining and processing operations; and warm-water discharges into cold-water streams.

The quality of water in underground basins and water-bearing soils is also considered generally good throughout most of Shasta County. Potential hazards

to groundwater quality involve nitrates and dissolved solids from agricultural and range practices and septic tank failures. The ability of soils in Shasta County to support septic tanks and on-site wastewater treatment systems is generally severely limited, particularly on older valley terrace soils and certain loosely confined volcanic soils in the eastern portions of the county (CVRWQCB 2009).

The surface water quality of streams and lakes draining the Shasta-Trinity National Forest (STNF) and adjacent private lands generally meets standards for beneficial uses defined by the Basin Plan (CVRWQCB 2009). There are, however, some areas where the water quality does not meet the standards during periods of storm runoff because of past management activities, or as a result of drainage from historic mining and processing operations. The cumulative impacts of successive activities, such as road construction and timber harvesting on private and National Forest lands, also contribute to the degradation of water quality in the STNF (USFS 1995). Within this portion of the primary study area, most of the road construction and timber harvest activities occur on private lands.

Shasta Dam and Shasta Lake constitute the “keystone of the Central Valley Project.” Approximately 6.2 million acre-feet of water flows annually into Shasta Lake from the Sacramento River, McCloud River, and Pit River drainages. A favorable inflow-outflow relationship of 1.4 to 1 results in good water quality, both in the lake and downstream (USFS 1996), although Shasta Lake is considered an impaired water body due to heavy metal accumulations (e.g., cadmium, copper and zinc) at locations throughout the reservoir (CVRWQCB 2009).

Nutrient inputs and bacteria are not of concern in the Sacramento River and McCloud River arms (USFS 1998); however, they could be an issue in the Pit River Arm as a result of runoff from agricultural and range lands in the upper Pit River watershed. Within Little Backbone Creek, Dry Creek, and the Squaw Creek Arm, the waters are locally limited by low pH and elevated concentrations of heavy metals caused by drainage from abandoned mines (CVRWQCB 2003a). In addition, data suggest that sediment and turbidity locally affect beneficial uses, mainly contact recreation. A recent 2-year study conducted by the State Water Resources Control Board (SWRCB) sampled mercury accumulations in fish at a number of locations throughout Shasta Lake. This study documented elevated levels of mercury in some specimens (Davis et al. 2010).

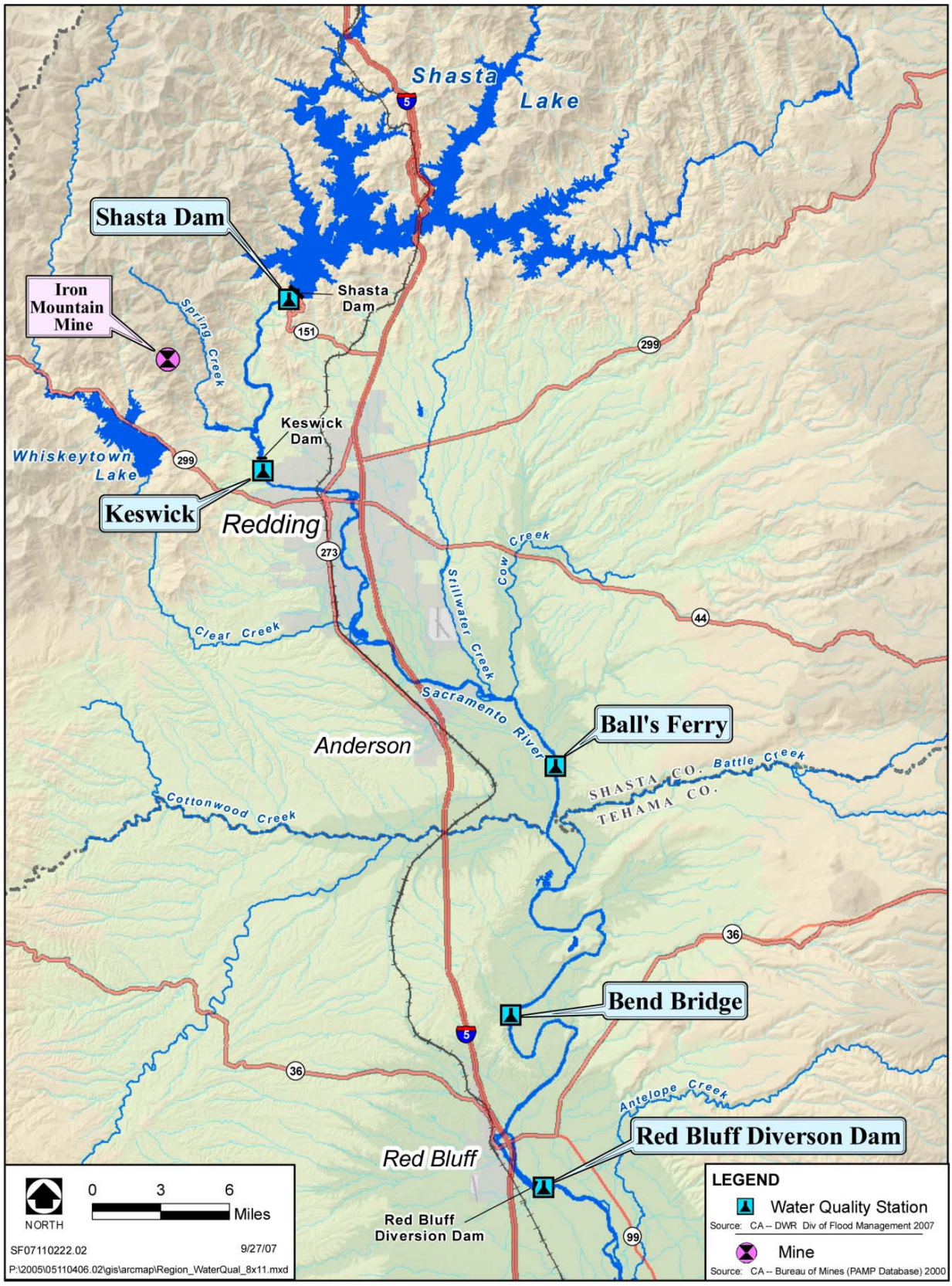


Figure 7-1. Upper Sacramento River Primary Study Area

Upper Sacramento River (Shasta Dam to Red Bluff)

Tributaries to the Upper Sacramento River, and place names referred to in the text are shown in Figure 7-1. The main sources of water in the Sacramento River below Keswick Dam are rain and snowmelt that collect in upstream reservoirs and are released in response to water needs or flood control. The quality of surface water downstream from Keswick Dam is also influenced by other human activities along the Sacramento River downstream from the dam, including agricultural, historical mining, and municipal and industrial (M&I) inputs.

The quality of water in the Sacramento River is relatively good. Only during conditions of stormwater-driven runoff are water quality objectives typically not met (Domagalski et al. 2000). Water quality issues within the primary study area of the Sacramento River include the presence of mercury, pesticides such as organochlorine pesticides, trace metals, turbidity, and toxicity from unknown origin (CALFED 2000a).

Water quality in the Sacramento River and its major tributaries above Red Bluff Diversion Dam (RBDD) is generally good (Table 7-1). Nutrients such as nitrate were found to be low throughout the Sacramento River basin (Domagalski and Dileanis 2000, as cited in Domagalski et al. 2000). Water temperature is a principal water quality issue in the upper Sacramento River between Keswick Dam and RBDD.

Table 7-1. Summary of Conventional Water Quality Constituents Collected in the Sacramento River at Red Bluff from 1996 to 1998

Constituent (unit)	Water Quality Objective	Average Measurement
Conventional Physical and Chemical Constituents		
Temperature	< 2.5ºF [a]	52.7ºF
Conductivity (µS/cm)	–	116
Dissolved Oxygen (mg/L)	7.0 [b]	10.7
Dissolved Oxygen Saturation (%)	85 [b]	99
pH (standard unit)	6.5 to 8.5 [c]	7.8
Alkalinity (mg/L $CaCO_3$)	–	48.3
Total Hardness (mg/L $CaCO_3$)	–	46.6
Suspended Sediment (mg/L)	–	38.8
Calcium (mg/L)	narrative [d]	10.3
Magnesium (mg/L)	–	5.0
Sodium (mg/L)	–	5.8
Potassium (mg/L)	–	1.1
Chloride (mg/L)	500 [e]	2.4

Table 7-1. Summary of Conventional Water Quality Constituents Collected in the Sacramento River at Red Bluff from 1996 to 1998 (contd.)

Constituent (unit)	Water Quality Objective	Average Measurement
Conventional Physical and Chemical Constituents		
Sulfate (mg/L)	500 [e]	4.5
Silica (mg/L)	–	20.5
$NO_2 + NO_3$ (mg/L N)	$NO_3 < 10$ [f]	0.12
Total Phosphorus (mg/L P)	–	0.0477
Trace Metals		
Arsenic (µg/L)	50 [g]	1.0
Chromium (µg/L)	180 [g]	1.0
Copper (µg/L)	5.1 [g]	1.6
Mercury (µg/L)	0.050 [g]	0.0045
Nickel (µg/L)	52 [g]	1.2
Zinc (µg/L)	120 [g]	2.3
Organic Pesticides		
Molinate (ng/L)	13,000 [h]	< 60
Simazine (ng/L)	3,400 [i]	< 22
Carbofuran (mg/L)	40,000 [e], 500 [i]	< 31
Diazinon (mg/L)	51 [j]	< 28
Carbaryl (ng/L)	700 [k]	< 41
Thiobencarb (ng/L)	1,000 [a]	< 38
Chlorpyrifos (ng/L)	14 [J]	< 25
Methidathion (ng/L)	–	< 38

Source: CBDA 2005

Notes:
[a] The Water Quality Control Plan (Basin Plan) for the Sacramento River and San Joaquin River Basins (Basin Plan) water quality objective for allowable change from controllable factors.
[b] Basin Plan water quality objective.
[c] Basin Plan water quality objective; < 0.5 allowable change from controllable factors.
[d] Basin Plan narrative objective: Water shall not contain constituent in concentrations that would cause nuisance or adversely affect beneficial uses.
[e] Secondary drinking water maximum contaminant level (MCL).
[f] Primary drinking water MCL.
[g] California Toxics Rule (CTR) aquatic life criteria for 4-day average dissolved concentration.
[h] CTR human health maximum criteria total recoverable concentration.
[i] California Department of Fish and Game hazard assessment value.
[j] DFG aquatic life guidance value for 4-day average concentration.
[k] U.S. Environmental Protection Agency Integrated Risk Information System reference dose for drinking water quality.

Key:
– = not applicable
µg/L = micrograms per liter
µS/cm = microSiemens per centimeter
$CaCO_3$ = calcium carbonate
mg/L = milligrams per liter
N = nitrogen
ng/L = nanograms per liter
NO_2 = nitrate
NO_3 = nitrite
ºF = degrees Fahrenheit
P = phosphorus

Although all trace metals shown in Table 7-1 were well below their established water quality objectives, one of the principal water quality issues in the upper

Sacramento River portion of the primary study area is acid mine drainage and associated heavy-metal contamination from the Spring Creek drainage and other abandoned mining sites. It should be noted that the U.S. Geological Survey (USGS) study detected mercury, but it did not exceed the criterion of ambient level specified in the California Toxics Rule; however, California Toxics Rule levels for mercury are not protective to prevent the high concentration of mercury found in fish tissue. In addition to heavy metal contamination, the Central Valley Regional Water Quality Control Board (CVRWQCB) determined that the 25-mile reach of the Sacramento River from Keswick Dam downstream to Cottonwood Creek is impaired because the water periodically contains levels of dissolved cadmium, copper, and zinc that exceed levels identified to protect aquatic organisms. The 26-mile reach from Keswick Dam to Red Bluff is listed for unknown sources of toxicity (CVRWQCB 2007a).

Lower Sacramento River and Delta

Water quality in the lower Sacramento River is affected by agricultural runoff, acid mine drainage, stormwater discharges, water releases from dams, diversions, and urban runoff. However, the flow volumes generally provide sufficient dilution to prevent excessive concentrations of contaminants in the river.

Several total maximum daily loads (TMDL) are currently proposed for the lower Sacramento River. In addition, the Sacramento River downstream from RBDD to Knights Landing is listed as an impaired water body under Section 303(d) of the Clean Water Act (CWA) for mercury and unknown toxicity. Elevated metals and pesticide levels have been found at some sites in the Sacramento River Valley downstream from Knights Landing. The parameters of concern in the Sacramento River from Knights Landing to the Delta include diazinon, mercury, and unknown sources of toxicity (CVRWQCB 2007a, 2007b).

Water quality in the Delta is highly variable temporally and spatially. It is a function of complex circulation patterns that are affected by inflows, pumping for Delta agricultural operations and exports, operation of flow control structures, and tidal action. The existing water quality problems of the Delta system may be categorized as presence of toxic materials, eutrophication and associated fluctuations in dissolved oxygen, presence of suspended sediments and turbidity, salinity, and presence of bacteria (SWRCB 1999).

The Delta waterways within the area under CVRWQCB jurisdiction are listed as impaired on the U.S. Environmental Protection Agency's (EPA) 303(d) list for dissolved oxygen, electrical conductivity (EC), dichlorodiphenyl-trichloroethane, mercury, Group A pesticides, diazinon and chlorpyrifos, and unknown toxicity (CVRWQCB 2003b). The area of the Delta that is under the jurisdiction of the San Francisco Bay Regional Water Quality Control Board (RWQCB) is listed as impaired for mercury, chlordane, selenium, dichlorodiphenyl-trichloroethane, dioxin compounds, polychlorinated biphenyl

compounds, dieldrin, nickel, exotic species, and furan compounds (SFBRWQCB 2007).

Organic carbon in the Delta originates from runoff from agricultural and urban land, drainage water pumped from Delta islands that have soils with high organic matter, runoff and drainage from wetlands, wastewater discharges, and primary production in Delta waters. Delta agricultural drainage can also contain high levels of nutrients, suspended solids, organic carbon, minerals (salinity), and trace chemicals such as organophosphate, carbamate, and organochlorine pesticides.

Salinity is also an important water quality constituent in the Delta. Salinity in the Delta is the result of tidal exchange with San Francisco Bay, variations in freshwater inflow from the San Joaquin and Sacramento rivers, agricultural and urban exports/diversions, and agricultural return flows. During dry conditions, seawater intrusion is the primary factor influencing Delta salinity and can adversely affect agricultural and municipal uses. The highest concentrations typically occur in late summer or early fall.

CVP/SWP Service Areas

The CVP and SWP service areas are affected by water quality from the Delta. Water quality concerns of particular concern are those related to salinity and drinking-water quality. Salinity is an issue because excessive salinity may adversely affect crop yields and require more water for salt leaching, may require additional M&I treatment, may increase salinity levels in agricultural soils and groundwater, and is the primary water quality constraint to recycling wastewater (CALFED 2000b).

Constituents that affect drinking-water quality include bromide, natural organic matter, microbial pathogens, nutrients, total dissolved solids (TDS), hardness, alkalinity, pH, organic carbon, disinfection byproducts, and turbidity.

7.1.2 Sediment

Shasta Lake and Vicinity

Sediment-caused turbidity is one of the limiting water quality issues for Shasta Lake and its tributaries. It is a noticeable recurring water quality problem that affects beneficial uses, including recreation and fisheries. Within the reservoir, turbid water results from clay- and silt-sized soil particles suspended in the water column. Under certain conditions, inflow to the Pit Arm appears to be influenced by water quality conditions upstream from Shasta Lake, but monitoring data are not available to adequately document this phenomenon.

Before the construction of Shasta Dam, the widespread loss of vegetation caused by historic copper mining and smelting operations resulted in large-scale erosion, particularly in the watersheds that are tributary to the Main Body of Shasta Lake and the Squaw Creek Arm. In addition to sediment sources from

upland areas, including roads and historic mining features, the construction and operation of Shasta Dam continue to influence erosional processes that introduce sediment into Shasta Lake, causing turbid conditions that are visible to the casual observer.

Nonpoint sources of fine sediment that increase turbidity in Shasta Lake include sediment discharge from tributaries, wave-related erosion below and adjacent to the fluctuating water surface, and surficial erosion of exposed surfaces as the lake levels fluctuate (USFS 1996). Erosion of the fine-textured soil and rock types that constitute much of the shoreline is a predominant factor in causing turbidity. The turbid water is noticeable along the shoreline throughout the year, but typically increases during wind and runoff events. Plumes of turbid water entering from tributaries are also visible periodically throughout the year. The fluctuation of lake levels, combined with various wave-generating processes, also influences the degree and location of erosion-related turbidity. Turbidity and, to a lesser degree, sediment suspended in the water column influence recreational uses of the lake, including fishing, swimming, and boating, by decreasing the clarity of the water along the shoreline.

Although some amount of fine sediment is transported downstream from Shasta Dam, the size and location of the reservoir provide an efficient sediment trap for material typically mobilized as bedload. Additional discussion of erosional processes is provided in Chapter 4, “Geology, Geomorphology, Minerals, and Soils.”

Upper Sacramento River (Shasta Dam to Red Bluff)

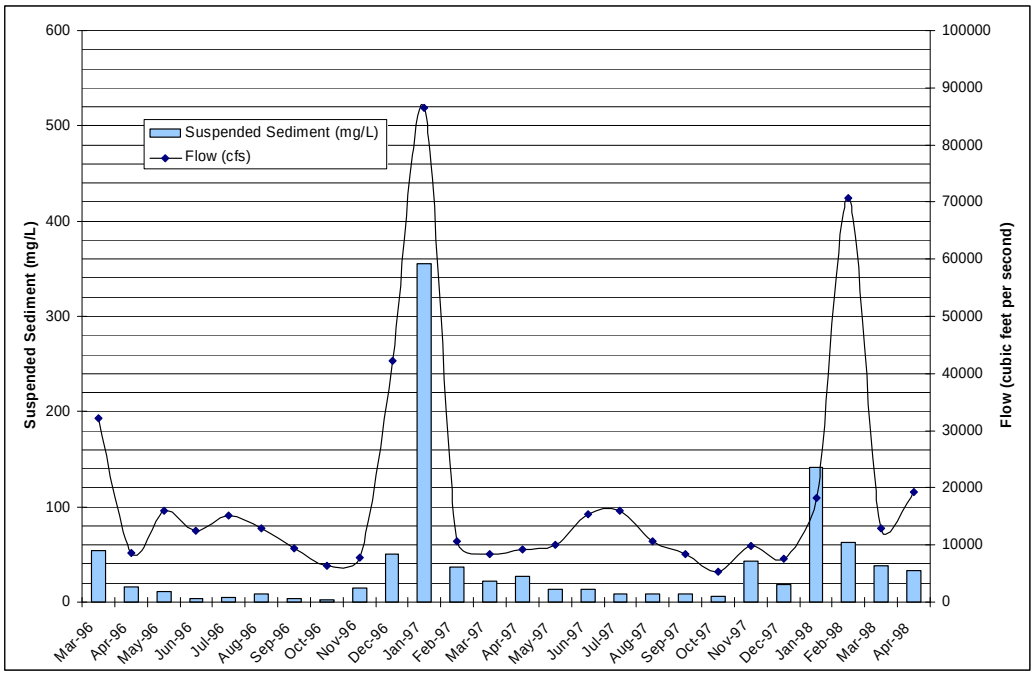
Rates of loading and discharge of suspended sediment within the upper Sacramento River watershed have been altered by activities such as mining, smelting, agriculture, urbanization, and dam construction. The storage and diversion of water within reservoirs for either hydroelectric or other purposes can affect sediment yield, downstream sediment levels, and transport characteristics. In particular, dams such as Shasta can trap sediment and result in the depletion of coarse sediments needed by fisheries. This has resulted in the creation of gravel replenishment programs on the upper Sacramento River as part of the Central Valley Project Improvement Act restoration program.

Historic hydraulic gold mining has probably had the greatest effect on sediment yield in the Sacramento River watershed (Wright and Schoellhamer 2004). During the late 1800s, such mining introduced mass quantities of silt, sand, and gravel into the Sacramento River system. Suspended sediment was washed downstream into the Delta. Current sediment transport patterns in the Sacramento River watershed are greatly affected by the trapping of sediment in reservoirs such as Shasta Lake (Wright and Schoellhamer 2004).

Characteristics of peak-flow events are fundamental regulators of sediment mobilization, bed scour, riparian recruitment, and bank erosion. However, upstream sediment supply rates and sediment load distribution also affect

suspended sediment loading (CALFED 2003). The upper Sacramento River contributes little coarse sediment from erosion because it is bounded by erosion-resistant bedrock and terrace deposits (Stillwater Sciences 2006). Therefore, today there is a decreasing trend in suspended sediment in the Sacramento River (Wright and Schoellhamer 2004).

USGS assessed concentrations of suspended sediment in the Sacramento River at Big Bend above Red Bluff from February 1996 to April 1998 (USGS 2000a). Concentrations of suspended sediment ranged from 3 milligrams per liter (mg/L) to 355 mg/L, with an average of 38.8 mg/L (see Figure 7-2).



Source: USGS 2000a

Figure 7-2. Concentrations of Suspended Sediment and Associated Flows in the Sacramento River above Big Bend near Red Bluff

Lower Sacramento River and Delta

Delivery of suspended sediment from the Sacramento River to the Delta and finally to San Francisco Bay decreased by about one-half during the period 1957 to 2001 (Wright and Schoellhamer 2004). Factors contributing to this trend in sediment yield included the depletion of erodible sediment from hydraulic mining in the late 1800s, trapping of sediment in reservoirs, riverbank protection, altered land uses, and levee construction.

Sediment supply to the Sacramento and San Joaquin river watersheds has declined over recent years because dams on rivers and other water management actions have resulted in less sediment transport (CALFED 2000c), although agricultural drainage in the Delta often contains high levels of suspended sediments (Reclamation and DWR 2005). Sediments that include fine sands,

silts, and clays are transported by rivers and the Yolo Bypass into the Delta. Coarser materials are deposited at points higher up in the river basins. The sands typically are transported in the bed load, while the clays and silts move the suspended load. The suspended load is composed of generally finer materials moving downstream in the water column. Sediment loads from the Sacramento River are higher than those from the San Joaquin River (Reclamation and DWR 2005).

Hydraulic gold mining, particularly through the major westerly flowing tributaries such as the American, Feather, Yuba, and Bear rivers, may also affect sediment transport in the extended study area. USGS found that the Sacramento River is the primary supplier of suspended sediment to the Delta.

CVP/SWP Service Areas

Some suspended sediments are transported within the CVP and SWP service areas, but turbidity and sedimentation are not issues within the service areas (CALFED 2000c).

7.1.3 Temperature

Shasta Lake and Vicinity

Water temperature is an important water quality parameter affecting the beneficial uses of Shasta Lake and its tributaries, including contact and noncontact recreation and aquatic organisms. Within the reservoir, water temperature commonly controls the growth of algae and the rate of biochemical processes. Shasta Lake periodically stratifies and a thermocline develops on an annual basis, although turnover is incomplete and the lake has not been known to freeze over (Bartholow et al. 2001). Strong stratification of the reservoir occurs during summer at a depth of 10 to 15 meters. This stratification isolates the epilimnion from nutrients available in the deeper hypolimnion, segregating spring and fall algal blooms when water temperatures might otherwise support algal production in the euphotic zone, the zone close to the surface that provides opportunities for photosynthesis. The period of stratification generally overlaps with the peak recreation season (May to September), when surface water temperatures are comfortable for contact recreation activities. During fall, the stratification dissipates and the surface water temperature is reduced.

Shasta Dam operations greatly influence the annual and seasonal water temperature of the reservoir. The wetness of a given water year or series of years generally controls the mean annual water temperature. The current temperature regime of Shasta Lake is related to CVP operational requirements, including those necessary to optimize the water temperatures in the Sacramento River downstream from Keswick Dam. Overall, the tributaries that enter Shasta Lake meet the Basin Plan water quality objective for temperature.

Upper Sacramento River (Shasta Dam to Red Bluff)

Water temperature in the Sacramento River from Shasta Dam to Keswick Dam is determined primarily by Shasta Dam releases. Shasta Dam release flows are then mixed with flows from Whiskeytown Reservoir at Keswick Reservoir and released into the upper Sacramento River.

Water temperature for rivers within the Sacramento River basin is reportedly maintained consistent with regulatory requirements (e.g., NMFS biological opinion (BO)) most of the time, but temperature management can be difficult during low-flow periods (USGS 2000a). Historically, low-flow events and a lack of flexibility in dam operations can cause water temperatures to periodically approach critical levels for sustaining juvenile salmon populations. In addition to low flows, high water temperatures released from reservoirs, coupled with natural instream warming, can cause elevated river water temperatures (Vermeyen 1997).

There are a number of water quality objectives for the upper Sacramento River. The Basin Plan specifies that water temperature shall not be elevated above 56 degrees Fahrenheit (°F) from Keswick Dam to Hamilton City (+9). In addition, the Basin Plan specifies that at no time or place shall the temperature of cold or warm intrastate waters be increased more than 5°F above natural receiving-water temperature (CVRWQCB 2009). Keswick Dam releases are managed to meet temperature control requirements.

According to the 2004 BO for CVP and SWP operations for the Sacramento River winter-run Chinook salmon, the Sacramento River water temperatures will be below 56°F at compliance locations between Balls Ferry and Bend Bridge from April 15 through September 30, and not in excess of 60°F at the same compliance locations between Balls Ferry and Bend Bridge from October 1 through October 31. On December 15, 2008, USFWS issued a BO on the Operations Criteria and Plan (OCAP) for delta smelt and its critical habitat governing the coordinated operations of the CVP and SWP. On June 4, 2009, NMFS issued the NMFS OCAP BO for listed anadromous fishes and marine mammal species and their critical habitats governing the long-term operations of the CVP and SWP. On May 18, 2010, in *The Consolidated Salmonid Cases*, Judge Oliver Wanger concluded that NMFS likely violated the Federal Endangered Species Act by failing to rely on the "best available science" when drafting its June 4, 2009, BO. Similarly, on May 27, 2010, Judge Wanger concluded that USFWS violated NEPA in failing to conduct environmental review before establishing pumping restrictions to protect delta smelt. The BOs and their requirements remain in litigation and are subject to change.

Before 1997, to help meet the needs of Federally listed winter-run Chinook salmon, cold water was released from low outlets at Shasta Dam. These cold-water releases bypassed hydropower facilities, causing the loss of power revenues. To achieve water temperature objectives in the Sacramento River without interrupting power generation, Reclamation constructed a temperature

control device (TCD) on Shasta Dam that became operational in 1997. The TCD allows selective withdrawal of water from different reservoir depths without bypassing power generation, provides flexibility to Shasta Dam operations, and allows downstream temperature goals to be consistently achieved (Reclamation 2004).

Historical Sacramento River water temperatures below Shasta Dam were analyzed from January 1991 through December 2005. The data set indicates that average temperatures vary seasonally, ranging from 47.9°F in February to 55.7°F in November. Water temperatures below Keswick Dam were analyzed for January 1990 through December 2006. Like the temperatures below Shasta Dam, average temperatures below Keswick Dam vary seasonally, ranging from 47.8°F in February to 54.9°F in November. Summer and fall temperatures typically increase by about 7°F. Water temperatures just downstream from Keswick Dam are influenced by releases from Shasta Lake and Whiskeytown Reservoir and Keswick Dam operations.

Lower Sacramento River and Delta

Water temperature in the Sacramento River at Colusa varies seasonally, ranging from 47.5°F to 67.5°F. Water temperatures gradually increase through the spring and summer and reach an average of about 65°F. Water temperature in the Sacramento River at Freeport varies seasonally, ranging from 48.7°F to 72.1°F (USGS 2000).

Water temperature in the Delta is influenced only slightly by water management activities (i.e., dam releases) (Reclamation and DWR 2005). The 2004 and 2009 BOs for Sacramento River winter-run Chinook salmon are among the most influential factors governing Shasta releases, in terms of both quantity and timing (NMFS 2004, 2009). The BOs sets temperature requirements below Keswick Dam for April through October. In years when CVP facilities cannot be operated to meet required temperature and storage objectives, Reclamation reinitiates consultation with NMFS (Reclamation 2004a).

CVP/SWP Service Areas

Water quality in the CVP and SWP service areas, including water temperature, is affected by fluctuations of water quality in the Delta, which in turn are influenced by water quality in the San Joaquin River, CVP and SWP export pumping rates, local agricultural diversions and drainage water, and the Sacramento River (CALFED 2000c).

7.1.4 Metals

Shasta Lake and Vicinity

Certain areas of Shasta Lake have been identified as impaired by toxic metal pollutants. For this reason, Shasta Lake is listed on the CWA Section 303(d) list of impaired water bodies. For water bodies on the Section 303(d) list, the CWA requires the development of TMDL allocations for the pollutants of concern. A

TMDL allocation must estimate the total maximum daily load, with seasonal variations and a margin of safety, for all suitable pollutants and thermal loads, at a level that would ensure protection and propagation of a balanced population of indigenous fish, shellfish, and wildlife. Table 7-2 shows the potential sources of pollution within specific areas of Shasta Lake, along with the TMDL priority and the estimated affected area of the pollutants.

Table 7-2. 303(d) List of Water Quality Limited Segments, Shasta Lake, 2006

Pollutant	Potential Sources	TMDL Priority	Estimated Area Affected
Horse Creek (from Rising Star Mine to Squaw Creek Arm of Shasta Lake)			
Cadmium	Resource extraction	Low	0.52 mile
Copper	Resource extraction	Low	0.52 mile
Lead	Resource extraction	Low	0.52 mile
Zinc	Resource extraction	Low	0.52 mile
Area where West Squaw Creek enters Squaw Creek Arm of Shasta Lake			
Cadmium	Resource extraction	Low	20 acres
Copper	Resource extraction	Low	20 acres
Zinc	Resource extraction	Low	20 acres

Source: SWRCB 2006

Key:
TMDL = total maximum daily load

Waters discharged by stream channels draining the areas disturbed by the mining of sulfide ore deposits are generally acidic and contain high concentrations of dissolved metals, including iron, copper, and zinc. The streams with the highest metal concentrations are Flat, Little Backbone, Spring, Squaw, Horse, and Zinc creeks (USGS 1978). Dissolved metals concentrations discharged by these streams violate water quality objectives (CVRWQCB 2003b). The sources of the metals are surface and groundwater discharge from underground mines and waters flowing through open pits, tunnels, mine tailings, waste rock, and tertiary deposits that include modern alluvium along the shoreline. Interaction with sulfide minerals and erosion of metal-rich material commonly result in low pH readings and high metal concentrations.

The sources of the metals in the two areas identified in Table 7-2 are associated with the Bully Hill/Rising Star mining complex adjacent to the Squaw Creek Arm. Although the mines are no longer operational and remedial action continues, these areas are a documented source of metals and continue to be subject to an abatement order issued by the CVRWQCB. A containment structure constructed sometime during the early 1900s has filled with sediment

downstream from the Bully Hill Mine. No information is available on the character of the material stored behind this earth fill dam. In 2006, North State Resources, Inc., conducted a Phase 1 Site Assessment of an area adjacent to, but over a small divide from, the Bully Hill Mine. This assessment documented elevated levels of sulfide minerals in sediment samples and extremely low pH values in surface waters draining the mine (NSR 2007).

Tributaries to the Main Body of Shasta Lake are also a source of metals, along with acid mine drainage from a number of mines in the Dry Creek and Little Backbone watersheds. In addition to runoff from the historic workings (i.e., adits and portals), there are a number of large tailing deposits that are currently leaching various metals into tributaries to Shasta Lake (CVRWQCB 2003a).

Between 2002 and 2003, the CVRWQCB conducted an investigation intended to increase the understanding of the relationship between elevated metal concentrations (dissolved copper and zinc) in discharges from Shasta Dam and the temporal and spatial distribution of these metals within and upslope of Shasta Lake (CVRWQCB 2003a). Specifically, this investigation attempted to answer two questions:

- Why do these elevated metal concentrations appear seasonally?
- Are the concentrations somehow related to the operation of the temperature control device that is attached to the upstream face of Shasta Dam?

In 2003, the CVRWQCB issued an interim report that provided data and limited analysis at 17 sites upstream from Shasta Dam. The data set included 412 discrete samples and included 1,043 specific chemical analyses for various chemical constituents (CVRWQCB 2003b). The interim report offers the following conclusion: “This study shows a direct correlation between dissolved copper concentrations in the upper water column near the dam and dissolved copper concentrations immediately downstream from the dam in the winter months.” The report goes on to suggest that this correlation may somehow be related to the operation of the temperature control device as it relates to the seasonal thermocline that develops in Shasta Lake (CVRWQCB 2003b).

Upper Sacramento River (Shasta Dam to Red Bluff)

A major source of metals to the Sacramento River is drainage from inactive mines in the Iron Mountain area of the West Shasta mining district. During mining and smelting activities from the 1880s to the 1960s, Iron Mountain’s acid mine drainage discharged directly to Spring Creek, a Sacramento River tributary upstream from Redding (USGS 2000b).

USGS conducted a water quality assessment of trace metal concentrations in the Sacramento River at Big Bend above Red Bluff from February 1996 to May 1998 (USGS 2000b). Although metals concentrations are a serious water quality

concern in the project area, metals did not exceed water quality objectives during the study period.

The CVRWQCB has determined that the 25-mile segment of the upper Sacramento River between Keswick Dam and Cottonwood Creek near Balls Ferry in Shasta County is impaired because of levels of dissolved cadmium, copper, and zinc that exceed water quality standards (CVRWQCB 2002). The impairment results primarily from inactive mines in the upper Sacramento River watershed, predominantly the Iron Mountain site upstream from Keswick Dam and other mines upstream from Shasta Dam.

Water quality enhancement actions at the mines and improved coordination of the Spring Creek and Keswick Reservoirs have resulted in a notable decrease in the number of water quality targets exceeded in the past 10 years. However, metal loading remains high enough to cause periodic exceedences (CVRWQCB 2002). The sediments found in the Spring Creek Arm of Keswick Reservoir contain high levels of copper and zinc, which settled out of the contaminated stormwater runoff from the Iron Mountain Mine Superfund site. In 2009 and 2010, EPA dredged and removed contaminated sediments at this location with the goal of protecting the downstream Sacramento River ecosystem during storm events, when contaminated sediments can become mobilized and carried downstream. EPA expects that dredging the contaminated sediments will eliminate the last major threat that contamination from the Iron Mountain Mine poses to human health and the environment (EPA 2009).

High mercury concentrations in the Sacramento River correlate with concentrations of suspended sediment and high flows, because much of the mercury is transported adsorbed to suspended sediments (Domagalski et al. 2000). In May 2000, EPA adopted a water quality objective for total mercury for the Sacramento River watershed of 50 nanograms per liter (30-day average). In a USGS study of mercury levels along the Sacramento River at Big Bend above Red Bluff, conducted from February 1996 to May 1998, mercury levels were consistently below the EPA criterion of 50 nanograms per liter (USGS 2000b).

Lower Sacramento River and Delta

The downstream tributaries Cache Creek and Putah Creek are known to be substantial sources of mercury to the Sacramento River. The Sacramento River from Knights Landing to the Delta is listed as impaired on EPA's 303(d) list for mercury (CVRWQCB 2002).

The Delta waterways within the area under CVRWQCB jurisdiction are listed on EPA's 303(d) list as impaired for mercury from agriculture and historic mining, while the western Delta, under the jurisdiction of the San Francisco Bay RWQCB, is listed as impaired for mercury, nickel, and selenium. The primary sources of mercury are abandoned mine sites in the upper watershed that drain into the lower Sacramento River and Delta. The City of Sacramento is also the

largest urban source of nitrogen, mercury, and assorted other urban waste products. Selenium concentrations are attributed to agriculture and oil refiners, while the primary source of nickel is unknown (SWRCB 2006).

CVP/SWP Service Areas

Water quality in the CVP and SWP service areas is affected by fluctuations of water quality in the south Delta, which in turn are influenced by water quality in the San Joaquin River, CVP and SWP export pumping rates, local agricultural diversions and drainage water, and the Sacramento River (CALFED 2000c).

7.1.5 Salinity

The following discussion of the affected environment in the study area with regard to salinity is limited to a discussion of conditions in the lower Sacramento River and Delta portion of the extended study area because of the potential effects of salinity in this geographic area on beneficial uses. Salinity is particularly important in the Delta, which is influenced by tidal exchange with San Francisco Bay; during low-flow periods, seawater intrusion results in increased salinity.

Lower Sacramento River and Delta

The following are recognized water quality issues in the Delta (Reclamation and DWR 2005):

- High salinity from Suisun Bay intrudes into the Delta during periods of low Delta outflow. Salinity can adversely affect agricultural, M&I, and recreational uses.

- Delta exports contain elevated concentrations of disinfection byproduct precursors (e.g., dissolved organic carbon), and the presence of bromide increases the potential for formation of brominated compounds in treated drinking water.

- Agricultural drainage in the Delta contains high levels of nutrients, suspended solids, dissolved organic carbon and minerals (salinity), and agricultural chemicals (pesticides).

- Synthetic organic chemicals and heavy metals have bioaccumulated in Delta fish and other aquatic organisms, occasionally exceeding standards for food consumption.

- The San Joaquin River delivers relatively poor-quality water to the Delta; agricultural drainage is a major source of salts and pollutants. Because the south Delta receives a substantial portion of water from the San Joaquin River, the influence of this relatively poor San Joaquin River water quality is greatest in the south Delta channels and in CVP and SWP exports.

Trends in Delta water quality reflect the effects of river inflows, tidal exchanges with San Francisco Bay, diversions, and pollutant releases. The north Delta tends to have better water quality primarily because of inflow from the Sacramento River. The quality of water in the west Delta is strongly influenced by tidal exchange with San Francisco Bay; during low-flow periods, seawater intrusion results in increased salinity. In the south Delta, water quality tends to be poorer because of the combination of inflows of poorer water quality from the San Joaquin River, discharges from Delta islands, export pumping, seasonal agricultural barriers, and effects of diversions that can sometimes increase seawater intrusion from San Francisco Bay.

The Sacramento and San Joaquin rivers contribute approximately 61 percent and 33 percent, respectively, to TDS concentrations within the Delta from tributary inflows. TDS concentrations are relatively low in the Sacramento River, but because of its large volumetric contribution, the river provides the majority of the TDS load supplied by tributary inflow to the Delta (DWR 2001). Although actual flow from the San Joaquin River is lower than flow from the Sacramento River, TDS concentrations in San Joaquin River water average approximately seven times the TDS concentrations in the Sacramento River.

7.2 Regulatory Framework

Several regulatory authorities at the Federal, State, and local levels control the flow, quality, and supply of water in California either directly or indirectly. This section focuses on laws related directly to the water quality aspect of the project.

Management of the Delta is partly determined by Federal and State regulations developed to protect both human and environmental beneficial uses. Primary institutional and regulatory influences on the use and management of the Delta consist of the CVP; the SWP; direct Delta diverters, including Contra Costa Water District (CCWD), Solano County Water Agency, and the City of Stockton Metropolitan Area; San Francisco Bay water quality needs; and multiple regulations governing protection of endangered species.

At the State level, the SWRCB and the RWQCBs regulate and monitor Delta water quality. Nine regional boards oversee water quality in California. Two of these, the CVRWQCB and San Francisco Bay RWQCB, oversee Delta water quality. EPA also plays an important role under the auspices of the CWA and the Safe Drinking Water Act (SDWA). The California Department of Public Health has an interest in the Delta because the Delta is the source of drinking water for more than 23 million Californians. DWR extensively monitors Delta water quality as part of its Municipal Water Quality Investigations program; in cooperation with Reclamation, DWR monitors Delta water quality under the SWRCB's compliance monitoring requirements.

At the local level, water agencies that divert from the Delta have both strong interest in and influence on Delta water quality management. These agencies include CCWD, Solano County Water Agency, and City of Stockton Metropolitan Area.

Two agencies with key planning roles in the Delta are the California Bay-Delta Authority and the Delta Protection Commission. The California Bay-Delta Authority became a State agency in January 2003, and is responsible for implementing the CALFED Bay-Delta Program (CALFED). State legislation created the Delta Protection Commission in 1992 with the goal of developing regional policies for the Delta to protect and enhance existing land uses. In 2000, the commission was made a permanent State agency. The Delta Protection Commission comments on applications for CALFED ecosystem restoration grants that affect the Delta, and participates in meetings with other CALFED agencies to provide input to CALFED management decisions.

7.2.1 Federal

Safe Drinking Water Act

The SDWA was established to protect the quality of drinking water in the United States. The SDWA authorized EPA to set national health-based standards for drinking water and requires many actions to protect drinking water and its sources, including rivers, lakes, reservoirs, springs, and groundwater wells. Furthermore, the SDWA requires all owners or operators of public water systems to comply with primary (health-related) standards. EPA has delegated to the California Department of Public Health, Division of Drinking Water and Environmental Management, the responsibility for administering California's drinking-water program. California Department of Public Health is accountable to EPA for program implementation and for adopting standards and regulations that are at least as stringent as those developed by EPA. Contaminants of concern relevant to domestic water supply are defined as those that pose a public health threat or that alter the aesthetic acceptability of the water. These types of contaminants are regulated by EPA primary and secondary maximum contaminant levels that are applicable to treated water supplies delivered to the distribution system. maximum contaminant levels and the process for setting these standards are reviewed triennially.

Clean Water Act

The CWA is the major Federal legislation governing the water quality aspects of the project. The objective of the act is "to restore and maintain the chemical, physical, and biological integrity of the nation's waters." The CWA establishes the basic structure for regulating discharge of pollutants into the waters of the United States and gives EPA the authority to implement pollution control programs such as setting wastewater standards for industries. In certain states such as California, EPA has delegated authority to state agencies.

Section 303 This section of the CWA requires states to adopt water quality standards for all surface waters of the United States. The three major components of water quality standards are as follows:

- **Designated uses** – Uses that society, through the Federal and State governments, determines should be attained in the water body, such as supporting communities of aquatic life, supplying water for drinking, irrigating crops and landscaping, and industrial purposes, and recreational uses (e.g., fishing, swimming, boating).

- **Water quality criteria** – Levels of individual pollutants or water quality characteristics, or descriptions of conditions of a water body that, if met, will generally protect the designated use of the water. Water quality criteria must be scientifically consistent with attainment of designated uses, which means that only scientific considerations can be taken into account when determining what water quality conditions are consistent with meeting a given designated use. Economic and social impacts are not considered when developing water quality criteria.

- **Antidegradation policy** – Designed to prevent deterioration of existing levels of good water quality (see the "Antidegradation Policy" section below for more information).

Where multiple uses exist, water quality standards must protect the most sensitive use. In California, EPA has given the SWRCB and its nine RWQCBs the authority to identify beneficial uses and adopt applicable water quality objectives.

Section 303(d) of the CWA requires states and authorized Native American tribes to develop a list of water quality–impaired segments of waterways. The list includes waters that do not meet water quality standards necessary to support the beneficial uses of that waterway, even after point sources of pollution have installed the minimum required levels of pollution control technology. Only waters impaired by "pollutants," not those impaired by other types of "pollution" (e.g., altered flow and/or channel modification), are to be included on the list. (Pollutants include clean sediments, nutrients (e.g., nitrogen and phosphorus), pathogens, acids/bases, temperature, metals, cyanide, and synthetic organic chemicals.)

Section 303(d) of the CWA also requires states to maintain a listing of impaired water bodies so that a TMDL can be established. A TMDL is a plan to restore the beneficial uses of a stream or to otherwise correct an impairment. It establishes the allowable pollutant loadings or other quantifiable parameters (e.g., pH or temperature) for a water body and thereby provides the basis for the establishment of water quality-based controls. The calculation for establishment of TMDLs for each water body must include a margin of safety to ensure that

the water body can be used for the purposes the State has designated. Additionally, the calculation also must account for seasonal variation in water quality. The CVRWQCB develops TMDLs for the Sacramento River (see discussion on the Porter-Cologne Water Quality Control Act below). Sedimentation/siltation impacts are the primary water quality parameters of concern with construction projects.

Reductions in pollutant loading are achieved by implementing strategies authorized by the CWA, such as the following, which are discussed in more detail below.

- **Section 401** – This section of the CWA requires Federal agencies to obtain certification from the State or Native American tribes before issuing permits that would result in increased pollutant loads to a water body. The certification is issued only if such increased loads would not cause or contribute to exceedences of water quality standards.

- **Section 402** – This section creates the National Pollutant Discharge Elimination System (NPDES) permit program. This program covers point sources of pollution discharging into a surface water body.

- **Section 404** – This section regulates the placement of dredged or fill materials into wetlands and other waters of the United States.

Section 401 – Water Quality Certification This section of the CWA requires an applicant for any Federal license or permit (e.g., a Section 404 permit) that may result in a discharge into waters of the United States to obtain a certification from the State that the discharge would comply with provisions of the CWA. The SWRCB and RWQCBs administer this program. The SWRCB issues Section 401 certifications for projects that would take place in two or more regions. Any condition of a Section 401 certification (or water quality certification) would be incorporated into the USACE permit.

For the primary study area the CVRWQCB has jurisdiction, while the extended study area encompasses the San Francisco Bay, Central Coast, Los Angeles, Lahontan, Colorado River Basin, Santa Ana, and San Diego RWQCBs. A Section 401 certification would not be required from the RWQCBs within the extended study area because no construction would occur in the extended study area.

Section 402 – National Pollutant Discharge Elimination System All point sources that discharge into waters of the United States must obtain an NPDES permit under provisions of Section 402 of the CWA. As with Section 401, the SWRCB and RWQCBs are responsible for implementing the NPDES permitting process at the State and regional levels, respectively.

The NPDES permit process also provides a regulatory mechanism for controlling nonpoint-source pollution created by runoff from construction and industrial activities, and general and urban land use, including runoff from streets. Projects involving construction activities (e.g., clearing, grading, or excavation) involving land disturbance greater than one acre must file a notice of intent with the appropriate RWQCB(s) to indicate their intent to comply with the General Permit for Discharges of Stormwater Associated with Construction Activity (Construction General Permit Order 2009-0009-DWQ, which went into effect and replaced Order 99-08-DWQ on July 1, 2010). This general permit establishes conditions to minimize sediment and pollutant loadings and requires preparation and implementation of a stormwater pollution prevention plan (SWPPP) before construction. The SWPPP is intended to help identify the sources of sediment and other pollutants, and to establish best management practices (BMP) for stormwater and nonstormwater source control and pollutant control. A sediment monitoring plan must be included in the SWPPP if the discharges occur directly to a water body listed on the Section 303(d) TMDL list for sediment.

For the primary study area the CVRWQCB has jurisdiction. A NPDES would not be required from the RWQCBs within the extended study area because no construction would occur.

Section 404 – Discharge of Dredged or Fill Material into Waters of the United States Section 404 deals with one broad type of pollution – the placement of dredged or fill material into "waters of the United States." Jurisdictional limits of these features are typically noted by the ordinary high-water mark. Isolated ponds or seasonal depressions had been previously regulated as waters of the United States. However, in *Solid Waste Agency of Northwestern Cook County v. United States Army Corps of Engineers et al.* (January 8, 2001), the U.S. Supreme Court ruled that certain "isolated" wetlands (e.g., nonnavigable, isolated, and intrastate) do not fall under the jurisdiction of the CWA and are no longer under USACE jurisdiction. (Although isolated wetlands may not be under Federal regulation, they are regulated by the State of California (see Porter-Cologne Water Quality Control Act discussion below).) Some circuit courts (e.g., *U.S. v. Deaton*, 2003; *U.S. v. Rapanos*, 2003; *Northern California River Watch v. City of Healdsburg*, 2006), however, have ruled that Solid Waste Agency of Northwestern Cook County does not prevent CWA jurisdiction if a "significant nexus" such as a hydrologic connection exists. The hydrologic connection may be human-made (e.g., roadside ditch) or a natural tributary to navigable waters, or direct seepage from the wetland to the navigable water, a surface or underground hydraulic connection. An ecological connection (e.g., the same bird, mammal, and fish populations are supported by both the wetland and the navigable water) and changes to chemical concentrations in the navigable water caused by water from the wetland may also constitute a significant nexus.

The discharge of dredge or fill generally includes the following activities:

- Placement of fill that is necessary for the construction of any structure or infrastructure in a water of the United States
- The building of any structure, infrastructure, or impoundment requiring rock, sand, dirt, or other material for its construction
- Site-development fills for recreational, industrial, commercial, residential, or other uses
- Causeways or road fills
- Dams and dikes
- Artificial islands
- Property protection and/or reclamation devices such as riprap, groins, seawalls, breakwaters, and revetments
- Beach nourishment
- Levees
- Fill for structures such as sewage treatment facilities, intake and outfall pipes associated with powerplants, and subaqueous utility lines
- Placement of fill material for construction or maintenance of any liner, berm, or other infrastructure associated with solid waste landfills
- Placement of overburden, slurry, or tailings or similar mining-related materials
- Artificial reefs

USACE regulations and policies mandate avoiding the filling of wetlands unless it can be demonstrated that no practicable alternatives (to filling wetlands) exist. There are four basic processes for obtaining Section 404 authorization from USACE. Because of its scale and potential impact, this project would require an individual permit.

For the primary study area, USACE's Sacramento District has jurisdiction, while the extended study area encompasses the San Francisco and Los Angeles Districts of USACE.

Antidegradation Policy

The antidegradation policy, established in 1968 and revised in 2005 (Title 40, Section 131.12 of the Code of Federal Regulations), is designed to protect

existing uses and water quality and national water resources, as authorized by Section 303(c) of the CWA. At a minimum, the policy and implementation methods must be consistent with the following:

- Existing instream water uses and the level of water quality necessary to protect the existing uses shall be maintained and protected.

- Where the quality of the waters exceeds levels necessary to support propagation of fish, shellfish, and wildlife and recreation in and on the water, that quality shall be maintained and protected unless the State finds that allowing lower water quality is necessary to accommodate important economic or social development in the area in which the waters are located. In allowing such degradation or lower water quality, the State shall assure water quality adequate to protect existing uses fully. Further, the State shall assure that there shall be achieved the highest statutory and regulatory requirements for all new and existing point sources and all cost-effective and reasonable BMPs for nonpoint source control.

- Where high-quality waters constitute an outstanding National resource, such as waters of National and State parks and wildlife refuges and waters of exceptional recreational or ecological significance, that water quality shall be maintained and protected.

Although the quality of water in the upper Sacramento River is relatively good, water quality problems do occur, including the presence of mercury, pesticides such as organochlorine pesticides, trace metals, turbidity, and toxicity from unknown origin (CALFED 2000a).

The CWA requires states to maintain a listing of impaired water bodies so that a TMDL can be established. A TMDL is a plan to restore the beneficial uses of a stream or to otherwise correct an impairment. The most prevalent contaminants in the Sacramento River basin are for organophosphate pesticides (agricultural runoff) and trace metals (acid mine drainage), for which TMDLs currently are being considered. Only during conditions of stormwater-driven runoff are water quality objectives typically not met (Domagalski et al. 2000).

Shasta-Trinity National Forest Land and Resource Management Plan

The STNF is guided by various laws, regulations, and policies that provide the framework for all levels of planning. These include regional guides, the *Shasta-Trinity National Forest Land and Resource Management Plan*, and site-specific planning documents, such as this document.

The *Shasta-Trinity National Forest Land and Resource Management Plan* provides guidance for managing National Forest System lands in the STNF. The development of a Forest land and resource management plan (LRMP) occurs within the framework of regional and national USFS planning. The LRMP

includes forest goals; forest objectives, including forest-wide prescription assignment by acres, outputs, and activities; and forest standards and guidelines. Forest goals state the management philosophy of the LRMP, and the Forest objectives describe the purpose of the management prescriptions. The Forest-wide management prescriptions apply a management theme to specific types of land (e.g., wilderness, roaded high-density recreation).

In essence, this LRMP requires that projects authorized by the STNF be designed and implemented in a manner that maintains the existing conditions or implements actions to restore biological and physical processes within their natural range of variability.

Water Quality
Goals (LRMP, p. 4-6)

- Maintain or improve water quality and quantity to meet fish habitat requirements and domestic use needs.
- Maintain water quality to meet or exceed applicable standards and regulations.

Standards and Guidelines (LRMP, p. 4-25)

- Implement BMPs for protection or improvement of water quality, as described in "Water Quality Management for National Forest System Lands in California," for applicable management activities. Determine specific practices or techniques during project level planning using information obtained from on-site soil, water, and geology investigations.

Best Management Practices
Standards and Guidelines (LRMP, Appendix E)

- STNF water quality BMPs were developed in compliance with Section 208 of the Federal CWA, Public Law 92-500, as amended and are certified by the RWQCB and approved by EPA. The following BMPs are applicable to the proposed action:

Road Building and Site Construction
Standards and Guidelines (LRMP, Appendix E, pp. E-2 through E-3)

- General guidelines for the location and design of roads
- Erosion control plan
- Timing of construction activities
- Road slope stabilization (preventive practice)
- Road slope stabilization (administrative practice)

- Dispersion of subsurface drainage from cut and fill slopes
- Control of road drainage
- Construction of stable embankments
- Minimization of sidecast material
- Servicing and refueling equipment
- Control of construction in riparian management zones
- Controlling in-channel excavation
- Diversion of flows around construction sites
- Bridge and culvert installation
- Disposal of right-of-way and roadside debris
- Specifying riprap composition
- Maintenance of roads
- Road surface treatment to prevent loss of materials
- Traffic control during wet periods
- Surface erosion control at facility sites

Recreation

Standards and Guidelines (LRMP, Appendix E, p. E-3)

- Sampling and surveillance of designated swimming sites
- On-site interdisciplinary sanitary surveys will be conducted to augment the sampling of swimming waters
- Documentation of water quality data
- Control of sanitation facilities
- Control of refuse disposal
- Protection of water quality within developed and dispersed recreation areas

U.S. Bureau of Land Management

The U.S. Bureau of Land Management's Resource Management Plan, which is its plan for managing Federal lands in Shasta County, was amended by the 1994 Record of Decision (ROD) for the Northwest Forest Plan (Final Supplemental Environmental Impact Statement (EIS) for Amendments to Forest Service and Bureau of Land Management Planning Documents within the Range of the Northern Spotted Owl). This amendment required preparation of Watershed Analysis prior to initiating U.S. Bureau of Land Management activities. As a party to the Northwest Forest Plan, U.S. Bureau of Land Management, like USFS, is also required to ensure that projects are consistent with the Aquatic Conservation Strategy.

Biological Opinions on the Long-term Central Valley Project and State Water Project Operations Criteria and Plan

During the past 6 years, NMFS and USFWS BOs regarding effects of the proposed OCAP have been revised twice. On October 22, 2004, NMFS issued a BO regarding effects of the proposed OCAP for the CVP in coordination with the SWP on winter-run Chinook salmon, spring-run Chinook salmon, Central Valley steelhead, Southern Oregon/Northern California Coast Coho salmon, and Central California Coast steelhead and their designated critical habitat. On February 16, 2005, USFWS issued a BO regarding effects of the proposed OCAP on delta smelt. The 2004 and 1995 BOs supersede the prior BOs issued by NMFS and USFWS, and contain reasonable and prudent measures and terms and conditions that specify fisheries monitoring actions, spawning gravel augmentation, forecasting of deliverable water, management of cold-water supply within reservoirs, temperature monitoring, adaptive management processes to analyze annual cold-water management, minimization of flow fluctuations, passage at RBDD, operation of gates in the Delta, fish screening at pumping facilities, and numerous other effects minimization measures. In response to litigation, the 2004 and 2005 BOs were remanded to USFWS and NMFS for revision, but were not vacated. USFWS and NMFS released revised BOs in 2008 and 2009, respectively. These revised BOs are in litigation.

7.2.2 State

Porter-Cologne Water Quality Control Act

The Porter-Cologne Water Quality Control Act (Porter-Cologne Act) is California's statutory authority for the protection of water quality. Under the act, the State must adopt water quality policies, plans, and objectives protecting the State's waters for the use and enjoyment of the people. Obligations of the SWRCB and RWQCBs to adopt and periodically update their basin plans are set forth in the act. A basin plan identifies the designated beneficial uses for specific surface water and groundwater resources, applicable water quality objectives necessary to support the beneficial uses, and implementation programs that are established to maintain and protect water quality from degradation for each of the RWQCBs. The act also requires waste dischargers to notify the RWQCBs of their activities through the filing of reports of waste

discharge and authorizes the SWRCB and RWQCBs to issue and enforce waste discharge requirements (WDR), NPDES permits, Section 401 water quality certifications, or other approvals. The RWQCBs also have authority to issue waivers to reports of waste discharge/WDRs for broad categories of "low threat" discharge activities that have minimal potential for adverse water quality effects when implemented according to prescribed terms and conditions.

The CVRWQCB Basin Plan (originally published in 1998, last revised in September 2009) (CVRWQCB 2009) regulates waters of the State located within the primary study area. The CVRWQCB Basin Plan covers an area including the entire Sacramento and San Joaquin river basins, involving an area bounded by the crests of the Sierra Nevada on the east and the Coast Ranges and Klamath Mountains on the west. The area covered in the CVRWQCB Basin Plan extends some 400 miles, from the California/Oregon border southward to the headwaters of the San Joaquin River, encompassing a substantial portion of the extended study area. The beneficial uses of the Sacramento River are as follows (CVRWQCB 2009):

- Municipal and domestic supply
- Irrigation and stock watering
- Service supply
- Power
- Contact recreation and canoeing and rafting
- Other noncontact recreation
- Freshwater habitat (warm and cold)
- Migration habitat (warm and cold)
- Spawning habitat (warm and cold)
- Wildlife habitat
- Navigation

The Basin Plan recognizes Shasta Reservoir (i.e., Shasta Lake) as a discrete water body and identifies a number of specific beneficial uses:

- Municipal and domestic supply
- Agricultural supply
- Hydropower generation

- Water contact recreation
- Noncontact recreation
- Freshwater habitat (warm and cold)
- Spawning, reproduction, and/or early development
- Wildlife habitat

The CVRWQCB has also promulgated water quality objectives for all surface waters in the Sacramento and San Joaquin River basins (CVRWQCB 2009) for the following:

- Bacteria levels
- Biostimulatory substances
- Chemical constituents
- Color
- Dissolved oxygen
- Floating material
- Methylmercury
- Oil and grease
- pH
- Pesticides
- Radioactivity
- Salinity
- Sediment
- Settleable material
- Suspended material
- Tastes and odors
- Temperature
- Toxicity
- Turbidity

Primary Study Area The CVRWQCB determined that the 25-mile reach of the Sacramento River from Keswick Dam downstream to Cottonwood Creek is impaired because the water periodically contains levels of dissolved cadmium, copper, and zinc that exceed levels identified to protect aquatic organisms.

Consequently, the CVRWQCB developed a TMDL program for dissolved cadmium, copper, and zinc loading into the upper Sacramento River because of these exceedences of water quality standards (CVRWQCB 2002) and has proposed implementing the water quality objectives listed in Table 7-3 as numeric targets for this TMDL. No other TMDLs have been finalized for this area (CVRWQCB 2007a).

Table 7-3. Proposed TMDL Numeric Targets for Dissolved Cadmium, Copper, and Zinc for a 25-Mile Segment of the Upper Sacramento River between Keswick Dam and Cottonwood Creek near Balls Ferry in Shasta County

Metals	Acute Numeric Target (μg/L)	Chronic Numeric Target (μg/L)
Cadmium	0.22	0.22
Copper	5.6	4.1
Zinc	16	16

Source: CVRWQCB 2002

Key:
μg/L = micrograms per liter
TMDL = total maximum daily load

Extended Study Area The Sacramento River downstream from RBDD was listed as an impaired water body under Section 303(d) of the CWA. The parameters of concern in this reach included diazinon, mercury, and unknown sources of toxicity (CVRWQCB 2003b). TMDLs under development for the Sacramento River are for diazinon, methylmercury, and chlorpyrifos (CVRWQCB 2007b). The extended study area encompasses the San Francisco, Central Coast, Los Angeles, Lahontan, Colorado River Basin, Santa Ana, and San Diego RWQCBs.

Clean Water Act Section 401 Water Quality Certification

The CVRWQCB, under the auspices of the SWRCB, requires that a project proponent obtain a CWA Section 401 water quality certification in conjunction with the Section 404 permits granted by USACE. Because the project would have the potential to affect water quality in Shasta Lake, the CVRWQCB is likely to impose water quality limitations on the project through WDRs. Reclamation will prepare and submit to the CVRWQCB a request for water quality certification before development of the project. A likely condition of the water quality certification is preparation of an erosion and sedimentation control plan and a spill prevention and containment plan.

Waste Discharge Permit

The CVRWQCB controls the discharge of wastes to surface waters from industrial processes or construction activities through the NPDES permit process. WDRs are established in the permit to protect beneficial uses. The

CVRWQCB will require an application for a waste discharge permit for the project.

Industrial Stormwater General Permit

The Industrial Stormwater General Permit (General Industrial Permit) is an NPDES permit that regulates discharges associated with 10 broad categories of industrial activities. This permit requires implementation of management measures that will achieve the performance standard of best available technology economically achievable and best conventional pollutant control technology. This permit also requires development of a SWPPP and a monitoring plan. Through the SWPPP, sources of pollutants are to be identified and the means to manage the sources to reduce stormwater pollution are described.

Stormwater Pollution Prevention Plan

The General Industrial Permit includes provisions for developing a SWPPP to maximize the potential benefits of pollution prevention and sediment- and erosion-control measures at construction sites. Developing and implementing a SWPPP would provide Reclamation with the framework for reducing soil erosion and minimizing pollutants in stormwater during project construction.

Water Quality Control Plan for the Control of Temperature in the Coastal and Interstate Waters and Enclosed Bays and Estuaries of California

The *Water Quality Control Plan for the Control of Temperature in the Coastal and Interstate Waters and Enclosed Bays and Estuaries of California* (Thermal Plan) sets limits for "thermal waste" and "elevated temperature waste" discharged into coastal and interstate waters and enclosed bays and estuaries of California (SWRCB no date). Estuarine waters are considered to extend from "…a bay or the open ocean to the upstream limit of tidal action" (SWRCB no date). This definition includes the Delta as defined by Section 12220 of the California Water Code, as well as portions of the Sacramento River that are subject to tidal action. Generally, the Basin Plan defines temperature objectives in two parts (CVRWQCB 2009):

> *At no time or place shall the temperature of COLD or WARM intrastate waters be increased more than 5°F above natural receiving water temperature.*
>
> *The temperature shall not be elevated above 56°F in the reach from Keswick Dam to Hamilton City nor above 68°F in the reach from Hamilton City to the I Street Bridge during periods when temperature increases will be detrimental to the fishery.*

The first water quality standards for the Delta were adopted in May 1967, when the State Water Rights Board (predecessor to the SWRCB) released Water Right Decision 1275 (D-1275), approving water rights for the SWP while setting agricultural salinity standards as terms and conditions. Since then, these

requirements were changed in 1971 under Water Right Decision 1379 (D-1379), and again in 1978 under Water Right Decision 1485 and the Water Quality Control Plan (WQCP) for the Delta and Suisun Marsh (1978 WQCP). In May 1995, SWRCB adopted a new Bay-Delta WQCP, and it was implemented through SWRCB Revised Water Rights Decision 1641 (D-1641) in March 2000.

1995 Water Quality Control Plan

The 1995 *Water Quality Control Plan for the San Francisco Bay/Sacramento-San Joaquin Delta Estuary* (SWRCB 1995) established water quality control measures that contribute to the protection of beneficial uses in the Delta. The 1995 WQCP identified (1) beneficial uses of the Delta to be protected, (2) water quality objectives for the reasonable protection of beneficial uses, and (3) a program of implementation for achieving the water quality objectives. The 1995 WQCP superseded the *Water Quality Control Plan for Salinity* (adopted in May 1991) and the *Water Quality Control Plan for the Sacramento-San Joaquin Delta and Suisun Marsh* that was adopted in August 1978.

The 1995 WQCP was developed as part of the December 15, 1994, Bay-Delta Accord, which committed the CVP and SWP to new Delta habitat objectives. Because these new beneficial objectives and water quality standards were more protective than those of the previous Water Right Decision 1485, the new objectives were adopted by amendment in 1995 through a Water Rights Order for operation of the CVP and SWP. One key feature of the 1995 WQCP was the estuarine habitat ("X2") objectives for Suisun Bay and the western Delta. The X2 objective required specific daily or 14-day surface EC criteria, or 3-day averaged outflow requirements to be met for a certain number of days each month, February through June. These requirements were designed to provide improved shallow water habitat for fish species in spring. Because of the relationship between seawater intrusion and interior Delta water quality, the X2 criteria also improved water quality at Delta drinking water intakes. Other new elements of the 1995 WQCP included export-to-inflow ratios intended to reduce entrainment of fish at the export pumps, Delta Cross Channel gate closures, and San Joaquin River EC and flow standards.

Water Right Decision 1641

D-1641 and Water Rights Order 2001-05 contain the current water right requirements to implement the 1995 WQCP. D-1641 incorporates water right settlement agreements between Reclamation and DWR and certain water users in the Delta and upstream watersheds regarding contributions of flows to meet water quality objectives. However, Reclamation and/or DWR are responsible for ensuring that objectives are met in the Delta. D-1641 also authorizes the CVP and SWP to use joint points of diversion (JPOD) in the south Delta, and recognizes the CALFED Operations Coordination Group process for operational flexibility in applying or relaxing certain protective standards. The additional exports allowed under the JPOD could result in additional degradation of water quality for water users in the south and central Delta. The

JPOD also could affect water levels in the south Delta and endangered fish species.

In February 2006, SWRCB issued notice to Reclamation and DWR that each agency is responsible for meeting the objectives in the interior south Delta, as described in D-1641. The SWRCB order requires Reclamation and DWR to comply with a detailed plan and time schedule that will bring them into compliance with their respective permit and license requirements for meeting interior south Delta salinity objectives by July 1, 2009. The SWRCB order also revised the previously issued (July 1, 2005) Water Quality Response Plan approval governing Reclamation's and DWR's use of each other's respective point of diversion in the south Delta. Additionally, the order specifies that JPOD operations are authorized pursuant to the 1995 WQCP, and that Reclamation and DWR may conduct JPOD diversions, provided that both agencies are in compliance with all conditions of their respective water right permits and licenses at the time the JPOD diversions would occur (SWRCB 2006).

Municipal and Industrial Water Quality Objectives

In the 1978 WQCP, the SWRCB set two objectives that it believed would provide reasonable protection for M&I beneficial uses of Delta waters from the effects of salinity intrusion. The first objective established a year-round maximum mean daily chloride concentration measured at five Delta intake facilities, including CCWD's Pumping Plant Number 1, of 250 mg/L for the reasonable protection of municipal beneficial uses. This objective was consistent with the EPA secondary maximum contaminant level for chloride of 250 mg/L, and is based only on aesthetic (taste) considerations. The second objective established a maximum mean daily chloride concentration of 150 mg/L (measured at either CCWD Pumping Plant No. 1 or the San Joaquin River at the Antioch water works intake) for the reasonable protection of industrial beneficial uses (specifically manufacture of cardboard boxes by Gaylord Container Corporation in Antioch). This requirement is in effect for a minimum of between 155 and 240 days each calendar year, depending on the water year type.

In the 1991 WQCP, the SWRCB reviewed the water quality objectives for M&I use contained in the 1978 WQCP, and reviewed potential new objectives for trihalomethanes and other disinfection byproducts, including bromides. The SWRCB concluded that technical information regarding trihalomethanes and other disinfection byproducts was not sufficient to set a scientifically sound objective. Accordingly, the SWRCB continued the existing objectives for chloride concentration, and until development of more information about these constituents, set a water quality "goal" for bromides of 0.15 mg/L (150 micrograms per liter). The SWRCB also noted that the 150 mg/L chloride objective was maintained in part because it provides ancillary protection for other M&I uses in the absence of objectives for trihalomethanes and other disinfection byproducts.

These objectives remained unchanged in the 1995 WQCP. The SWRCB and CVRWQCB basin plans specify water quality objectives to protect designated beneficial uses, including municipal drinking-water supply. The CVRWQCB is also currently developing a Central Valley drinking-water policy that may lead to regulations limiting the discharge of bromide, organic carbon, pathogens, and other drinking water constituents of concern. The CVRWQCB took the important step of adopting resolutions in July 2004 (Resolution No. R5-2004-0091) and in July 2010 (Resolution No. R5-2010-0079) supporting development of the policy. Resolution No. R5-2010-0079 directed CVRWQCB staff to develop and bring a comprehensive drinking water policy to the board within 3 years (i.e., by 2013).

Coordinated Operations Agreement

The Coordinated Operations Agreement defines how Reclamation and DWR share their joint responsibility to meet Delta water quality standards and meet the water demands of senior water right holders. The Coordinated Operations Agreement defines the Delta as being in either "balanced water conditions" or "excess water conditions." Balanced conditions are periods when Delta inflows are just sufficient to meet water user demands within the Delta, outflow requirements for water quality and flow standards, and export demands. Under excess conditions, Delta outflow exceeds the flow required to meet the water quality and flow standards. Typically, the Delta is in balanced water conditions from June to November, and in excess water conditions from December through May. However, depending on the volume and timing of winter runoff, excess or balanced conditions may extend throughout the year.

During excess water conditions, but during periods when Delta outflow is still relatively low, additional Delta diversions can degrade the water quality needed to meet drinking water standards, even when SWRCB M&I objectives are being met.

7.2.3 Local

The primary study area is located within both Shasta and Tehama counties, while the extended study area includes the following counties: Glenn, Butte, Colusa, Sutter, Yolo, Yuba, Sacramento, Napa, Solano, San Francisco, Contra Costa, San Joaquin, Alameda, Santa Clara, Stanislaus, Santa Cruz, San Benito, Merced, Madera, Fresno, Tulare, King, Kern, Santa Barbara, Ventura, Los Angeles, San Bernardino, Orange, Riverside, San Diego, and Imperial. Each of these counties has a general plan that includes general policies to protect water quality, water supply, water resources, and watersheds. There are no specific local requirements that are pertinent to this analysis.

Water quality protection measures are included in the *Shasta County General Plan*. The county's goal is to protect all aspects of water quality in the county. The county defines erosion and downstream sedimentation as geologic hazards that must be prevented as part of grading and site development. The Shasta County Grading Ordinance sets requirements for grading and erosion control,

including prevention of sedimentation or damage to off-site property. Grading permits require a vested map and the following information:

- A detailed grading plan
- Geological studies, if the project is located within an area that is prone to slippage, or has highly erodible soils or known geologic hazards
- Detailed drainage or flood control information as required by the Department of Public Works
- A final development plan, if the project is located in a zone or district that requires a final development plan
- A noise analysis, if the project is located in the vicinity of a high-noise-generating use

The water quality protection goal included in the Open Space and Conservation Element of the *Tehama County General Plan* (Tehama County 2009) is to ensure that water supplies are of sufficient quality and quality, now and into the future, to serve the needs of Tehama County (Goal OS-1). Policies in support of this goal include sound watershed management, protection of surface water quality and streamflows, and protection of groundwater quality through the minimization of erosion and prevention of intrusion of wastes into water supplies.

7.3 Environmental Consequences and Mitigation Measures

7.3.1 Methods and Assumptions

A combination of water quality monitoring data and computer modeling was used to aid in the evaluation of potential impacts of the project alternatives on water quality. Anticipated construction practices and materials, location, and duration of construction were also evaluated.

To evaluate potential Delta water quality impacts, the analysis relied on quantitative modeling tools to simulate conditions that would be expected to occur under the SLWRI alternatives compared to the bases of comparison (existing conditions without project, and future conditions without project). The analysis of potential impacts on water quality in the Delta includes an analysis of potential impacts on water quality for all in-Delta water users. Delta parameters used in the evaluation include simulated changes in X2 location, Delta outflow, export-to-inflow ratio, salinity, and chloride ion concentrations.

The water quality impact assessment focuses on EC, measured in millimhos per centimeter (mmhos/cm), and chloride ion concentration in mg/L, as indicators of Delta water quality because they are the primary water quality constituents most

likely to be affected by changes in Delta outflow and pumping operations. EC also is the parameter for which considerable monitoring data are available, and which has been used to calibrate the modeling tools used to simulate Delta water quality conditions.

A suite of modeling tools was used to evaluate the potential impacts of existing conditions, and the No-Action and other SLWRI alternatives on the Delta water quality of the project, and to quantify potential benefits. CalSim-II was used to simulate CVP and SWP operations, determining surface water flows, storages, and deliveries associated with each alternative. (A detailed description of CalSim-II is included in Chapter 2 of the Modeling Appendix.) Delta Simulation Model 2 (DSM2) was used to simulate the hydrodynamics of the Delta, providing the data used in discussion of the water-quality-related impacts of each alternative. (A detailed description of DSM2 and the assumptions used in the SLWRI analysis are included in Chapter 8 of the Modeling Appendix.) Summaries of the analysis and modeling results are provided below. (More detailed results of the CalSim-II output can be found in Attachment A of the *Hydrology, Hydraulics, and Water Management Technical Report*.) Attachment A of the *Water Quality Technical Report* contains more detailed DSM2 output.

To understand the effects of the alternatives under both existing and future conditions, each alternative was modeled using two different assumptions about level of development (2005 and 2030) and compared to the appropriate baseline modeling results to determine the character and extent of impacts.

CalSim-II

CalSim-II is the application of the Water Resources Integrated Modeling System software to the CVP/SWP. This application was jointly developed by Reclamation and DWR for planning studies relating to CVP/SWP operations. The primary purpose of CalSim-II is to evaluate the water supply reliability of the CVP and SWP at current or future levels of development (e.g., 2005, 2030), with and without various assumed future facilities, and with different modes of facility operations. Geographically, the model covers the drainage basin of the Delta, and CVP/SWP exports to the Bay Area, San Joaquin Valley, Central Coast, and Southern California.

CalSim-II typically simulates system operations for an 83-year period using a monthly time step. The model assumes that facilities, land use, water supply contracts, and regulatory requirements are constant over this period, representing a fixed level of development (e.g., 2005, 2030). The historical flow record of October 1921 to September 2003, adjusted for the influences of land use changes and upstream flow regulation, is used to represent the possible range of water supply conditions. Major Central Valley rivers, reservoirs, and CVP/SWP facilities are represented by a network of arcs and nodes. CalSim-II uses a mass balance approach to route water through this network. Simulated flows are mean flows for the month; reservoir storage volumes correspond to end-of-month storage.

CalSim-II models a complex and extensive set of regulatory standards and operations criteria. (Descriptions of both are contained in Chapter 2 of the Modeling Appendix.) The hydrologic analysis presented for this EIS used the Common Assumptions Common Modeling Package version 8D CalSim-II models, which are the best available hydrological modeling tools, to approximate the changes in storage, flow, salinity, and reservoir system reoperation associated with the SLWRI alternatives. Although CalSim-II is the best available tool for simulating system-wide operations, the model also contains simplifying assumptions in its representation of the real system.

A general external review of the methodology, software, and applications of CalSim-II was conducted in 2003 (Close et al. 2003). Recently, an external review of the San Joaquin River Valley CalSim-II model was also conducted (Ford et al. 2006). Several limitations of the CalSim-II models were identified in these external reviews. The main limitations of the CalSim-II models are as follows:

- Model uses a monthly time step
- Accuracy of the inflow hydrology is uncertain:
  - Model lacks a fully explicit groundwater representation

Reclamation, DWR, and the external reviewers have identified the need for a comprehensive error and uncertainty analysis for various aspects of the CalSim-II model. DWR has issued a CalSim-II Model Sensitivity Analysis Study (DWR 2005), and Reclamation is currently embarking on a similar sensitivity and uncertainty analysis for the San Joaquin River basin. This information will improve understanding of the model results.

Despite these limitations, the monthly CalSim-II model results remain useful for comparative purposes. It is important to differentiate between “absolute” or “predictive” modeling applications and “comparative” applications. In “absolute” applications, the model is run once to predict a future outcome and errors or assumptions in formulation, system representation, data, operational criteria, etc., all contribute to total error or uncertainty in model results. In “comparative” applications, the model is run twice, once to represent a base condition (no-project) and a second time with a specific change (project) to assess the change in the outcome because of the input change. In this mode (the mode used for this EIS), the difference between the two simulations is of principal importance. Potential errors or uncertainties that exist in the “no-project” simulation are also present in the “project” simulation such that their impacts are reduced when assessing the change in outcomes. The SLWRI analysis is a comparative analysis.

DSM2

DSM2 is a branched 1-dimensional model for simulation of hydrodynamics, water quality, and particle tracking in a network of riverine or estuarine

channels (DWR 2002). The hydrodynamic module can simulate channel stage, flow, and water velocity. The water quality module can simulate the movement of both conservative and nonconservative constituents. The model is used by DWR to perform operational and planning studies of the Delta.

Impact analyses for planning studies of the Delta are typically performed for a 72-year period (1922 to 1994). In model simulations, EC is typically used as a surrogate for salinity. Results from CalSim-II are used to define Delta boundary inflows. CalSim-II-derived boundary inflows include the Sacramento River flow at Hood, San Joaquin River flow at Vernalis, inflow from the Yolo Bypass, and inflow from the eastside streams. In addition, Net Delta Outflow from CalSim-II is used to calculate the salinity boundary at Martinez.

Details of the model, including source codes and model performance, are available from the DWR Bay-Delta Office, Modeling Support Branch Web site (http://modeling.water.ca.gov/delta/models/dsm2/index.html). Documentation on model development is discussed in annual reports on Methodology for Flow and Salinity Estimates in the Sacramento-San Joaquin Delta and Suisun Marsh submitted to the SWRCB by the DWR Delta Modeling Section.

Sediment

The potential impacts from sediment in terms of erosion and geomorphology are analyzed in Chapter 4, “Geology, Geomorphology, Minerals, and Soils.”

Temperature

The analysis presented in Chapter 6, “Hydrology, Hydraulics, and Water Management,” assumed that the SLWRI alternatives would not alter existing operational rules or protocols and that there would be no formal changes to CVP or SWP operating criteria. Each action alternative would include storing some additional flows behind Shasta Dam during periods when the flows would have otherwise been released downstream. The resulting increase in storage would be used both to create an expanded cold-water pool (CWP), thus benefiting fisheries, and for subsequent release downstream when there are opportunities to put the water to beneficial use.

HEC-5Q temperature modeling was used to simulate flow and temperature for the Sacramento River system above RBDD. This model was updated to better represent the upper Sacramento River system with an emphasis on operation of the Shasta TCD. CalSim-II results were used as flow inputs to the HEC-5Q model. Temperature results are presented in Chapter 11, “Fisheries and Aquatic Ecosystems.” The water quality impacts analysis for temperature based on those results is summarized below.

Metals

Water quality data available for Shasta Lake and its tributaries were used to assess the impacts related to the discharge of metals into Shasta Lake. Available

monitoring data for the Sacramento River were used to assess the impacts of metals in Keswick Reservoir and the Sacramento River downstream.

7.3.2 Criteria for Determining Significance of Effects

An environmental document prepared to comply with NEPA must consider the context and intensity of the environmental effects that would be caused by, or result from, the proposed action. Under NEPA, the significance of an effect is used solely to determine whether an environmental impact statement must be prepared. An environmental document prepared to comply with CEQA must identify the potentially significant environmental effects of a proposed project. A "[s]ignificant effect on the environment" means a substantial, or potentially substantial, adverse change in any of the physical conditions within the area affected by the project" (State CEQA Guidelines, Section 15382). CEQA also requires that the environmental document propose feasible measures to avoid or substantially reduce significant environmental effects (State CEQA Guidelines, Section 15126.4(a)).

Overall Impact Indicators for Water Quality

The significance criteria described below were developed based on guidance provided by the State CEQA Guidelines for use in assessing potential impacts on water quality; they also consider the context and intensity of the environmental effects as required under NEPA. These significance criteria were applied to the qualitative assessment and quantitative modeling results and used to determine impact significance. The analysis of water quality impacts and benefits focuses on temperature, metals, and sediment, because they are important water quality constituents in the both the primary and extended study areas.

The impact significance criteria for Delta water quality variables that have regulatory objectives or numerical standards, such as those contained in the 1995 WQCP, are developed from the general considerations listed below.

Impacts of an alternative on water quality would be significant if project implementation would do any of the following:

- Violate existing water quality standards or otherwise substantially degrade water quality
- Result in substantial water quality changes that would adversely affect beneficial uses
- Result in substantive undesirable impacts on public health or environmental receptors

Significance statements are relative to both existing conditions (2005) and future conditions (2030) unless stated otherwise.

Impact Indicators for Delta Salinity

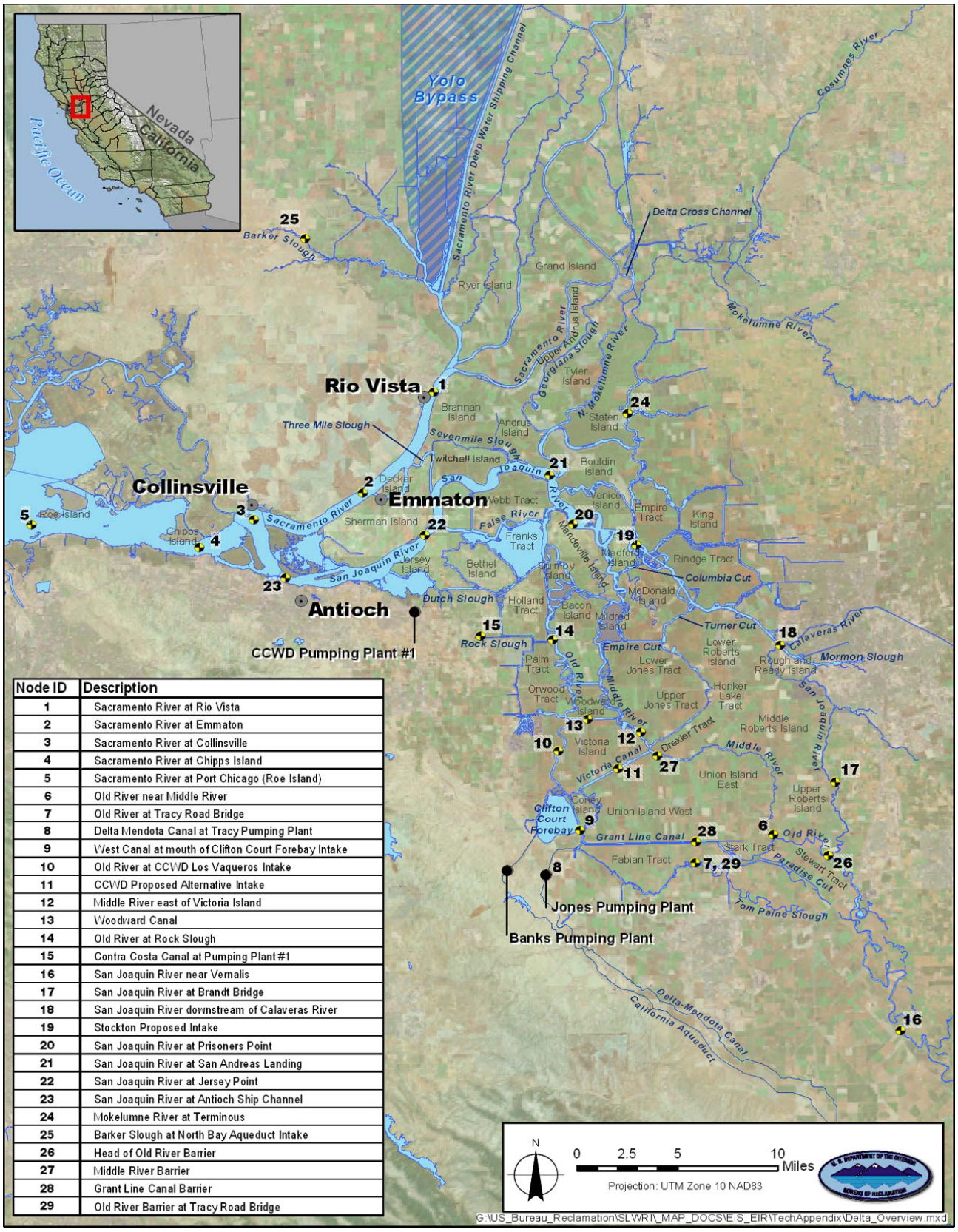
If changes in salinity within the Delta during months of increased pumping would result in an increase in salinity, relative to the basis of comparison, of sufficient frequency and magnitude over the long term to adversely affect designated beneficial uses, to increase the frequency that existing regulatory standards are exceeded, or to substantially degrade water quality at the locations below, then the impact would be considered significant:

- Sacramento River at Collinsville
- San Joaquin River at Jersey Point
- Sacramento River at Emmaton
- Old River at Rock Slough
- Delta-Mendota Canal at Jones Pumping Plant
- West Canal at mouth of the Clifton Court Forebay
- San Joaquin River at Vernalis
- Old River near Tracy Road Bridge
- Old River at Middle River
- San Joaquin River at Brandt Bridge

Figure 7-3 shows the major Delta islands, waterways, water quality control stations, and M&I intakes within the Delta.

Salinity Salinity-related water quality impacts associated with the operational component of the SLWRI alternatives were assessed at several locations in the Delta. EC was used as a surrogate for salinity. Using the assumptions discussed above, and detailed in Chapter 6 of the Modeling Appendix, the DSM2 model calculated changes in monthly mean EC values for the alternatives, relative to the bases of comparison. Monthly EC results were derived for a 73-year simulation period, extending from 1922 through 1994.

DSM2 model output was used to evaluate potential changes in salinity under the SWLRI alternatives, relative to the bases of comparison: changes equal to or greater than 5 percent in long-term monthly average EC values and average monthly EC values by water year type, and compliance with water quality standards, including the number of occurrences during which an EC compliance standard was met or exceeded.



Node ID	Description
1	Sacramento River at Rio Vista
2	Sacramento River at Emmaton
3	Sacramento River at Collinsville
4	Sacramento River at Chipps Island
5	Sacramento River at Port Chicago (Roe Island)
6	Old River near Middle River
7	Old River at Tracy Road Bridge
8	Delta Mendota Canal at Tracy Pumping Plant
9	West Canal at mouth of Clifton Court Forebay Intake
10	Old River at CCWD Los Vaqueros Intake
11	CCWD Proposed Alternative Intake
12	Middle River east of Victoria Island
13	Woodward Canal
14	Old River at Rock Slough
15	Contra Costa Canal at Pumping Plant #1
16	San Joaquin River near Vernalis
17	San Joaquin River at Brandt Bridge
18	San Joaquin River downstream of Calaveras River
19	Stockton Proposed Intake
20	San Joaquin River at Prisoners Point
21	San Joaquin River at San Andreas Landing
22	San Joaquin River at Jersey Point
23	San Joaquin River at Antioch Ship Channel
24	Mokelumne River at Terminous
25	Barker Slough at North Bay Aqueduct Intake
26	Head of Old River Barrier
27	Middle River Barrier
28	Grant Line Canal Barrier
29	Old River Barrier at Tracy Road Bridge

Figure 7-3. Major Delta Islands, Waterways, Water Quality Control Stations, and Municipal and Industrial Intakes

Changes in salinity were evaluated in the Delta during months of increased pumping under the alternatives, relative to the bases of comparison. Potential significant impacts could occur if salinity increases were of sufficient frequency and magnitude over the long term to adversely affect designated beneficial uses, to exceed existing regulatory standards, or to substantially degrade water quality.

Delta water quality is directly controlled by existing Delta water quality objectives (SWRCB 1995) for M&I, agricultural, and fish and wildlife uses that are incorporated in SWRCB D-1641 (SWRCB 2000). The 1995 WQCP objectives vary with month and water year type. Also, the 1995 WQCP objectives may only apply for some months and at some locations.

Applicable EC objectives were evaluated for the agricultural diversion season of April through August at Emmaton and Jersey Point, and during the entire year at each of the CVP/SWP export locations, and three south Delta locations. Increases in EC values that result in exceedence of the objective at specified locations in the Delta were considered to be significant water quality impacts. Monthly changes in EC values are also considered to be significant if they exceeded 10 percent of the applicable objective.

Impact Indicators for X2 Position

If a change in mean monthly position of X2, relative to the bases of comparison, would be of sufficient frequency and magnitude to adversely affect water quality, then it shall be considered a significant impact.

The X2 parameter represents the geographical location of the 2 parts per thousand near-bottom salinity isohaline in the Delta, which is measured in distance upstream from the Golden Gate Bridge in Suisun Bay (Jassby et al. 1995). The location of the estuarine salinity gradient is regulated during the months of February through June by the location of the X2 objective in the 1995 WQCP. During this time period, the X2 location must remain downstream from the confluence of the Sacramento and San Joaquin rivers[1] at Collinsville for the entire 5-month period. The X2 objective also specifies the number of days each month that that location of X2 must be downstream from Chipps Island or downstream from Roe Island.[2]

Estuarine EC objectives (i.e., X2) specified in the 1995 WQCP are applicable at Chipps Island during February through June for most years. The maximum EC objective at Chipps Island is 2.640 mmhos/cm (corresponding to a 2 parts per thousand salinity at Chipps Island) and must be satisfied for a specified number of days each month, depending on the previous month's Eight River Index (a measure of runoff in the Sacramento and San Joaquin valleys).

[1] Also referred to as Collinsville.
[2] Also referred to as the Port Chicago EC monitoring station.

7.3.3 Topics Eliminated from Further Consideration

The comprehensive plans include measures to remove or abandon on-site wastewater treatment facilities (e.g., septic tanks and/or drain fields) in conjunction with relocation activities. Several wastewater treatment packages will be developed to ensure that management of effluent from lakeshore developments is consistent with requirements of Federal, State, and local agencies. Only minor project-related effects on nutrients are expected to occur in either the primary study area or the extended study area; therefore, potential effects on the study area related to nutrients are not discussed further in this EIS.

7.3.4 Direct and Indirect Effects

No-Action Alternative

Shasta Lake and Vicinity Under the No-Action Alternative, the full-pool elevation of Shasta Lake would not be increased, and no ground-disturbing activities associated with construction would occur. Therefore, there would be no short-term increases in turbidity and suspended sediment in Shasta Lake and tributary streams. Ongoing impacts of sediment on beneficial uses would remain consistent with those that occur periodically under baseline conditions.

Under the No-Action Alternative, the operation of Shasta Dam would continue to influence the amount and duration of exposed shoreline below the maximum elevation of the reservoir. As described in Chapter 4, "Geology, Geomorphology, Minerals, and Soils," the shoreline would continue to erode, and impacts to beneficial uses, namely recreation and to some extent, the warm-water fishery along the shoreline of Shasta Lake, would be ongoing. In addition to active areas of shoreline erosion, sediment would continue to periodically be transported into Shasta Lake from tributaries as a result of other ongoing actions within the project area. Wave action and nearshore currents would continue to remobilize sediment that is typically visible as turbid plumes of water along portions of the shoreline. Sediment and turbidity would remain consistent with baseline conditions.

Reclamation operates the Shasta Dam TCD to manage water temperatures in the upper Sacramento River to (1) improve habitat for the endangered winter-run Chinook salmon and other threatened runs; (2) withdraw warmer surface water in the winter and spring to preserve cold-water storage for release during the temperature operation season; and (3) enable power generation to continue while controlling release temperatures, thereby eliminating the need to bypass the power plant penstocks via the low-level river outlets. Generally, to accomplish these temperature objectives during the temperature operation season, the TCD functions to select water temperatures in the 47˚F to 52˚F range. Therefore, a good index of the temperature-related benefits of the alternative is the volume of the CWP with a water temperature lower than 52˚F at the end of April.

In the context of historical project operation, reservoir storage and CWP conditions in mid-spring represent the available cold-water "bank" managed throughout the temperature operation season (July through October), as prescribed by Reclamation and implemented by Central Valley Operations.

Under the No-Action Alternative, no new facilities associated with raising Shasta Dam would be constructed within the vicinity of Shasta Lake; therefore, there would be no short-term changes in the temperature regime of waters within Shasta Lake or its tributaries.

Under the No-Action Alternative, Shasta Dam would continue to be operated consistent with current regulatory requirements with respect to storage and release of water to the upper Sacramento River. As described in Chapter 6, "Hydrology, Hydraulics, and Water Management," the temperature profile within Shasta Lake would not be changed under the No-Action Alternative. Therefore, there would be no change in the temperature regime of waters within Shasta Lake or its tributaries. Periodic changes in water temperature on a seasonal or interannual basis would be consistent with those that occur under baseline conditions.

Under the No-Action Alternative, no new facilities associated with raising Shasta Dam would be constructed in the vicinity of Shasta Lake. Metal concentrations in the Main Body and the Squaw Creek Arm would continue to be within the range of variability that currently exists with respect to the ongoing discharge and potential storage of heavy metals associated with historic mining and smelting operations. Concentrations of metals, specifically copper and zinc, that may persist within the water column of Shasta Lake would continue to remain in suspension at locations and levels similar to baseline conditions. Ongoing remediation of historic mining properties at locations in the Dry Creek, Little Backbone, Squaw Creek, and Horse Creek watersheds are anticipated to reduce the amount of acid mine drainage into Shasta Lake over time, thereby reducing metal concentrations in the water column.

Upper Sacramento River (Shasta Dam to Red Bluff) Under the No-Action Alternative, no new facilities would be constructed at Shasta Lake; thus there would be no construction-related degradation of water quality. In addition, there would be no changes in releases at Shasta or other CVP reservoirs as a result of a Shasta Lake enlargement that would either adversely affect or improve water quality. It is anticipated that if the project alternatives were not implemented, current operations to meet existing regulatory requirements would be continued. The ability to comply with existing temperature requirements would not be improved. Analysis of flow and temperature modeling results indicates little change in flows or compliance with temperature objectives on the upper Sacramento River between existing conditions and the future No-Action Alternative conditions. Remediation activities at Iron Mountain Mine and other mine sites over the last several years, as well as dredging of contaminated sediment in the Spring Creek Arm of Keswick Reservoir in 2009 and 2010,

would be expected to maintain or reduce the likelihood of future exceedences of the TMDL numeric targets below Keswick Dam. Therefore, there would be no impacts on water quality in the primary study area associated with the No-Action Alternative.

Lower Sacramento River and Delta and CVP/SWP Service Areas Under the No-Action Alternative, Shasta Dam would not be modified, and the CVP and SWP would continue operating similarly to existing conditions. Changes in regulatory conditions and water supply demands would result in differences in flows on the Sacramento River and the Delta. However, the No-Action Alternative would not, in itself, result in any changes in Delta water quality. Modeling indicates that the No-Action Alternative would continue to meet water quality requirements at levels of compliance similar to existing conditions, and would not result in any appreciable degradation of water quality.

CP1 – 6.5-Foot Dam Raise, Anadromous Fish Survival and Water Supply Reliability

CP1 focuses on increasing water supply reliability while contributing to increased survival of anadromous fish. Seven measures are included, to some degree, in all of the comprehensive plans:

- Enlarge Shasta Lake's cold-water pool
- Modify the TCD
- Increase conservation storage
- Reduce demand
- Modify flood control operations
- Increase public safety at Shasta Dam
- Modify hydropower facilities

In addition to these common features, CP1 consists primarily of raising Shasta Dam 6.5 feet, an elevation change that would increase the reservoir's full pool elevation by 8.5 feet and would enlarge the total storage space in the reservoir by 256 thousand acre-feet (TAF). Under this plan, operational guidelines for Shasta Dam would continue unchanged, with the additional storage retained for water supply reliability. This scenario would help to reduce future water shortages by increasing the reliability of the water supply in drought and average years. The increased pool depth and volume would also contribute to maintaining lower seasonal water temperatures for anadromous fish on the upper Sacramento River.

Shasta Lake and Vicinity

Impact WQ-1 (CP1): Temporary Construction-Related Sediment Effects on Shasta Lake and Its Tributaries That Would Cause Violations of Water Quality Standards or Adversely Affect Beneficial Uses The construction-related

activities described in Chapter 2, “Alternatives,” would result in short-term changes in the amount of exposed area that would be subject to erosion. In addition to the clearing of vegetation in various areas to accommodate relocation activities, about 500 acres of vegetation in parts of the new inundation area would be cleared. Removal of vegetation would reduce the amount of effective ground cover (e.g., duff, large woody debris), thereby increasing the potential for short-term erosion and sedimentation along the shoreline.

The relocation activities would result in exposing as many as 3,337 acres to some amount of soil disturbance. These effects are described in more detail in Chapter 4, “Geology, Geomorphology, Minerals, and Soils.” The disturbed sites would have the potential to contribute sediments to nearby water bodies.

Although the environmental protection measures and BMPs described in Chapter 2, “Alternatives.” are intended to reduce the potential effects of introducing sediment into Shasta Lake and its tributaries, CP1 would affect water quality by increasing the levels of turbidity and suspended sediment in the receiving waters at levels that could be inconsistent with the Basin Plan. These increased levels of turbidity and suspended sediment could affect the beneficial uses of Shasta Lake and/or its tributaries. Therefore, this impact would be potentially significant. Mitigation for this impact is proposed in Section 7.3.5.

Impact WQ-2 (CP1): Temporary Construction-Related Temperature Effects on Shasta Lake and Its Tributaries That Would Cause Violations of Water Quality Standards or Adversely Affect Beneficial Uses Under CP1, construction activities associated with enlarging Shasta Dam as well as the relocation actions would result in sizeable areas that would be subject to surface disturbance, including jurisdictional waters within the influence zone of this alternative. Efforts to document jurisdictional waters associated with relocation areas are ongoing. This information will be included if available in the Final EIS, as well as in the Section 404 permitting package, prior to issuance of a ROD.

Environmental commitments and BMPs for the various construction and relocation activities (e.g., bridge replacement, boat ramp construction, demolition of facilities) have been incorporated into CP1. These activities could include removal of riparian vegetation, thereby exposing water bodies to increased solar radiation for various time periods. As described in Chapter 2, “Alternatives,” a riparian revegetation program would be implemented at all construction and relocation sites as applicable to ensure that shade is quickly reestablished after construction is completed.

As described in Chapter 2, “Alternatives,” although the TCD may not be operational for some period of time during construction, project sequencing would ensure that changes to water temperature and associated limnological conditions would be consistent with those that occur periodically under the No-Action Alternative associated with maintenance and outage periods.

Because of the large water surface area of Shasta Lake, coupled with the isolated and discrete nature of the relocation activities on the tributaries, temporary construction-related effects are not expected to modify water temperature in a manner that would have a negative effect on beneficial uses or result in a water quality violation. Therefore, this impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact WQ-3 (CP1): Temporary Construction-Related Metal Effects on Shasta Lake and Its Tributaries That Would Cause Violations of Water Quality Standards or Adversely Affect Beneficial Uses Under CP1, there would be no construction activities that would disturb locations known to contain elevated metal concentrations in either sediments or the water column. Therefore, this impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact WQ-4 (CP1): Long-Term Sediment Effects That Would Cause Violations of Water Quality Standards or Adversely Affect Beneficial Uses in Shasta Lake or Its Tributaries Under CP1, the exposure of an additional 1,227 acres of shoreline surrounding Shasta Lake would result in a potential for increased wave-related shoreline erosion (see Chapter 4, "Geology, Geomorphology, Minerals, and Soils"). As the reservoir is lowered during summer and fall, the exposed surface area would also be subject to surficial erosion processes that could mobilize and transport sediment to the newly expanded Shasta Lake. Although environmental commitments and BMPs are incorporated into the project description, the project would result in an incremental increase in the delivery of suspended sediment and turbidity to the receiving waters. The amount of sediment that could be delivered is not quantifiable because of the size of the lake and the number of variables that influence sediment transport and delivery. This impact would be potentially significant. Mitigation for this impact is proposed in Section 7.3.5.

Impact WQ-5 (CP1): Long-Term Temperature Effects That Would Cause Violations of Water Quality Standards or Adversely Affect Beneficial Uses in Shasta Lake or Its Tributaries The analysis presented in Chapter 6, "Hydrology, Hydraulics, and Water Management," assumed that the existing CVP or SWP operating criteria would not be changed from an annual perspective and that the action alternatives would increase storage on a monthly basis. Reductions in releases would typically occur during winter (November through March) in relatively wet years, and increases in releases would typically occur in the late spring and summer (June through September) of drier years. CP1 would store some additional flows behind Shasta Dam during periods when the flows would have otherwise been released downstream. The resulting increase in storage would then be used both to create an expanded CWP available for carryover storage, thus benefiting fisheries, and for subsequent release to support beneficial uses downstream. On average, CP1 would provide about a 5 percent increase in annual storage.

Table 7-4 shows the simulated monthly change in storage for CP1 as a percent increase above the No-Action Alternative.

Table 7-4. Simulated Average End-of-Month Shasta Lake Storage – CP1

Month	Existing Condition (TAF)	CP1 (TAF)	CP1 % Increase
Oct	2,671	144	5.4%
Nov	2,690	148	5.5%
Dec	2,815	160	5.4%
Jan	3,067	165	5.4%
Feb	3,291	175	5.3%
Mar	3,624	175	4.8%
Apr	3,919	170	4.3%
May	3,950	171	4.3%
Jun	3,642	169	4.6%
Jul	3,187	162	5.1%
Aug	2,879	150	5.2%
Sep	2,782	145	5.2%

Source: Common Assumptions Common Modeling Package Version 8D CalSim-II 2005 and 2030 simulations (Node S4+S44)
Note:
Simulation period: 1922-2003
Key:
TAF = thousand acre-feet

Under CP1, existing water temperature requirements would typically be met in most years; therefore, the additional increase in water storage shown in Table 7-4 would primarily be released for water supply purposes. Accordingly, minimal increases in releases from Shasta Dam would be expected in months when Delta exports are constrained, or when flow is not usable for water supply purposes.

As illustrated in Table 7-4, the increase in storage provided by CP1 fluctuates greatly throughout a year; storage is typically highest at the end of winter, in April and May, as the need for flood control reservation space in the reservoir is reduced. Storage is typically at its lowest in September and October, after the irrigation season and before the winter refill begins. This additional storage would typically be greatest in winter (February or March), and would be lowest at the end of summer (September or October), which is consistent with Shasta Reservoir's current operation. Additional runoff captured by the increased storage increment would typically remain in storage and available to support beneficial uses downstream. Conversely, if there were insufficient water in storage to meet downstream demands, the first increment to be reduced would be deliveries to water service contractors. As such, increased releases would typically be made on a schedule providing increased reliability of deliveries to

water service contractors, typically in July through October of relatively dry years.

A key indicator of the water temperature benefits of CP1 to the upper Sacramento River between Keswick Dam and Red Bluff is the amount of cold water available in Shasta Lake prior to the water temperature operation season, about May through October. As previously described, Shasta Lake generally reaches its maximum storage during late April or early May. Also, the CWP volume in the lake accumulates during winter and early spring and is not likely to increase after April. Therefore, the expected increase in spring storage for CP1 should also result in an incremental increase in the CWP volume.

The simulated end-of-April volume of water with a temperature lower than 52˚F for the No-Action Alternative and the change in CWP volume for CP1 is shown, by Sacramento Valley Index (SVI) year type, in Table 7-5.

In addition to illustrating the average change in available CWP, Table 7-5 also shows the influence of climatic conditions on these values. The diversity between water year types, coupled with unique combinations of storage and rainfall, would continue to influence the ability to manage storage in Shasta Lake to maximize carryover capacity. Although there would be a meaningful increase in the active storage and carryover storage of the CWP, this increase is considered a less than significant impact. Mitigation for this impact is not needed, and thus not proposed.

Table 7-5. Simulated Average Volume of Water Less than 52˚F in Shasta Lake at the End of April – CP1

SVI Year Type	Existing Condition (TAF)	CP1 (TAF)	CP1 % Increase
Average of All Years	1,577	90	5.7%
Wet	1,807	137	7.6%
Above Normal	1,721	110	6.4%
Below Normal	1,743	72	4.1%
Dry	1,451	71	4.9%
Critical	928	16	1.7%

Source: Common Assumptions Common Modeling Package Version 8D SRWQM 2005 and 2030 simulations.
Notes:
Simulation period: 1922–2003
Year types as defined by the Sacramento Valley Index
Key:
SVI = Sacramento Valley Index
TAF = thousand acre-feet

Impact WQ-6 (CP1): Long-Term Metals Effects That Would Cause Violations of Water Quality Standards or Adversely Affect Beneficial Uses in Shasta Lake or Its Tributaries The increase in storage associated with CP1 would result in modifying the depth and thickness of the thermocline in Shasta Lake. The level of change would be correlated to a number of parameters, including carryover storage, climatic conditions, and the timing and duration of stratification (Bartholow et al. 2001). A study conducted by the CVRWQCB in 2002 and 2003 suggests that there is a direct correlation between dissolved copper concentrations in the upper levels of Shasta Lake near the dam and dissolved copper concentrations in the waters immediately downstream from the power plant (CVRWQCB 2003a). This study concluded that there appears to be a correlation between operation of the TCD and concentration of dissolved metals within the thermocline; an increase in available storage, however, would increase the opportunity to dilute metals concentrations below current levels.

Within the Squaw Creek Arm, two depositional features associated with historic copper mining and smelting operations are immediately adjacent to the shoreline of Shasta Lake in the general vicinity of the Bully Hill Mine. As mapped, these two sites appear to have about 7,300 cubic yards of material that could be subjected to shoreline and surficial erosional processes, with a high potential for delivery to Shasta Lake. This impact would be potentially significant. Mitigation for this impact is proposed in Section 7.3.5.

Upper Sacramento River (Shasta Dam to Red Bluff)
Impact WQ-7 (CP1): Temporary Construction-Related Sediment Effects on the Upper Sacramento River That Would Cause Violations of Water Quality Standards or Adversely Affect Beneficial Uses Construction would include ground-disturbing activities that could result in soil erosion and sediment effects on the upper Sacramento River. This impact would be potentially significant.

As described in Impact WQ-1 (CP1), ground-disturbing activities associated with construction could cause soil erosion and sedimentation of local drainages and eventually the Sacramento River. Construction activities could also discharge waste petroleum products or other construction-related substances that could enter these waterways/facilities in runoff. The environmental protection measures and BMPs described in Chapter 2, “Alternatives,” are intended to reduce the potential effects of introducing sediment into Shasta Lake and into downstream releases to the upper Sacramento River; however, CP1 would affect water quality by increasing the levels of turbidity and suspended sediment in the receiving waters at levels that could be inconsistent with the Basin Plan. These increased levels of turbidity and suspended sediment could affect the beneficial uses of the upper Sacramento River. Therefore, this temporary impact would be potentially significant. Mitigation for this impact is proposed in Section 7.3.5.

Impact WQ-8 (CP1): Temporary Construction-Related Temperature Effects on the Upper Sacramento River That Would Cause Violations of Water Quality

Standards or Adversely Affect Beneficial Uses Construction activities are not anticipated to result in temperature effects on the upper Sacramento River because changes to water temperature in Shasta Lake and subsequent releases to the Sacramento River would be consistent with typical periodic fluctuations. This impact would be less than significant.

As described for Impact WQ-2 (CP1), changes to water temperature and associated limnological conditions in Shasta Lake would be consistent with those that occur periodically under the No-Action Alternative associated with maintenance and outage periods. Therefore, water temperatures in the upper Sacramento River, which are related to releases from Shasta Lake, would not be expected to be modified during construction in a manner that would negatively affect beneficial uses or result in a water quality violation. This temporary impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact WQ-9 (CP1): Temporary Construction-Related Metal Effects on the Upper Sacramento River That Would Cause Violations of Water Quality Standards or Adversely Affect Beneficial Uses Construction activities are not anticipated to result in water quality effects on the upper Sacramento River related to metals because construction would not disturb locations of known elevated metal concentrations. This impact would be less than significant.

As described in Impact WQ-3 (CP1), there would be no construction activities that would disturb locations known to contain elevated metal concentrations in either sediments or the water column of Shasta Lake. Because water quality in the upper Sacramento River is related to the quality of releases from Shasta Lake, metals concentrations would not be expected to be modified during construction in a manner that would negatively affect beneficial uses or result in a water quality violation. This temporary impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact WQ-10 (CP1): Long-Term Sediment Effects That Cause Violations of Water Quality Standards or Adversely Affect Beneficial Uses in the Upper Sacramento River No long-term water quality impacts are anticipated in the upper Sacramento River in regard to sediment, because modeling results have indicated that CP1 would cause little change in average mean monthly flow, and could cause a decrease in peak flows that are associated with increased sediment transport. This impact would be less than significant.

Long-term effects on water quality could be caused by changes in the size and timing of releases from the reservoir associated with CP1. The analysis used flow data from hydrologic modeling as an indicator of effects on sediment and metals.

For CP1, fall and winter flows on the upper Sacramento River would be reduced in some years, and summer flows would increase in many years. In addition,

retention of winter flows would reduce or eliminate some overbank flood events in the upper Sacramento River. Because the reservoir would be able to store additional water during high-flow periods, in some years wintertime peak flows would be reduced as a result of the project. High-flow events transport sediments and can produce bank erosion and meander.

The Basin Plan specifies that changes to suspended sediment loading and discharge rates cannot cause nuisance or adversely affect beneficial uses (CVRWQCB 2007b). Under both existing and future conditions, analysis of modeling results indicates that the generally small changes in average mean monthly flow from CP1 are unlikely to have a significant effect on sediment transport within the upper Sacramento River. In addition, it appears that CP1 would reduce wintertime peak flow events, which may reduce sediment loading and discharge rates. Beneficial uses that may be beneficially affected include municipal and domestic supply, irrigation and stock watering, service supply, power, contact recreation and canoeing and rafting, other noncontact recreation, and navigation. However, there could be varying effects on beneficial uses concerning habitat, such as freshwater and spawning habitat. These impacts are explored further in Chapter 11, “Aquatic and Fisheries Ecosystems,”. Because the project would cause little change in average mean monthly flow, and a potential decrease in peak flows, the water quality impact of CP1 related to sediment would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact WQ-11 (CP1): Long-Term Temperature Effects That Would Cause Violations of Water Quality Standards or Adversely Affect Beneficial Uses in the Upper Sacramento River Analysis of temperature modeling results indicates that CP1 would improve compliance with the temperature requirements on the Sacramento River because of the increased depth of the cold-water pool in Shasta Lake and the associated enhanced ability to regulate water temperature releases to the upper Sacramento River. Therefore, the impact of CP1 on water quality measured as temperature would be beneficial.

The temperature analysis used temperature modeling; the analysis was limited to using monthly average flows by the modeling tools used. CP1 would increase the ability of Shasta Dam to release cold water and regulate water temperature in the upper Sacramento River, primarily in dry and critically dry years. This would be accomplished by raising Shasta Dam 6.5 feet, thus increasing the depth of the cold-water pool in Shasta Lake and resulting in an increase in seasonal cold-water volume below the thermocline (i.e., layer of greatest water temperature and density change). Cold water released from Shasta Dam influences water temperature conditions in the Sacramento River between Keswick Dam and RBDD, with effects diminishing downstream.

This section focuses on compliance with water quality standards for temperature. For an analysis of temperature effects on fisheries and aquatic habitat, see Chapter 11, “Fisheries and Aquatic Resources.”

Analysis of temperature modeling results indicates that CP1 would improve compliance with the temperature requirements on the Sacramento River. The 2009 BO for CVP and SWP operations and their effects on the Sacramento River winter-run Chinook salmon require that Sacramento River water temperatures be below 56°F at compliance locations between Balls Ferry and Bend Bridge from April 15 through September 30, and not in excess of 60°F at the same compliance locations in during October. Currently, this standard is not always met, particularly in dry and critically dry years. CP1 would reduce the amount of daily exceedences of the 2009 BO standards under both existing and future conditions. Table 7-6 provides a summary of modeled reductions in exceedences over the 82-year modeling period under each of the alternatives.

Based on this analysis, the impact of CP1 on water quality measured as temperature would be beneficial. Mitigation for this impact is not needed, and thus not proposed.

Impact WQ-12 (CP1): Long-Term Metals Effects That Would Cause Violations of Water Quality Standards or Adversely Affect Beneficial Uses in the Upper Sacramento River Long-term operation of the project could result in water quality effects on the upper Sacramento River in regard to metals as a result of erosional processes to historic mining and smelting operation features. This impact would be potentially significant.

Table 7-6. Modeled Reduction in Daily Exceedences of Sacramento River Temperature Requirements (as Defined by the 2004 Biological Opinion for CVP and SWP Operations and Their Effects on the Sacramento River Winter-Run Chinook Salmon) for April 1 – October 31

Comprehensive Plan	Existing Conditions (2005)		Future Conditions (2030)	
	Balls Ferry	Bend Bridge	Balls Ferry	Bend Bridge
CP1	10%	4%	14%	5%
CP2	15%	6%	19%	8%
CP3 and CP5	18%	8%	24%	11%
CP4	37%	13%	40%	15%

Source: Common Assumptions Common Modeling Package Version 8D SRWQM 2005 and 2030 simulations

Note:
Simulation period: 1922–2003
Source: Data provided by MWH in 2007

Key:
CVP = Central Valley Project
SWP = State Water Project

The analysis used flow data from hydrologic modeling as an indicator of effects on sediment and metals. The Sacramento River and its tributaries upstream from Keswick Dam are the primary source of metals to the lower Sacramento River (USGS 2000b). Shasta Lake is also listed as impaired for metals. As described

in Impact WQ-6 (CP1), a study conducted by the CVRWQCB in 2002 and 2003 suggests that there is a direct correlation between dissolved copper concentrations in the upper levels of Shasta Lake near the dam and dissolved copper concentrations in the waters immediately downstream from the power plant (CVRWQCB 2003a).

The 25-mile reach of the Sacramento River from Keswick Dam downstream to Cottonwood Creek is impaired for cadmium, copper, and zinc. The CVRWQCB developed a TMDL program for these constituents in the upper Sacramento River because of exceedences of water quality standards. Heavy metals such as copper, zinc, mercury, lead, and cadmium are water quality parameters that are impairing beneficial uses. Natural mineral deposits and historical mining practices are a source of metals, including mercury, within Shasta Lake and the upper Sacramento River. High metals concentrations in the Sacramento River correlate with concentrations of suspended sediment and high flows because metals are transported adsorbed to suspended sediments (USGS 2000b; Domagalski et al. 2000).

Under both existing and future conditions, the generally small changes in average mean monthly flow from the project predicted by modeling are unlikely to have a significant effect on metals within the upper Sacramento River and would not be expected to result in exceedences of the dissolved metals numeric targets established in the TMDL (as shown in Table 7-3). Remediation activities at Iron Mountain Mine and other mine sites over the last several years, as well as dredging of contaminated sediment in the Spring Creek Arm of Keswick Reservoir in 2009 to 2010, are also expected to reduce the likelihood of future exceedences of the TMDL numeric targets below Keswick Dam.

However, as described in Impact WQ-6 (CP1), two depositional features associated with historic copper mining and smelting operation within the Squaw Creek Arm of Shasta Lake could be subjected to shoreline and surficial erosional processes, with a high potential for delivery to Shasta Lake and subsequent delivery to the upper Sacramento River. Therefore, the water quality impact of CP1 related to metals in the upper Sacramento River would be potentially significant. Mitigation for this impact is proposed in Section 7.3.5.

Lower Sacramento River and Delta and CVP/SWP Service Areas
Impact WQ-13 (CP1): Temporary Construction-Related Sediment Effects on the Extended Study Area That Would Cause Violations of Water Quality Standards or Adversely Affect Beneficial Uses Construction is not anticipated to affect water quality conditions in the extended study area. This impact would be less than significant.

Construction would only temporarily influence water quality in the primary study area. Construction effects are anticipated to be localized and would be further minimized with appropriate BMPs. Therefore, construction is not anticipated to affect water quality conditions downstream in the extended study

area. This impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact WQ-14 (CP1): Temporary Construction-Related Temperature Effects on the Extended Study Area That Would Cause Violations of Water Quality Standards or Adversely Affect Beneficial Uses As described in Impact WQ-13 (CP1), construction is not anticipated to affect water temperature in the extended study area. This impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact WQ-15 (CP1): Temporary Construction-Related Metal Effects on the Extended Study Area That Cause Violations of Water Quality Standards or Adversely Affect Beneficial Uses As described in Impact WQ-13 (CP1), construction is not anticipated to affect metals in the extended study area. This impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact WQ-16 (CP1): Long-Term Sediment Effects That Would Cause Violations of Water Quality Standards or Adversely Affect Beneficial Uses in the Extended Study Area Water quality effects of CP1 could influence the extended study area, but effects would diminish with distance into the study area. Water quality effects are attenuated by multiple factors including flow from tributaries, stormwater runoff, and municipal and agricultural discharges, as described below.

Because the Sacramento River is the primary supplier of suspended sediment to the Delta, sediment loading and discharge rates from the upper Sacramento River could affect water quality and beneficial uses in the extended study area. However, changes in sediment loading in the upper Sacramento River would be less than significant and changes in the extended study area would be even smaller. Therefore, the impact on sediment would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact WQ-17 (CP1): Long-Term Temperature Effects That Cause Violations of Water Quality Standards or Adversely Affect Beneficial Uses in the Extended Study Area Analysis of temperature modeling shows little to no change in temperature at RBDD caused by CP1. This suggests that there would be no changes in temperature beyond RBDD as a result of CP1. This conclusion is further supported by the operational experience of the CVP, which indicates that the 60-mile stretch of river between Keswick Dam and Red Bluff is the extent to which the Shasta-Trinity Division can control temperatures through normal operations of the CVP. Therefore, no temperature effects are anticipated in the extended study area. This impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact WQ-18 (CP1): Long-Term Metals Effects That Would Cause Violations of Water Quality Standards or Adversely Affect Beneficial Uses in the Extended

Study Area CP1 would alter the operations of Shasta Lake. Increases in metals concentrations can result from changes in flows that cause increases in concentrations of suspended sediments during high-flow periods. The reduction in frequency and magnitude of peak flow events resulting from CP1 would suggest a beneficial impact for metals; however, as described in Impact WQ-6 (CP1), two depositional features associated with historic copper mining and smelting operation within the Squaw Creek Arm of Shasta Lake could be subjected to shoreline and surficial erosional processes, with the potential for delivery to Shasta Lake and subsequent delivery to the Sacramento River. Therefore, the water quality impact of CP1 related to metals in the lower Sacramento River could be potentially significant, because operation of the project could add substantial additional amounts of metal to the river system. Mitigation for this impact is proposed in Section 7.3.5.

Salinity CP1 would differ from the No-Action Alternative primarily through a 256-TAF enlargement of Shasta Lake. Potential impacts, which are evaluated below, include the following:

- Delta salinity on the Sacramento River at Collinsville
- Delta salinity on the San Joaquin River at Jersey Point
- Delta salinity on the Sacramento River at Emmaton
- Delta salinity on the Old River at Rock Slough
- Delta water quality on the Delta-Mendota Canal at Jones Pumping Plant
- Delta water quality on the West Canal at the mouth of the Clifton Court Forebay
- Delta salinity on the San Joaquin River at Vernalis
- Delta salinity on the San Joaquin River at Brandt Bridge
- Delta salinity on the Old River near the Middle River
- Delta salinity on the Old River at Tracy Road Bridge
- X2 position

Impact WQ-19a (CP1): Delta Salinity on the Sacramento River at Collinsville Operations for CP1 would result in both increases and decreases in salinity; however, none of the increases would be sufficient to change compliance for the Sacramento River at Collinsville. Similarly, on a percentage basis, all increases

in salinity would be less than 10 percent; this would be within the range of natural variability. This impact would be less than significant.

The water quality requirement on the Sacramento River at Collinsville is specified in D-1641, and is defined for all year types, from October through April. The D-1641 objectives for the Sacramento River at Collinsville are defined in Table 7-7.

Table 7-7. D-1641 Water Quality Objectives for the Sacramento River at Collinsville

Months	Year-Type	Value (mmhos/cm)
October	All	19.0
November–December	All	15.5
January	All	12.5
February–March	All	8.0
April–May	All	11.0

Source: SWRCB 2000

Notes:
Year types defined by Sacramento Valley Index.
The requirement is the maximum monthly average of both daily high tide EC values or demonstration that equivalent or better protection will be provided at the location.

Key:
D-1641 = Revised Water Right Decision 1641
EC = electrical conductivity
mmhos/cm = millimhos per centimeter (unit of EC)

As shown in Table 7-8, operations for CP1 would result in both increases and decreases in salinity; however, none of the increases would be sufficient to change compliance for the Sacramento River at Collinsville. Similarly, on a percentage basis, all increases in salinity would be less than 10 percent; this would be within the range of natural variability. Table 7-9 shows the number of months simulated EC values exceeded the standards for the Sacramento River at Collinsville in the period of simulation. The operation of CP1 would not result in any additional violations of the salinity standards for the Sacramento River at Collinsville under both Existing and Future conditions. This impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Table 7-8. Simulated Monthly Average Salinity and Percent Change for the Sacramento River at Collinsville

Month	Existing Condition (2005)				Future Condition (2030)			
	Average All Years		Dry and Critical Years		Average All Years		Dry and Critical Years	
	Existing Condition (mmhos/cm)	CP1 Change (mmhos/cm (%))	Existing Condition (mmhos/cm)	CP1 Change (mmhos/cm (%))	No-Action Alternative (mmhos/cm)	CP1 Change (mmhos/cm (%))	No-Action Alternative (mmhos/cm)	CP1 Change (mmhos/cm (%))
Oct	7.1	0.0 (0.1%)	8.3	0.0 (0.2%)	7.4	0.0 (-0.2%)	8.4	0.0 (-0.2%)
Nov	6.4	0.0 (0.2%)	8.0	0.0 (-0.3%)	6.6	0.0 (0.0%)	8.1	0.0 (-0.4%)
Dec	4.4	0.0 (-1.1%)	6.5	-0.1 (-1.5%)	4.5	0.0 (-0.7%)	6.6	-0.1 (-1.4%)
Jan	2.6	0.0 (-0.5%)	4.8	0.0 (-0.4%)	2.7	0.0 (-0.8%)	4.9	-0.1 (-1.4%)
Feb	1.0	0.1 (6.3%)	2.2	0.2 (8.3%)	1.1	0.0 (-4.4%)	2.3	-0.1 (-5.6%)
Mar	0.7	0.0 (2.7%)	1.4	0.1 (3.9%)	0.7	0.0 (-1.8%)	1.4	0.0 (-2.3%)
Apr	0.9	0.0 (0.9%)	1.9	0.0 (1.1%)	1.0	0.0 (-0.4%)	1.9	0.0 (-0.6%)
May	1.5	0.0 (-0.1%)	3.0	0.0 (-0.1%)	1.4	0.0 (-0.1%)	2.9	0.0 (-0.5%)
Jun	2.5	0.0 (0.0%)	4.5	0.0 (-0.1%)	2.4	0.0 (0.5%)	4.4	0.0 (-0.7%)
Jul	3.4	0.0 (-0.6%)	5.5	0.0 (-0.6%)	3.2	0.0 (-0.2%)	5.4	0.0 (-0.4%)
Aug	5.3	-0.1 (-1.0%)	6.7	-0.1 (-1.6%)	5.0	0.0 (0.0%)	6.6	0.0 (0.1%)
Sep	6.6	0.0 (-0.3%)	8.4	-0.1 (-0.9%)	6.5	0.0 (-0.3%)	8.1	-0.1 (-0.6%)

Source: Common Assumptions Common Modeling Package, version 8D, DSM2 Existing and Future simulations (Node RSAC081)

Note:
Simulation period: 1922–1994. Change as measured from either Existing Condition or No-Action Alternative. Dry and critical years as defined by the Sacramento Valley Index.

Key:
CP = Comprehensive Plan
mmhos/cm = millimhos per centimeter

Table 7-9. Simulated Number of Months of Exceedence of the Salinity Standard for the Sacramento River at Collinsville

Month	Existing Condition (2005)				Future Condition (2030)			
	Total All Years		Dry and Critical Years		Total All Years		Dry and Critical Years	
	Existing Condition (Number of Months)	CP1 Change (Number of Months (%))	Existing Condition (Number of Months)	CP1 Change (Number of Months (%))	No-Action Alternative (Number of Months)	CP1 Change (Number of Months (%))	No-Action Alternative (Number of Months)	CP1 Change (Number of Months (%))
Oct	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Nov	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Dec	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Jan	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Feb	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Mar	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Apr	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
May	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Jun	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Jul	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Aug	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Sep	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)

Source: Common Assumptions Common Modeling Package, version 8D, DSM2 Existing and Future simulations (Node RSAC081)

Note:
Simulation period: 1922–1994. Change as measured from either Existing Condition or No-Action Alternative. Dry and critical years as defined by the Sacramento Valley Index.

Key:
CP = Comprehensive Plan

Impact WQ-19b (CP1): Delta Salinity on the San Joaquin River at Jersey Point
On an average monthly basis, for the basis of comparison, EC would meet the requirements in all months in an average year. Moreover, CP1 would not increase the EC at Jersey Point. This impact would be less than significant.

The water quality requirement on the San Joaquin River at Jersey Point is specified in D-1641 as two components. The first component of the requirement begins on April 1, and extends through a year-type–dependent date. The second component of the Jersey Point requirement begins at the end of the first component, and ends on August 15. The numerical requirement of the second component is dependent on the year type. Objectives for the San Joaquin River at Jersey Point are defined in Table 7-10.

Table 7-10. D-1641 Water Quality Objectives for the San Joaquin River at Jersey Point

Year Type	0.45 EC April 1 to the Date Shown	EC from Date Shown to August 15 (mmhos/cm)
Wet	August 15	0.45
Above Normal	August 15	0.45
Below Normal	June 20	0.74
Dry	June 15	1.35
Critical	April 1	2.20

Source: SWRCB 2000.

Note:
Year types defined by Sacramento Valley Index. While requirement in D-1641 is the maximum 14-day running average of mean daily EC, modeling uses a monthly average.

Key:
D-1641 = Water Right Decision 1641
EC = electrical conductivity
mmhos/cm = millimhos per centimeter

While Table 7-11 shows EC for all months, the Jersey Point water quality requirement is only defined for April 1 through August 15. On an average monthly basis, for the basis of comparison, EC would meet the requirements in all months in an average year. Moreover, CP1 would not increase the EC at Jersey Point. Table 7-12 shows the number of months simulated EC values exceeded the standards for the San Joaquin River at Jersey Point in the period of simulation. CP1 would result in a slight increase in the frequency of violations (4 percent) during August under the Existing Conditions and up to 6 percent during June under the Future Conditions. Overall, the frequency of exceedence of salinity standards for the San Joaquin River at Jersey Point under CP1 would be similar to those under Existing and Future conditions.

This impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact WQ-19c (CP1): Delta Salinity on the Sacramento River at Emmaton
On an average monthly basis, for the basis of comparison, EC would meet the requirements in all months on an average annual basis; moreover, CP1 would not increase the EC at Emmaton during this period by more than 0.2 percent. This impact would be less than significant.

Similar to the water quality requirement on the San Joaquin River at Jersey Point, the water quality requirement on the Sacramento River at Emmaton is specified in D-1641 as two components. The first component of the requirement begins on April 1, and extends through a year-type-dependent date. The second component of the Emmaton requirement begins at the end of the first component, and ends on August 15. The numerical requirement of the second

component is dependent on the year type. Objectives for the Sacramento River at Emmaton are defined in Table 7-13.

Table 7-11. Simulated Monthly Average Salinity and Percent Change for the San Joaquin River at Jersey Point

Month	Existing Condition (2005)				Future Condition (2030)			
	Average All Years		Dry and Critical Years		Average All Years		Dry and Critical Years	
	Existing Condition (mmhos/cm)	CP1 Change (mmhos/cm (%))	Existing Condition (mmhos/cm)	CP1 Change (mmhos/cm (%))	No-Action Alternative (mmhos/cm)	CP1 Change (mmhos/cm (%))	No-Action Alternative (mmhos/cm)	CP1 Change (mmhos/cm (%))
Oct	2.1	0.0 (0.3%)	2.3	0.0 (0.7%)	2.1	0.0 (0.4%)	2.3	0.0 (0.6%)
Nov	1.9	0.0 (1.1%)	2.3	0.0 (1.2%)	2.0	0.0 (0.6%)	2.3	0.0 (0.0%)
Dec	1.5	0.0 (-0.5%)	2.1	0.0 (-1.2%)	1.6	0.0 (-0.4%)	2.1	0.0 (-0.9%)
Jan	1.0	0.0 (-0.2%)	1.6	0.0 (-0.1%)	1.1	0.0 (-1.0%)	1.7	0.0 (-1.6%)
Feb	0.5	0.0 (4.2%)	0.9	0.1 (6.7%)	0.5	0.0 (-0.8%)	0.9	0.0 (-1.4%)
Mar	0.3	0.0 (2.4%)	0.4	0.0 (5.0%)	0.3	0.0 (-1.9%)	0.4	0.0 (-3.6%)
Apr	0.3	0.0 (0.6%)	0.3	0.0 (1.2%)	0.3	0.0 (-0.4%)	0.4	0.0 (-0.9%)
May	0.3	0.0 (0.0%)	0.5	0.0 (0.0%)	0.3	0.0 (-0.5%)	0.5	0.0 (-1.0%)
Jun	0.5	0.0 (0.6%)	0.9	0.0 (0.8%)	0.5	0.0 (-0.8%)	0.9	0.0 (-2.0%)
Jul	0.7	0.0 (2.2%)	1.3	0.0 (2.7%)	0.7	0.0 (0.9%)	1.3	0.0 (1.0%)
Aug	1.2	0.0 (1.0%)	1.6	0.0 (1.1%)	1.2	0.0 (0.4%)	1.7	0.0 (0.8%)
Sep	1.9	0.0 (0.0%)	2.3	0.0 (-0.6%)	2.0	0.0 (0.2%)	2.4	0.0 (0.5%)

Source: Common Assumptions Common Modeling Package, version 8D, DSM2 Existing and Future simulations (Node RSAN018)

Note:
Simulation period: 1922-1994. Change as measured from either Existing Condition or No-Action Alternative. Dry and critical years as defined by the Sacramento Valley Index.

Key:
CP = Comprehensive Plan
mmhos/cm = millimhos per centimeter

Table 7-12. Simulated Number of Months of Exceedence of the Salinity Standard for the San Joaquin River at Jersey Point

Month	Existing Condition (2005)				Future Condition (2030)			
	Total All Years		Dry and Critical Years		Total All Years		Dry and Critical Years	
	Existing Condition (Number of Months)	CP1 Change (Number of Months (%))	Existing Condition (Number of Months)	CP1 Change (Number of Months (%))	No-Action Alternative (Number of Months)	CP1 Change (Number of Months (%))	No-Action Alternative (Number of Months)	CP1 Change (Number of Months (%))
Oct	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Nov	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Dec	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Jan	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Feb	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Mar	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Apr	0	0.0 (0.0%)	0	0.0 (0.0%)	1	0.0 (0.0%)	1	0.0 (0.0%)
May	0	0.0 (0.0%)	0	0.0 (0.0%)	1	-1.0 (-100.0%)	1	-1.0 (-100.0%)
Jun	17	0.0 (0.0%)	13	0.0 (0.0%)	17	1.0 (5.9%)	13	0.0 (0.0%)
Jul	1	0.0 (0.0%)	1	0.0 (0.0%)	0	1.0 (0.0%)	0	1.0 (0.0%)
Aug	56	2.0 (3.6%)	13	2.0 (15.4%)	58	0.0 (0.0%)	14	0.0 (0.0%)
Sep	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)

Source: Common Assumptions Common Modeling Package, version 8D, DSM2 Existing and Future simulations (Node RSAN018)

Note:
Simulation period: 1922-1994. Change as measured from either Existing Condition or No-Action Alternative. Dry and critical years as defined by the Sacramento Valley Index.

Key:
CP = Comprehensive Plan

Table 7-13. D-1641 Water Quality Objective for the Sacramento River at Emmaton

Year Type	0.45 EC April 1 to the Date Shown	EC from Date Shown to August 15 (mmhos/cm)
Wet	August 15	0.45
Above Normal	July 1	0.63
Below Normal	June 20	1.14
Dry	June 15	1.67
Critical	April 1	2.78

Source: SWRCB 2000

Note:
Year types defined by Sacramento Valley Index. While requirement in D-1641 is the maximum 14-day running average of mean daily EC, modeling uses a monthly average.

Key:
D-1641 = Water Right Decision 1641
EC = electrical conductivity
mmhos/cm = millimhos per centimeter

While Table 7-14 shows the EC for all months, the Emmaton water quality requirement is only defined for April 1 through August 15. On an average monthly basis, for the basis of comparison, EC would meet the requirements in all months on an average annual basis; moreover, CP1 would not increase the EC at Emmaton during this period by more than 0.2 percent. Table 7-15 shows the number of months simulated EC values exceeded the standards for the Sacramento River at Emmaton in the period of simulation. Operations of CP1 would not result in any additional violation of salinity standards between October and March. Between April and September, CP1 would result in a decrease in the frequency of violations when compared to the baseline values under the Existing and Future conditions, except in June and August when there would be a slight increase under the Future Conditions. Overall, the compliance of standards for the Sacramento River at Emmaton would be similar to the baseline levels under both Existing and Future conditions. This impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Table 7-14. Simulated Monthly Average Salinity and Percent Change for the Sacramento River at Emmaton

Month	Existing Condition (2005)				Future Condition (2030)			
	Average All Years		Dry and Critical Years		Average All Years		Dry and Critical Years	
	Existing Condition (mmhos/cm)	CP1 Change (mmhos/cm (%))	Existing Condition (mmhos/cm)	CP1 Change (mmhos/cm (%))	No-Action Alternative (mmhos/cm)	CP1 Change (mmhos/cm (%))	No-Action Alternative (mmhos/cm)	CP1 Change (mmhos/cm (%))
Oct	2.2	0.0 (0.2%)	2.7	0.0 (0.4%)	2.4	0.0 (-0.4%)	2.8	0.0 (-0.7%)
Nov	1.9	0.0 (-0.3%)	2.5	0.0 (-1.0%)	1.9	0.0 (-0.4%)	2.5	0.0 (-0.8%)
Dec	1.2	0.0 (-1.8%)	1.7	0.0 (-2.3%)	1.2	0.0 (-1.4%)	1.8	0.0 (-2.5%)
Jan	0.7	0.0 (-1.0%)	1.2	0.0 (-1.0%)	0.7	0.0 (-0.9%)	1.2	0.0 (-1.7%)
Feb	0.3	0.0 (4.8%)	0.5	0.0 (8.0%)	0.3	0.0 (-5.2%)	0.6	0.0 (-8.4%)
Mar	0.2	0.0 (1.6%)	0.3	0.0 (3.1%)	0.3	0.0 (-1.5%)	0.3	0.0 (-2.8%)
Apr	0.3	0.0 (0.5%)	0.4	0.0 (0.9%)	0.3	0.0 (-0.5%)	0.4	0.0 (-0.9%)
May	0.4	0.0 (-0.1%)	0.7	0.0 (-0.1%)	0.4	0.0 (-0.2%)	0.7	0.0 (-0.4%)
Jun	0.6	0.0 (0.1%)	1.2	0.0 (0.2%)	0.6	0.0 (0.6%)	1.1	0.0 (-0.3%)
Jul	0.8	0.0 (-1.5%)	1.5	0.0 (-1.5%)	0.8	0.0 (-0.8%)	1.4	0.0 (-1.1%)
Aug	1.4	0.0 (-1.8%)	2.0	-0.1 (-2.7%)	1.3	0.0 (-0.1%)	1.9	0.0 (0.0%)
Sep	2.0	0.0 (-0.5%)	2.9	0.0 (-1.3%)	2.0	0.0 (-0.9%)	2.7	0.0 (-1.5%)

Source: Common Assumptions Common Modeling Package, version 8D, DSM2 Existing and Future simulations (Node RSAC092)

Note:
Simulation period: 1922–1994. Change as measured from either Existing Condition or No-Action Alternative. Dry and critical years as defined by the Sacramento Valley Index.

Key:
CP = Comprehensive Plan
mmhos/cm = millimhos per centimeter

Table 7-15. Simulated Number of Months of Exceedence of the Salinity Standard for the San Sacramento River at Emmaton

Month	Existing Condition (2005)				Future Condition (2030)			
	Total All Years		Dry and Critical Years		Total All Years		Dry and Critical Years	
	Existing Condition (Number of Months)	CP1 Change (Number of Months (%))	Existing Condition (Number of Months)	CP1 Change (Number of Months (%))	No-Action Alternative (Number of Months)	CP1 Change (Number of Months (%))	No-Action Alternative (Number of Months)	CP1 Change (Number of Months (%))
Oct	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Nov	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Dec	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Jan	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Feb	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Mar	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Apr	1	0.0 (0.0%)	1	0.0 (0.0%)	1	0.0 (0.0%)	1	0.0 (0.0%)
May	2	0.0 (0.0%)	1	0.0 (0.0%)	3	-1.0 (-33.3%)	2	0.0 (0.0%)
Jun	19	0.0 (0.0%)	13	0.0 (0.0%)	19	1.0 (5.3%)	14	0.0 (0.0%)
Jul	1	0.0 (0.0%)	0	0.0 (0.0%)	1	0.0 (0.0%)	0	0.0 (0.0%)
Aug	51	-5.0 (-9.8%)	9	-3.0 (-33.3%)	41	2.0 (4.9%)	7	1.0 (14.3%)
Sep	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)

Source: Common Assumptions Common Modeling Package, version 8D, DSM2 Existing and Future simulations (Node RSAC092)

Note:
Simulation period: 1922-1994. Change as measured from either Existing Condition or No-Action Alternative. Dry and critical years as defined by the Sacramento Valley Index.

Key:
CP = Comprehensive Plan

Impact WQ-19d (CP1): Delta Salinity on the Old River at Rock Slough On an average annual basis, all months except October through January under both the Existing Condition and Future Condition would be less than 150 mg/L. In dry and critical years, only October and November would exceed the standard under the Existing Condition, and October through February would exceed the standard in the Future Condition. In average annual years, CP1 would not increase chlorides by more than 1.2 percent, and even in that instance, the standard would be met. For dry and critical years, larger increases in chlorides would occur in November and December under the Existing Condition. However, the change in chloride concentration would not affect compliance with the standard; it would already be exceeded under the basis of comparison. This impact would be less than significant.

Rock Slough is the location of the CCWD diversion for the Contra Costa Canal. The actual requirement location is at Contra Costa Canal Pumping Plant No. 1, but in DSM2, the location is measured in the Old River at Rock Slough. The requirements, as defined in D-1641, specify a minimum number of days during the calendar year that the maximum mean daily chloride concentration of 150

mg/L must be maintained. Objectives for the Contra Costa Canal Pumping Plant No. 1 are defined in Table 7-16.

Table 7-16. D-1641 Water Quality Objective for Contra Costa Canal Pumping Plant No. 1

Year Type	Number of Days Each Calendar Year Chlorides Less Than or Equal to 150 mg/L
Wet	240
Above Normal	190
Below Normal	175
Dry	165
Critical	155

Source: SWRCB 2000

Note:
Year-types defined by Sacramento Valley Index. Maximum mean daily 150 mg/L Cl- for at least the number of days shown.

Key:
Cl- = chlorides
D-1641 = Water Right Decision 1641
mg/L = milligram per liter

The standard for chlorides at the Contra Costa Canal is defined by the number of days with less than 150 mg/L of chloride. The analysis of modeling output is limited to monthly average chlorides. However, on an average annual basis, all months except October through January under both the Existing Condition and Future Condition would be less than 150 mg/L. In dry and critical years, only October and November would exceed the standard under the Existing Condition, and October through February would exceed the standard in the Future Condition. As shown in Table 7-17, in average annual years, CP1 would not increase chlorides by more than 1.2 percent, and even in that instance (August under the Existing Condition), the standard would be met. For dry and critical years, larger increases in chlorides would occur in November and December under the Existing Condition. However, the change in chloride concentration would not affect compliance with the standard; it would already be exceeded under the basis of comparison. Table 7-18 shows the number of days simulated chloride values exceeded the standards of 250 mg/L for the Old River at Rock Slough in the period of simulation. CP1 would result in fewer violations compared to the basis of comparison under the Existing Conditions. Overall, CP1 would not alter the compliance level for Old River at Rock Slough observed under both Existing and Future conditions.

This impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Table 7-17. Simulated Monthly Average Chlorides and Percent Change for the Old River at Rock Slough

Month	Existing Condition (2005)				Future Condition (2030)			
	Average All Years		Dry and Critical Years		Average All Years		Dry and Critical Years	
	Existing Condition (mg/L)	CP1 Change (mg/L (%))	Existing Condition (mg/L)	CP1 Change (mg/L (%))	No-Action Alternative (mg/L)	CP1 Change (mg/L (%))	No-Action Alternative (mg/L)	CP1 Change (mg/L (%))
Oct	175.4	0.3 (0.2%)	195.6	1.6 (0.8%)	178.6	0.2 (0.1%)	197.4	0.3 (0.1%)
Nov	167.5	1.2 (0.7%)	195.8	1.0 (0.5%)	167.1	0.8 (0.5%)	191.3	0.0 (0.0%)
Dec	168.0	0.6 (0.4%)	204.2	1.2 (0.6%)	175.9	0.3 (0.2%)	206.4	-1.3 (-0.6%)
Jan	156.2	-1.1 (-0.7%)	195.0	-2.8 (-1.4%)	170.2	-1.1 (-0.6%)	205.6	-2.5 (-1.2%)
Feb	124.9	1.1 (0.9%)	157.9	3.4 (2.2%)	140.9	-0.6 (-0.4%)	176.1	-1.6 (-0.9%)
Mar	80.4	0.5 (0.6%)	85.8	1.7 (1.9%)	83.1	-1.3 (-1.6%)	91.3	-3.6 (-3.9%)
Apr	76.9	0.2 (0.2%)	78.0	0.5 (0.6%)	73.5	-0.5 (-0.7%)	74.6	-1.3 (-1.8%)
May	68.8	0.0 (0.0%)	73.9	0.1 (0.1%)	62.9	-0.1 (-0.2%)	71.4	-0.4 (-0.5%)
Jun	61.0	0.1 (0.1%)	82.3	0.1 (0.1%)	60.7	-0.3 (-0.4%)	81.5	-0.8 (-1.0%)
Jul	70.1	0.6 (0.8%)	102.0	1.7 (1.6%)	68.7	-0.1 (-0.1%)	101.6	-0.3 (-0.3%)
Aug	88.5	1.0 (1.2%)	133.6	2.1 (1.6%)	90.7	0.3 (0.3%)	133.2	1.2 (0.9%)
Sep	134.6	0.3 (0.2%)	172.7	-0.7 (-0.4%)	145.7	0.4 (0.2%)	178.1	0.8 (0.5%)

*Source: Common Assumptions Common Modeling Package, version 8D, DSM2 Existing and Future simulations (Node CHCCC006) converted to chlorides using the equation EC*0.268-24.*

Note:
Simulation period: 1922-1994. Change as measured from either Existing Condition or No-Action Alternative. Dry and critical years as defined by the Sacramento Valley Index.

Key:
CP = Comprehensive Plan
EC = electrical conductivity
mg/L = milligrams per liter

Table 7-18. Simulated Number of Days by Month of Exceedence of the Chloride Standard for the Old River at Rock Slough

Month	Existing Condition (2005)				Future Condition (2030)			
	Total All Years		Dry and Critical Years		Total All Years		Dry and Critical Years	
	Existing Condition (Number of Days)	CP1 Change (Number of Days (%))	Existing Condition (Number of Days)	CP1 Change (Number of Days (%))	No-Action Alternative (Number of Days)	CP1 Change (Number of Days (%))	No-Action Alternative (Number of Days)	CP1 Change (Number of Days (%))
Oct	119	-8.0 (-6.7%)	57	9.0 (15.8%)	149	10.0 (6.7%)	61	5.0 (8.2%)
Nov	176	-7.0 (-4.0%)	107	-13.0 (-12.1%)	152	14.0 (9.2%)	84	3.0 (3.6%)
Dec	332	15.0 (4.5%)	173	15.0 (8.7%)	309	4.0 (1.3%)	151	-5.0 (-3.3%)
Jan	295	-31.0 (-10.5%)	185	-29.0 (-15.7%)	320	-14.0 (-4.4%)	204	-2.0 (-1.0%)
Feb	102	18.0 (17.6%)	90	20.0 (22.2%)	193	4.0 (2.1%)	148	4.0 (2.7%)
Mar	0	0.0 (0.0%)	0	0.0 (0.0%)	4	0.0 (0.0%)	0	0.0 (0.0%)
Apr	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
May	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Jun	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Jul	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Aug	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Sep	0	0.0 (0.0%)	0	0.0 (0.0%)	12	-6.0 (-50.0%)	12	-6.0 (-50.0%)

Source: Common Assumptions Common Modeling Package, version 8D, DSM2 Existing and Future simulations (Node RHCCC006)

Note:
Simulation period: 1922-1994. Change as measured from either Existing Condition or No-Action Alternative. Dry and critical years as defined by the Sacramento Valley Index.

Key:
CP = Comprehensive Plan

Impact WQ-19e (CP1): Delta Water Quality on the Delta-Mendota Canal at Jones Pumping Plant The water quality requirement on the Delta-Mendota Canal at Jones Pumping Plant has two components, a chloride requirement and an EC requirement. CP1 would not measurably change EC, and the increases in chloride concentration would be less than 1.0 percent. This impact would be less than significant.

The Jones Pumping Plant is the primary point of export for the CVP water supply south of the Delta. The water quality requirement on the Delta-Mendota Canal at Jones Pumping Plant has two components, a chloride requirement and an EC requirement. Table 7-19 shows both the chloride and EC concentration requirements.

Table 7-20 shows the simulated chloride concentrations and Table 7-21 shows the EC for the Delta-Mendota Canal at Jones Pumping Plant.

Table 7-19. D-1641 Water Quality Objective for the Delta-Mendota Canal at the Jones Pumping Plant

Year Type	Month	Chloride Concentration (mg/L)	Electrical conductivity (mmhos/cm)
All	October-September	250	1.0

Source: SWRCB 2000

Note:
Year types defined by Sacramento Valley Index.

Key:
D-1641 = Water Right Decision 16-41
mg/L = milligrams per liter
mmhos/cm = millimhos per centimeter

Table 7-20. Simulated Monthly Average Chlorides and Percent Change for the Delta-Mendota Canal at the Jones Pumping Plant

Month	Existing Condition (2005)				Future Condition (2030)			
	Average All Years		Dry and Critical Years		Average All Years		Dry and Critical Years	
	Existing Condition (mg/L)	CP1 Change (mg/L (%))	Existing Condition (mg/L)	CP1 Change (mg/L (%))	No-Action Alternative (mg/L)	CP1 Change (mg/L (%))	No-Action Alternative (mg/L)	CP1 Change (mg/L (%))
Oct	113.2	0.2 (0.2%)	124.3	1.0 (0.8%)	112.6	0.1 (0.1%)	123.4	0.2 (0.2%)
Nov	111.5	0.7 (0.6%)	128.1	0.8 (0.7%)	109.8	0.4 (0.4%)	124.8	-0.1 (-0.1%)
Dec	129.3	0.2 (0.1%)	149.6	0.5 (0.3%)	126.3	0.1 (0.1%)	144.3	-0.6 (-0.4%)
Jan	128.2	-0.6 (-0.5%)	156.9	-1.5 (-0.9%)	125.9	-0.1 (-0.1%)	153.7	-0.3 (-0.2%)
Feb	120.1	-0.6 (-0.5%)	164.3	-1.2 (-0.7%)	117.2	-0.6 (-0.5%)	161.7	-1.5 (-0.9%)
Mar	105.3	-0.2 (-0.1%)	147.1	0.0 (0.0%)	102.0	-0.5 (-0.5%)	141.9	-0.7 (-0.5%)
Apr	70.5	-0.1 (-0.2%)	97.1	-0.3 (-0.3%)	59.2	-0.5 (-0.9%)	82.1	-1.3 (-1.5%)
May	63.3	0.0 (0.0%)	84.3	0.0 (0.0%)	53.3	-0.2 (-0.4%)	75.0	-0.4 (-0.6%)
Jun	61.2	0.0 (0.0%)	72.8	-0.1 (-0.1%)	60.9	-0.1 (-0.1%)	77.7	-0.2 (-0.3%)
Jul	61.9	-0.4 (-0.7%)	75.1	0.2 (0.2%)	59.4	-0.5 (-0.8%)	76.4	-1.1 (-1.4%)
Aug	65.4	0.4 (0.7%)	91.8	0.8 (0.9%)	64.5	0.0 (0.1%)	91.6	0.5 (0.5%)
Sep	89.4	0.2 (0.2%)	113.7	-0.4 (-0.3%)	90.9	0.2 (0.2%)	111.4	0.4 (0.4%)

*Source: Common Assumptions Common Modeling Package, version 8D, DSM2 Existing and Future simulations (Node CHCDMC006) converted to chlorides using the equation EC*0.273-43.9)*

Note:
Simulation period: 1922-1994. Change as measured from either Existing Condition or No-Action Alternative. Dry and critical years as defined by the Sacramento Valley Index.

Key:
CP = Comprehensive Plan
mg/L = milligrams per liter

Table 7-21. Simulated Monthly Average Salinity and Percent Change for the Delta-Mendota Canal at the Jones Pumping Plant

Month	Existing Condition (2005)				Future Condition (2030)			
	Average All Years		Dry and Critical Years		Average All Years		Dry and Critical Years	
	Existing Condition (mmhos/cm)	CP1 Change (mmhos/cm (%))	Existing Condition (mmhos/cm)	CP1 Change (mmhos/cm (%))	No-Action Alternative (mmhos/cm)	CP1 Change (mmhos/cm (%))	No-Action Alternative (mmhos/cm)	CP1 Change (mmhos/cm (%))
Oct	0.6	0.0 (0.1%)	0.6	0.0 (0.6%)	0.6	0.0 (0.1%)	0.6	0.0 (0.1%)
Nov	0.6	0.0 (0.5%)	0.6	0.0 (0.5%)	0.6	0.0 (0.3%)	0.6	0.0 (-0.1%)
Dec	0.6	0.0 (0.1%)	0.7	0.0 (0.2%)	0.6	0.0 (0.1%)	0.7	0.0 (-0.3%)
Jan	0.6	0.0 (-0.4%)	0.7	0.0 (-0.7%)	0.6	0.0 (-0.1%)	0.7	0.0 (-0.2%)
Feb	0.6	0.0 (-0.4%)	0.8	0.0 (-0.6%)	0.6	0.0 (-0.4%)	0.8	0.0 (-0.7%)
Mar	0.5	0.0 (-0.1%)	0.7	0.0 (0.0%)	0.5	0.0 (-0.3%)	0.7	0.0 (-0.4%)
Apr	0.4	0.0 (-0.1%)	0.5	0.0 (-0.2%)	0.4	0.0 (-0.5%)	0.5	0.0 (-1.0%)
May	0.4	0.0 (0.0%)	0.5	0.0 (0.0%)	0.4	0.0 (-0.2%)	0.4	0.0 (-0.4%)
Jun	0.4	0.0 (0.0%)	0.4	0.0 (-0.1%)	0.4	0.0 (0.0%)	0.4	0.0 (-0.2%)
Jul	0.4	0.0 (-0.4%)	0.4	0.0 (0.2%)	0.4	0.0 (-0.5%)	0.4	0.0 (-0.9%)
Aug	0.4	0.0 (0.4%)	0.5	0.0 (0.6%)	0.4	0.0 (0.0%)	0.5	0.0 (0.3%)
Sep	0.5	0.0 (0.2%)	0.6	0.0 (-0.2%)	0.5	0.0 (0.1%)	0.6	0.0 (0.3%)

Source: Common Assumptions Common Modeling Package, version 8D, DSM2 Existing and Future simulations (Node CHCDMC006)

Note:
Simulation period: 1922-1994. Change as measured from either Existing Condition or No-Action Alternative. Dry and critical years as defined by the Sacramento Valley Index.

Key:
CP = Comprehensive Plan
mmhos/cm = millimhos per centimeter

Table 7-22 shows the number of days simulated chloride values exceeded the standards of 250 mg/L for the Delta-Mendota Canal at the Jones Pumping Plant in the period of simulation. As seen in Table 7-22, there would be no additional violations throughout the year except during February. Even in February, chloride values under CP1 would be similar to the baseline values under both Existing and Future conditions.

As evidenced by Table 7-22, the 250 mg/L chloride concentration would not be exceeded on an average annual or dry and critical year basis. Furthermore, chloride concentrations would typically be lower under CP1 than under the basis of comparisons.

Similar to the chloride concentrations, the average annual and dry and critical year averages under the basis of comparison would be under the requirement in all months. CP1 would not measurably change EC, and the increases in chloride concentration would be less than 1.0 percent.

This impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Table 7-22. Simulated Number of Days by Month of Exceedence of the Chloride Standard for the Delta-Mendota Canal at the Jones Pumping Plant

Month	Existing Condition (2005)				Future Condition (2030)			
	Total All Years		Dry and Critical Years		Total All Years		Dry and Critical Years	
	Existing Condition (Number of Days)	CP1 Change (Number of Days (%))	Existing Condition (Number of Days)	CP1 Change (Number of Days (%))	No-Action Alternative (Number of Days)	CP1 Change (Number of Days (%))	No-Action Alternative (Number of Days)	CP1 Change (Number of Days (%))
Oct	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Nov	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Dec	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Jan	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Feb	36	0.0 (0.0%)	36	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Mar	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Apr	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
May	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Jun	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Jul	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Aug	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Sep	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)

Source: Common Assumptions Common Modeling Package, version 8D, DSM2 Existing and Future simulations (Node CHCDMC006)

Note:
Simulation period: 1922–1994. Change as measured from either Existing Condition or No-Action Alternative. Dry and critical years as defined by the Sacramento Valley Index.

Key:
CP = Comprehensive Plan

Table 7-23 shows the number of months simulated EC values exceeded the standards for the Delta-Mendota Canal at the Jones Pumping Plant in the period of simulation. CP1 would not result in any additional violations of the salinity standards except during February. Even in February, CP1 would not change the baseline compliance levels under both Existing and Future conditions.

Impact WQ-19f (CP1): Delta Water Quality on the West Canal at the Mouth of the Clifton Court Forebay The 250 mg/L chloride concentration at the West Canal would not be exceeded on an average annual or dry and critical year basis. Furthermore, chloride concentrations would typically be lower under CP1 than under the basis of comparisons. CP1 would not measurably change EC, and the increases in chloride concentration would be less than 1.0 percent. This impact would be less than significant.

Clifton Court Forebay is the source of water supply for the Banks Pumping Plant and SWP exports south of the Delta. Similar to the Delta-Mendota Canal at Jones Pumping Plant, the water quality requirement on the West Canal at the mouth of the Clifton Court Forebay has two components, a chloride requirement and an EC requirement. Table 7-24 shows both the chloride and EC concentration requirements.

Table 7-23. Simulated Number of Months of Exceedence of the Salinity Standard for the Delta-Mendota Canal at the Jones Pumping Plant

Month	Existing Condition (2005)				Future Condition (2030)			
	Total All Years		Dry and Critical Years		Total All Years		Dry and Critical Years	
	Existing Condition (Number of Months)	CP1 Change (Number of Months (%))	Existing Condition (Number of Months)	CP1 Change (Number of Months (%))	No-Action Alternative (Number of Months)	CP1 Change (Number of Months (%))	No-Action Alternative (Number of Months)	CP1 Change (Number of Months (%))
Oct	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Nov	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Dec	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Jan	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Feb	2	0.0 (0.0%)	2	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Mar	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Apr	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
May	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Jun	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Jul	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Aug	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Sep	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)

Source: Common Assumptions Common Modeling Package, version 8D, DSM2 Existing and Future simulations (Node CHCDMC006)

Note:
Simulation period: 1922-1994. Change as measured from either Existing Condition or No-Action Alternative. Dry and critical years as defined by the Sacramento Valley Index.

Key:
CP = Comprehensive Plan

Table 7-24. D-1641 Water Quality Objective for the West Canal at the Mouth of the Clifton Court Forebay

Year Type	Month	Chloride Concentration (mg/L)	Electrical conductivity (mmhos/cm)
All	October–September	250	1.0

Source: SWRCB 2000

Note:
Year types defined by Sacramento Valley Index.

Key:
D-1641 = Water Right Decision 1641
mg/L = milligrams per liter
mmhos/cm = millimhos per centimeter

Table 7-25 shows the simulated chloride concentrations and Table 7-26 shows the EC for the West Canal at the mouth of the Clifton Court Forebay.

Table 7-25. Simulated Monthly Average Chlorides and Percent Change for West Canal at the Clifton Court Forebay

Month	Existing Condition (2005)				Future Condition (2030)			
	Average All Years		Dry and Critical Years		Average All Years		Dry and Critical Years	
	Existing Condition (mg/L)	CP1 Change (mg/L (%))	Existing Condition (mg/L)	CP1 Change (mg/L (%))	No-Action Alternative (mg/L)	CP1 Change (mg/L (%))	No-Action Alternative (mg/L)	CP1 Change (mg/L (%))
Oct	111.2	0.2 (0.2%)	123.4	1.1 (0.9%)	113.5	0.1 (0.1%)	125.3	0.2 (0.1%)
Nov	108.3	0.9 (0.8%)	126.8	1.0 (0.8%)	109.7	0.4 (0.4%)	125.7	-0.2 (-0.1%)
Dec	121.2	0.2 (0.2%)	144.9	0.5 (0.3%)	116.3	0.2 (0.1%)	138.9	-1.0 (-0.7%)
Jan	116.4	-0.8 (-0.7%)	148.2	-1.8 (-1.2%)	111.8	-0.3 (-0.3%)	144.4	-0.7 (-0.5%)
Feb	107.2	-0.6 (-0.6%)	150.5	-1.1 (-0.8%)	99.7	-0.9 (-0.9%)	143.7	-1.9 (-1.4%)
Mar	92.2	-0.6 (-0.7%)	129.8	-1.2 (-0.9%)	80.5	-0.6 (-0.8%)	115.7	-0.9 (-0.8%)
Apr	63.0	-0.1 (-0.2%)	87.6	-0.3 (-0.3%)	55.0	-0.5 (-1.0%)	76.1	-1.3 (-1.7%)
May	57.5	0.0 (0.1%)	78.2	-0.1 (-0.1%)	50.7	-0.2 (-0.5%)	72.3	-0.4 (-0.6%)
Jun	52.9	0.0 (0.1%)	66.9	-0.1 (-0.2%)	53.7	-0.1 (-0.3%)	71.5	-0.4 (-0.6%)
Jul	53.3	-0.4 (-0.8%)	70.4	0.3 (0.5%)	51.2	-0.5 (-1.0%)	69.8	-1.1 (-1.5%)
Aug	57.2	0.4 (0.7%)	86.1	0.9 (1.0%)	58.8	0.1 (0.1%)	87.6	0.6 (0.7%)
Sep	84.5	0.3 (0.3%)	110.4	-0.3 (-0.3%)	89.6	0.2 (0.2%)	111.5	0.5 (0.4%)

*Source: Common Assumptions Common Modeling Package, version 8D, DSM2 Existing and Future simulations (Node CHSWP003) converted to chlorides using the equation EC*0.273-43.9)*

Note:
Simulation period: 1922-1994. Change as measured from either Existing Condition or No-Action Alternative. Dry and critical years as defined by the Sacramento Valley Index.

Key:
CP = Comprehensive Plan
EC = electrical conductivity
mg/L= milligrams per liter

Table 7-26. Simulated Monthly Average Salinity and Percent Change for West Canal at the Clifton Court Forebay

Month	Existing Condition (2005)				Future Condition (2030)			
	Average All Years		Dry and Critical Years		Average All Years		Dry and Critical Years	
	Existing Condition (mmhos/cm)	CP1 Change (mmhos/cm (%))	Existing Condition (mmhos/cm)	CP1 Change (mmhos/cm (%))	No-Action Alternative (mmhos/cm)	CP1 Change (mmhos/cm (%))	No-Action Alternative (mmhos/cm)	CP1 Change (mmhos/cm (%))
Oct	0.6	0.0 (0.2%)	0.6	0.0 (0.7%)	0.6	0.0 (0.0%)	0.6	0.0 (0.1%)
Nov	0.6	0.0 (0.6%)	0.6	0.0 (0.6%)	0.6	0.0 (0.3%)	0.6	0.0 (-0.1%)
Dec	0.6	0.0 (0.1%)	0.7	0.0 (0.3%)	0.6	0.0 (0.1%)	0.7	0.0 (-0.5%)
Jan	0.6	0.0 (-0.5%)	0.7	0.0 (-1.0%)	0.6	0.0 (-0.2%)	0.7	0.0 (-0.4%)
Feb	0.6	0.0 (-0.4%)	0.7	0.0 (-0.6%)	0.5	0.0 (-0.6%)	0.7	0.0 (-1.0%)
Mar	0.5	0.0 (-0.5%)	0.6	0.0 (-0.7%)	0.5	0.0 (-0.5%)	0.6	0.0 (-0.6%)
Apr	0.4	0.0 (-0.1%)	0.5	0.0 (-0.2%)	0.4	0.0 (-0.5%)	0.4	0.0 (-1.1%)
May	0.4	0.0 (0.0%)	0.4	0.0 (0.0%)	0.3	0.0 (-0.3%)	0.4	0.0 (-0.4%)
Jun	0.4	0.0 (0.0%)	0.4	0.0 (-0.1%)	0.4	0.0 (-0.1%)	0.4	0.0 (-0.4%)
Jul	0.4	0.0 (-0.4%)	0.4	0.0 (0.3%)	0.3	0.0 (-0.6%)	0.4	0.0 (-0.9%)
Aug	0.4	0.0 (0.4%)	0.5	0.0 (0.7%)	0.4	0.0 (0.1%)	0.5	0.0 (0.5%)
Sep	0.5	0.0 (0.2%)	0.6	0.0 (-0.2%)	0.5	0.0 (0.2%)	0.6	0.0 (0.3%)

Source: Common Assumptions Common Modeling Package, version 8D, DSM2 Existing and Future simulations (Node CHSWP003)

Note:
Simulation period: 1922-1994. Change as measured from either Existing Condition or No-Action Alternative. Dry and critical years as defined by the Sacramento Valley Index.

Key:
CP = Comprehensive Plan
mmhos/cm = millimhos per centimeter

Table 7-27 shows the number of days simulated chloride values exceeded the standards of 250 mg/L for the West Canal at the Clifton Court Forebay in the period of simulation. As seen in Table 7-27, there would be no additional violations throughout the year except during February. Even in February, CP1 would not change the baseline compliance levels under both Existing and Future conditions.

As shown in Table 7-27, the 250 mg/L chloride concentration would not be exceeded on an average annual or dry and critical year basis. Furthermore, chloride concentrations would typically be lower under CP1 than under the basis of comparisons.

Similar to the chloride concentrations, the average annual and dry and critical year averages under the basis of comparison would be under the requirement in all months. CP1 would not measurably change EC, and the increases in chloride concentration would be less than 1.0 percent.

This impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Table 7-27. Simulated Number of Days by Month of Exceedence of the Chloride Standard for the West Canal at the Clifton Court Forebay

Month	Existing Condition (2005)				Future Condition (2030)			
	Total All Years		Dry and Critical Years		Total All Years		Dry and Critical Years	
	Existing Condition (Number of Days)	CP1 Change (Number of Days (%))	Existing Condition (Number of Days)	CP1 Change (Number of Days (%))	No-Action Alternative (Number of Days)	CP1 Change (Number of Days (%))	No-Action Alternative (Number of Days)	CP1 Change (Number of Days (%))
Oct	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Nov	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Dec	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Jan	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Feb	22	0.0 (0.0%)	22	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Mar	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Apr	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
May	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Jun	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Jul	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Aug	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Sep	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)

Source: Common Assumptions Common Modeling Package, version 8D, DSM2 Existing and Future simulations (Node CHSWP003)

Note:
Simulation period: 1922-1994. Change as measured from either Existing Condition or No-Action Alternative. Dry and critical years as defined by the Sacramento Valley Index.

Key:
CP = Comprehensive Plan

Tables 7-27 and 7-28 show average monthly simulated EC values and the number of months simulated EC values exceeded the standards for West Canal at the Clifton Court Forebay in the period of simulation. CP1 would not result in any additional violations of the salinity standards except during February. Even in February, CP1 would not change the baseline compliance levels under both Existing and Future conditions.

Table 7-28. Simulated Number of Months of Exceedence of the Salinity Standard for the West Canal at the Clifton Court Forebay

Month	Existing Condition (2005)				Future Condition (2030)			
	Total All Years		Dry and Critical Years		Total All Years		Dry and Critical Years	
	Existing Condition (Number of Months)	CP1 Change (Number of Months (%))	Existing Condition (Number of Months)	CP1 Change (Number of Months (%))	No-Action Alternative (Number of Months)	CP1 Change (Number of Months (%))	No-Action Alternative (Number of Months)	CP1 Change (Number of Months (%))
Oct	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Nov	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Dec	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Jan	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Feb	2	0.0 (0.0%)	2	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Mar	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Apr	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
May	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Jun	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Jul	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Aug	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Sep	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)

Source: Common Assumptions Common Modeling Package, version 8D, DSM2 Existing and Future simulations (Node CHSWP003)

Note:
Simulation period: 1922-1994. Change as measured from either Existing Condition or No-Action Alternative. Dry and critical years as defined by the Sacramento Valley Index.

Key:
CP = Comprehensive Plan

Impact WQ-19g (CP1): Delta Salinity on the San Joaquin River at Vernalis On an average monthly basis, for the basis of comparison, EC would meet requirements in all months, in both average years and in dry and critical years. Moreover, CP1 would not measurably change the EC on the San Joaquin River at Vernalis. This impact would be less than significant.

To protect water quality in the south Delta, D-1641 includes a salinity objective at several locations on the San Joaquin River and on the Old River. The objective is the same for all four locations: the San Joaquin River at Airport Way Bridge in Vernalis, the San Joaquin River at Brandt Bridge, the Old River near the Middle River, and the Old River at Tracy Road Bridge. The water quality requirement is a maximum 30-day average of mean daily EC. Table 7-29 shows the south Delta water quality requirement.

Table 7-29. D-1641 South Delta Water Quality Objective

Year Type	Months	EC Standard (mmhos/cm)
All	April–August	0.7
All	September–March	1.0

Source: SWRCB 2000

Note:
Year types defined by Sacramento Valley Index. While requirement in D-1641 is the maximum 30-day running average of mean daily EC, modeling uses a monthly average. San Joaquin River at Vernalis measured at the Airport Way Bridge.

Key:
D-1641 = Water Right Decision 1641
EC = electrical conductivity
mmhos/cm = millimhos per centimeter

On an average monthly basis, for the basis of comparison, EC would meet requirements in all months, in both average years and in dry and critical years. Moreover, CP1 would not measurably change the EC on the San Joaquin River at Vernalis, as shown in Table 7-30. Table 7-31 shows the number of months simulated EC values exceeded the standards for the San Joaquin River at Vernalis in the period of simulation. CP1 would not change the baseline compliance levels under both Existing and Future conditions.

This impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact WQ-19h (CP1): Delta Salinity on the San Joaquin River at Brandt Bridge Impact WQ-19h (CP1) would be the same as Impact WQ-19g (CP1). On an average monthly basis, for the basis of comparison, EC would meet requirements in all months, in both average years and in dry and critical years. Moreover, CP1 would not measurably change EC on the San Joaquin River at Brandt Bridge. This impact would be less than significant.

As previously mentioned, D-1641 contains a south Delta water quality requirement applicable at several locations, including on the San Joaquin River at Brandt Bridge. Table 7-29 contains the water quality requirement standards.

Table 7-30. Simulated Monthly Average Salinity and Percent Change for the San Joaquin River at Vernalis

Month	Existing Condition (2005)				Future Condition (2030)			
	Average All Years		Dry and Critical Years		Average All Years		Dry and Critical Years	
	Existing Condition (mmhos/cm)	CP1 Change (mmhos/cm (%))	Existing Condition (mmhos/cm)	CP1 Change (mmhos/cm (%))	No-Action Alternative (mmhos/cm)	CP1 Change (mmhos/cm (%))	No-Action Alternative (mmhos/cm)	CP1 Change (mmhos/cm (%))
Oct	0.6	0.0 (0.0%)	0.6	0.0 (0.0%)	0.5	0.0 (0.0%)	0.6	0.0 (0.0%)
Nov	0.6	0.0 (0.0%)	0.6	0.0 (0.0%)	0.6	0.0 (0.0%)	0.6	0.0 (0.0%)
Dec	0.8	0.0 (0.0%)	0.8	0.0 (0.0%)	0.7	0.0 (0.0%)	0.8	0.0 (0.0%)
Jan	0.7	0.0 (0.0%)	0.9	0.0 (0.0%)	0.7	0.0 (0.0%)	0.8	0.0 (0.0%)
Feb	0.7	0.0 (0.0%)	1.0	0.0 (0.0%)	0.7	0.0 (0.1%)	0.9	0.0 (0.2%)
Mar	0.7	0.0 (0.0%)	1.0	0.0 (0.0%)	0.7	0.0 (0.0%)	0.9	0.0 (0.0%)
Apr	0.4	0.0 (0.0%)	0.6	0.0 (0.0%)	0.4	0.0 (0.0%)	0.5	0.0 (0.0%)
May	0.5	0.0 (0.0%)	0.6	0.0 (0.0%)	0.4	0.0 (0.0%)	0.6	0.0 (0.0%)
Jun	0.6	0.0 (0.0%)	0.7	0.0 (0.0%)	0.5	0.0 (0.0%)	0.6	0.0 (0.1%)
Jul	0.6	0.0 (0.0%)	0.7	0.0 (0.0%)	0.6	0.0 (0.0%)	0.6	0.0 (0.1%)
Aug	0.6	0.0 (0.0%)	0.7	0.0 (0.0%)	0.5	0.0 (0.0%)	0.6	0.0 (0.1%)
Sep	0.5	0.0 (0.0%)	0.6	0.0 (0.0%)	0.5	0.0 (0.0%)	0.6	0.0 (0.0%)

Source: Common Assumptions Common Modeling Package, version 8D, DSM2 Existing and Future simulations (Node RSAN112)

Note:
Simulation period: 1922-1994. Change as measured from either Existing Condition or No-Action Alternative. Dry and critical years as defined by the Sacramento Valley Index.

Key:
CP = Comprehensive Plan
mmhos/cm = millimhos per centimeter

Table 7-31. Simulated Number of Months of Exceedence of the Salinity Standard for the San Joaquin River at Vernalis

Month	Existing Condition (2005)				Future Condition (2030)			
	Total All Years		Dry and Critical Years		Total All Years		Dry and Critical Years	
	Existing Condition (Number of Months)	CP1 Change (Number of Months (%))	Existing Condition (Number of Months)	CP1 Change (Number of Months (%))	No-Action Alternative (Number of Months)	CP1 Change (Number of Months (%))	No-Action Alternative (Number of Months)	CP1 Change (Number of Months (%))
Oct	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Nov	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Dec	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Jan	1	0.0 (0.0%)	1	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Feb	6	0.0 (0.0%)	5	0.0 (0.0%)	1	0.0 (0.0%)	1	0.0 (0.0%)
Mar	10	0.0 (0.0%)	10	0.0 (0.0%)	8	0.0 (0.0%)	8	0.0 (0.0%)
Apr	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
May	1	0.0 (0.0%)	1	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Jun	2	0.0 (0.0%)	2	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Jul	1	0.0 (0.0%)	1	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Aug	4	0.0 (0.0%)	4	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Sep	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)

Source: Common Assumptions Common Modeling Package, version 8D, DSM2 Existing and Future simulations (Node RSAN112)

Note:
Simulation period: 1922-1994. Change as measured from either Existing Condition or No-Action Alternative. Dry and critical years as defined by the Sacramento Valley Index.

Key:
CP = Comprehensive Plan

Impact WQ-19h (CP1) would be the same as Impact WQ-19g (CP1). On an average monthly basis, for the basis of comparison, EC would meet requirements in all months, in both average years and in dry and critical years. Moreover, CP1 would not measurably change EC on the San Joaquin River at Brandt Bridge, as shown in Table 7-32. Table 7-33 shows the number of months simulated EC values exceeded the standards for the San Joaquin River at Brandt Bridge in the period of simulation. CP1 would not change the existing compliance level except in June under the Future Conditions. Even in June, CP1 would result in 4 months of violation of salinity standards as compared to 3 months under the baseline conditions.

This impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Table 7-32. Simulated Monthly Average Salinity and Percent Change for the San Joaquin River at Brandt Bridge

Month	Existing Condition (2005)				Future Condition (2030)			
	Average All Years		Dry and Critical Years		Average All Years		Dry and Critical Years	
	Existing Condition (mmhos/cm)	CP1 Change (mmhos/cm (%))	Existing Condition (mmhos/cm)	CP1 Change (mmhos/cm (%))	No-Action Alternative (mmhos/cm)	CP1 Change (mmhos/cm (%))	No-Action Alternative (mmhos/cm)	CP1 Change (mmhos/cm (%))
Oct	0.6	0.0 (0.0%)	0.6	0.0 (0.0%)	0.5	0.0 (0.0%)	0.6	0.0 (0.0%)
Nov	0.6	0.0 (0.0%)	0.6	0.0 (0.0%)	0.6	0.0 (0.0%)	0.6	0.0 (0.0%)
Dec	0.7	0.0 (0.0%)	0.8	0.0 (0.0%)	0.7	0.0 (0.0%)	0.8	0.0 (0.0%)
Jan	0.7	0.0 (0.0%)	0.9	0.0 (0.0%)	0.7	0.0 (0.0%)	0.8	0.0 (0.0%)
Feb	0.7	0.0 (0.0%)	1.0	0.0 (0.0%)	0.7	0.0 (0.1%)	0.9	0.0 (0.1%)
Mar	0.7	0.0 (0.0%)	1.0	0.0 (0.0%)	0.7	0.0 (0.0%)	0.9	0.0 (0.0%)
Apr	0.5	0.0 (0.0%)	0.6	0.0 (0.0%)	0.4	0.0 (0.0%)	0.6	0.0 (0.0%)
May	0.5	0.0 (0.0%)	0.6	0.0 (0.0%)	0.4	0.0 (0.0%)	0.6	0.0 (0.0%)
Jun	0.6	0.0 (0.0%)	0.7	0.0 (0.0%)	0.5	0.0 (0.0%)	0.7	0.0 (0.0%)
Jul	0.6	0.0 (0.0%)	0.7	0.0 (0.0%)	0.6	0.0 (0.0%)	0.7	0.0 (0.0%)
Aug	0.6	0.0 (0.0%)	0.7	0.0 (0.0%)	0.5	0.0 (0.0%)	0.6	0.0 (0.1%)
Sep	0.6	0.0 (0.0%)	0.6	0.0 (0.0%)	0.5	0.0 (0.0%)	0.6	0.0 (0.0%)

Source: Common Assumptions Common Modeling Package, version 8D, DSM2 Existing and Future simulations (Node RSAN112)

Note:
Simulation period: 1922-1994. Change as measured from either Existing Condition or No-Action Alternative. Dry and critical years as defined by the Sacramento Valley Index.

Key:
CP = Comprehensive Plan
mmhos/cm = millimhos per centimeter

Table 7-33. Simulated Number of Months of Exceedence of the Salinity Standard for the San Joaquin River at Brandt Bridge

Month	Existing Condition (2005)				Future Condition (2030)			
	Total All Years		Dry and Critical Years		Total All Years		Dry and Critical Years	
	Existing Condition (Number of Months)	CP1 Change (Number of Months (%))	Existing Condition (Number of Months)	CP1 Change (Number of Months (%))	No-Action Alternative (Number of Months)	CP1 Change (Number of Months (%))	No-Action Alternative (Number of Months)	CP1 Change (Number of Months (%))
Oct	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Nov	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Dec	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Jan	1	0.0 (0.0%)	1	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Feb	6	0.0 (0.0%)	5	0.0 (0.0%)	1	0.0 (0.0%)	1	0.0 (0.0%)
Mar	21	0.0 (0.0%)	19	0.0 (0.0%)	14	0.0 (0.0%)	13	0.0 (0.0%)
Apr	7	0.0 (0.0%)	7	0.0 (0.0%)	1	0.0 (0.0%)	1	0.0 (0.0%)
May	1	0.0 (0.0%)	1	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Jun	22	0.0 (0.0%)	20	0.0 (0.0%)	3	1.0 (33.3%)	3	1.0 (33.3%)
Jul	7	0.0 (0.0%)	7	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Aug	4	0.0 (0.0%)	4	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Sep	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)

Source: Common Assumptions Common Modeling Package, version 8D, DSM2 Existing and Future simulations (Node RSAN112)

Note:
Simulation period: 1922-1994. Change as measured from either Existing Condition or No-Action Alternative. Dry and critical years as defined by the Sacramento Valley Index.

Key:
CP = Comprehensive Plan

Impact WQ-19i (CP1): Delta Salinity on the Old River near the Middle River
Impact WQ-19i (CP1) would be similar to Impact WQ-19g (CP1). On an average monthly basis, for the basis of comparison, EC would meet requirements in all months, in both average years and in dry and critical years. Moreover, CP1 would not measurably change EC on the Old River near the Middle River. This impact would be less than significant.

As previously mentioned, D-1641 contains a south Delta water quality requirement applicable at several locations, including on the Old River near the Middle River. Table 7-29 contains the water quality requirement standards.

Impact WQ-19i (CP1) would be similar to Impact WQ-19g (CP1). On an average monthly basis, for the basis of comparison, EC would meet requirements in all months, in both average years and in dry and critical years. Moreover, CP1 would not measurably change EC on the Old River near the Middle River, as shown in Table 7-34. Table 7-35 shows the number of months simulated EC values exceeded the standards for the Old River near the Middle

River in the period of simulation. The compliance of salinity standards for the Old River near the Middle River would not change under CP1 except in July under Existing Conditions. In July, CP1 would result in 8 months of violation of salinity standards as compared to 7 months for the baseline under the Existing Conditions.

This impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Table 7-34. Simulated Monthly Average Salinity and Percent Change for the Old River near the Middle River

Month	Existing Condition (2005)				Future Condition (2030)			
	Average All Years		Dry and Critical Years		Average All Years		Dry and Critical Years	
	Existing Condition (mmhos/cm)	CP1 Change (mmhos/cm (%))	Existing Condition (mmhos/cm)	CP1 Change (mmhos/cm (%))	No-Action Alternative (mmhos/cm)	CP1 Change (mmhos/cm (%))	No-Action Alternative (mmhos/cm)	CP1 Change (mmhos/cm (%))
Oct	0.6	0.0 (0.0%)	0.6	0.0 (0.0%)	0.4	0.0 (0.1%)	0.5	0.0 (0.0%)
Nov	0.6	0.0 (0.0%)	0.6	0.0 (0.0%)	0.5	0.0 (0.1%)	0.5	0.0 (-0.1%)
Dec	0.8	0.0 (0.0%)	0.8	0.0 (0.0%)	0.6	0.0 (0.1%)	0.6	0.0 (-0.2%)
Jan	0.7	0.0 (0.0%)	0.9	0.0 (0.0%)	0.6	0.0 (-0.1%)	0.7	0.0 (-0.2%)
Feb	0.7	0.0 (0.0%)	1.0	0.0 (0.0%)	0.6	0.0 (-0.3%)	0.7	0.0 (-0.7%)
Mar	0.7	0.0 (0.0%)	1.0	0.0 (0.0%)	0.5	0.0 (-0.4%)	0.7	0.0 (-0.9%)
Apr	0.5	0.0 (0.0%)	0.6	0.0 (0.0%)	0.4	0.0 (-0.4%)	0.5	0.0 (-0.8%)
May	0.5	0.0 (0.0%)	0.6	0.0 (0.0%)	0.4	0.0 (-0.1%)	0.5	0.0 (-0.2%)
Jun	0.6	0.0 (0.0%)	0.7	0.0 (0.0%)	0.4	0.0 (0.1%)	0.5	0.0 (0.2%)
Jul	0.6	0.0 (0.0%)	0.7	0.0 (0.0%)	0.4	0.0 (-0.4%)	0.4	0.0 (-1.2%)
Aug	0.6	0.0 (0.0%)	0.7	0.0 (0.0%)	0.4	0.0 (-0.1%)	0.4	0.0 (0.0%)
Sep	0.6	0.0 (0.0%)	0.6	0.0 (0.0%)	0.4	0.0 (0.0%)	0.4	0.0 (0.0%)

Source: Common Assumptions Common Modeling Package, version 8D, DSM2 Existing and Future simulations (Node RMID041)

Note:
Simulation period: 1922-1994. Change as measured from either Existing Condition or No-Action Alternative. Dry and critical years as defined by the Sacramento Valley Index.

Key:
CP = Comprehensive Plan
mmhos/cm = millimhos per centimeter

Table 7-35. Simulated Number of Months of Exceedence of the Salinity Standard for the Old River near the Middle River

Month	Existing Condition (2005)				Future Condition (2030)			
	Total All Years		Dry and Critical Years		Total All Years		Dry and Critical Years	
	Existing Condition (Number of Months)	CP1 Change (Number of Months (%))	Existing Condition (Number of Months)	CP1 Change (Number of Months (%))	No-Action Alternative (Number of Months)	CP1 Change (Number of Months (%))	No-Action Alternative (Number of Months)	CP1 Change (Number of Months (%))
Oct	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Nov	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Dec	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Jan	1	0.0 (0.0%)	1	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Feb	6	0.0 (0.0%)	5	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Mar	20	0.0 (0.0%)	18	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Apr	5	0.0 (0.0%)	5	0.0 (0.0%)	1	-1.0 (-100.0%)	1	-1.0 (-100.0%)
May	2	0.0 (0.0%)	2	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Jun	22	0.0 (0.0%)	20	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Jul	7	1.0 (14.3%)	7	1.0 (14.3%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Aug	4	0.0 (0.0%)	4	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Sep	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)

Source: Common Assumptions Common Modeling Package, version 8D, DSM2 Existing and Future simulations (Node RMID041)

Note:
Simulation period: 1922-1994. Change as measured from either Existing Condition or No-Action Alternative. Dry and critical years as defined by the Sacramento Valley Index.

Key:
CP = Comprehensive Plan

Impact WQ-19j (CP1): Delta Salinity on the Old River at Tracy Road Bridge
Impact WQ-19j (CP1) would be similar to Impact WQ-19g (CP1). On an average monthly basis, for the basis of comparison, EC would meet requirements in all months, in both average years and in dry and critical years. Moreover, CP1 would not measurably change EC on the Old River at Tracy Road Bridge. This impact would be less than significant.

As previously mentioned, D-1641 contains a south Delta water quality requirement applicable at several locations, including on the Old River at Tracy Road Bridge. Table 7-29 contains the water quality requirement standards.

Impact WQ-19j (CP1) would be similar to Impact WQ-19g (CP1). On an average monthly basis, for the basis of comparison, EC would meet requirements in all months, in both average years and in dry and critical years. Moreover, CP1 would not measurably change EC on the Old River at Tracy Road Bridge, as shown in Table 7-36. Table 7-37 shows the number of months simulated EC values exceeded the standards for the Old River near Tracy Road

Bridge in the period of simulation. On an annual average basis, the compliance of salinity standards under CP1 would not change from the Existing Conditions by more than 2 percent. Overall, CP1 would not alter the compliance level for the Old River near Tracy Road Bridge observed under both Existing and Future conditions.

This impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Table 7-36. Simulated Monthly Average Salinity and Percent Change for the Old River at Tracy Road Bridge

Month	Existing Condition (2005)				Future Condition (2030)			
	Average All Years		Dry and Critical Years		Average All Years		Dry and Critical Years	
	Existing Condition (mmhos/cm)	CP1 Change (mmhos/cm (%))	Existing Condition (mmhos/cm)	CP1 Change (mmhos/cm (%))	No-Action Alternative (mmhos/cm)	CP1 Change (mmhos/cm (%))	No-Action Alternative (mmhos/cm)	CP1 Change (mmhos/cm (%))
Oct	0.6	0.0 (0.0%)	0.6	0.0 (0.0%)	0.6	0.0 (0.1%)	0.6	0.0 (0.1%)
Nov	0.6	0.0 (0.0%)	0.6	0.0 (0.0%)	0.6	0.0 (0.3%)	0.6	0.0 (0.0%)
Dec	0.8	0.0 (0.0%)	0.8	0.0 (0.0%)	0.6	0.0 (0.1%)	0.7	0.0 (-0.5%)
Jan	0.8	0.0 (0.0%)	0.9	0.0 (0.0%)	0.6	0.0 (-0.2%)	0.7	0.0 (-0.4%)
Feb	0.8	0.0 (0.0%)	1.0	0.0 (0.0%)	0.6	0.0 (-0.5%)	0.7	0.0 (-1.1%)
Mar	0.7	0.0 (0.0%)	1.0	0.0 (0.0%)	0.5	0.0 (-0.1%)	0.7	0.0 (0.0%)
Apr	0.5	0.0 (0.0%)	0.7	0.0 (0.0%)	0.4	0.0 (-0.3%)	0.5	0.0 (-0.7%)
May	0.5	0.0 (0.0%)	0.6	0.0 (0.0%)	0.4	0.0 (-0.2%)	0.5	0.0 (-0.4%)
Jun	0.6	0.0 (-0.1%)	0.7	0.0 (-0.1%)	0.4	0.0 (0.0%)	0.5	0.0 (-0.1%)
Jul	0.6	0.0 (-0.1%)	0.7	0.0 (-0.3%)	0.4	0.0 (-0.4%)	0.5	0.0 (-0.9%)
Aug	0.6	0.0 (0.2%)	0.6	0.0 (0.5%)	0.4	0.0 (0.0%)	0.5	0.0 (0.3%)
Sep	0.6	0.0 (0.0%)	0.6	0.0 (0.1%)	0.5	0.0 (0.1%)	0.6	0.0 (0.2%)

Source: Common Assumptions Common Modeling Package, version 8D, DSM2 Existing and Future simulations (Node ROLD059)

Note:
Simulation period: 1922-1994. Change as measured from either Existing Condition or No-Action Alternative. Dry and critical years as defined by the Sacramento Valley Index.

Key:
CP = Comprehensive Plan
mmhos/cm = millimhos per centimeter

Table 7-37. Simulated Number of Days by Month of Exceedence of the Salinity Standard for the Old River at Tracy Road Bridge

Month	Existing Condition (2005)				Future Condition (2030)			
	Total All Years		Dry and Critical Years		Total All Years		Dry and Critical Years	
	Existing Condition (Number of Months)	CP1 Change (Number of Months (%))	Existing Condition (Number of Months)	CP1 Change (Number of Months (%))	No-Action Alternative (Number of Months)	CP1 Change (Number of Months (%))	No-Action Alternative (Number of Months)	CP1 Change (Number of Months (%))
Oct	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Nov	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Dec	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Jan	2	0.0 (0.0%)	1	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Feb	11	0.0 (0.0%)	10	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Mar	21	0.0 (0.0%)	19	0.0 (0.0%)	1	-1.0 (-100.0%)	1	-1.0 (-100.0%)
Apr	23	0.0 (0.0%)	21	0.0 (0.0%)	2	-1.0 (-50.0%)	2	-1.0 (-50.0%)
May	0	1.0 (0.0%)	0	1.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Jun	16	0.0 (0.0%)	14	-1.0 (-7.1%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Jul	10	1.0 (10.0%)	8	1.0 (12.5%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Aug	2	0.0 (0.0%)	2	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Sep	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)

Source: Common Assumptions Common Modeling Package, version 8D, DSM2 Existing and Future simulations (Node ROLD059)

Note:
Simulation period: 1922-1994. Change as measured from either Existing Condition or No-Action Alternative. Dry and critical years as defined by the Sacramento Valley Index.

Key:
CP = Comprehensive Plan

Impact WQ-20 (CP1): X2 Position CP1 would not change average monthly X2 in either average years or in dry and critical years by more than 0.1 kilometer (km) under either the Existing Condition or Future Condition. While several months may be out of compliance under the bases of comparison, the change resulting from CP1 would not increase the amount out of compliance. This impact would be less than significant.

Table 7-38 shows the simulated monthly average X2 position for CP1 compared to the Existing Condition and Future Condition baselines. CalSim-II calculates the X2 position on a 1-month delay; the values shown have been corrected to accurately reflect the X2 position for the specified month.

CP1 would not change average monthly X2 in either average years or in dry and critical years by more than 0.1 km under either the Existing Condition or Future Condition. While several months may be out of compliance under the bases of comparison, the change resulting from CP1 would not increase the amount out of compliance.

This impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Table 7-38. Simulated Monthly Average X2 Position

Month	Existing Condition (2005)				Future Condition (2030)			
	Average All Years		Dry and Critical Years		Average All Years		Dry and Critical Years	
	Existing Condition (km)	CP1 Change (km (%))	Existing Condition (km)	CP1 Change (km (%))	No-Action Alternative (km)	CP1 Change (km (%))	No-Action Alternative (km)	CP1 Change (km (%))
Oct	85.2	0.0 (0.0%)	86.7	0.0 (0.0%)	85.6	0.0 (0.0%)	86.9	0.0 (0.0%)
Nov	82.7	0.0 (0.0%)	85.2	0.0 (0.0%)	83.1	0.0 (0.0%)	85.4	0.0 (-0.1%)
Dec	77.3	0.0 (0.0%)	83.0	-0.1 (-0.2%)	77.7	0.0 (0.0%)	83.3	-0.1 (-0.2%)
Jan	71.6	0.1 (0.1%)	80.4	0.1 (0.1%)	72.0	0.0 (0.0%)	80.7	-0.1 (-0.1%)
Feb	66.1	0.2 (0.3%)	75.1	0.4 (0.5%)	66.3	0.0 (0.0%)	75.3	-0.1 (-0.2%)
Mar	65.7	0.1 (0.2%)	74.0	0.2 (0.3%)	65.8	0.0 (0.1%)	74.1	0.1 (0.1%)
Apr	68.1	0.0 (0.1%)	75.5	0.1 (0.1%)	68.1	0.0 (0.0%)	75.6	0.0 (0.0%)
May	71.3	0.0 (0.0%)	78.9	0.0 (0.0%)	71.3	0.0 (0.0%)	78.8	0.0 (0.0%)
Jun	75.2	0.0 (0.0%)	81.3	0.0 (0.0%)	75.2	0.0 (0.0%)	81.2	-0.1 (-0.2%)
Jul	79.2	0.0 (0.0%)	83.9	0.0 (0.0%)	78.8	0.0 (0.0%)	83.7	0.0 (0.0%)
Aug	84.1	-0.1 (-0.1%)	85.7	-0.2 (-0.2%)	84.0	0.0 (0.0%)	85.5	0.0 (0.0%)
Sep	85.6	0.0 (0.0%)	88.8	-0.1 (-0.1%)	85.8	-0.1 (-0.1%)	88.5	-0.1 (-0.1%)

Source: Common Assumptions Common Modeling Package version 8D CalSim-II 2005 and 2030 simulations (Node X2_PRV)

Note:
Simulation period: 1922-1994. Change as measured from either Existing Condition or No-Action Alternative. Dry and critical years as defined by the Sacramento Valley Index.

Key:
CP = Comprehensive Plan
km = kilometer
X2 = geographic location of 2 parts per thousand near-bottom salinity isohaline in the Delta, measured in distance upstream from Golden Gate Bridge in Suisun Bay.

CP2 – 12.5-Foot Dam Raise, Anadromous Fish Survival and Water Supply Reliability

Like CP1, CP2 focuses on enlarging Shasta Dam and Shasta Lake consistent with the goals of the 2000 CALFED ROD, and was formulated for the primary purposes of increasing water supply reliability, increasing survival of anadromous fish, and improving water quality. In addition to the common features, CP2 consists of raising Shasta Dam 12.5 feet, an elevation change that would increase the full pool elevation by 14.5 feet and enlarge the total storage space in the reservoir by 443 TAF. This alternative would help reduce future shortages by increasing the reliability of the water supply in drought and average years. The increased CWP would also contribute to improved seasonal water temperatures for anadromous fish in the upper Sacramento River.

Shasta Lake and Vicinity

Impact WQ-1 (CP2): Temporary Construction-Related Sediment Effects on Shasta Lake and Its Tributaries That Would Violate Water Quality Standards or Adversely Affect Beneficial Uses This impact is similar to WQ-1 (CP1). However, the construction-related activities described in Chapter 2, "Alternatives," would result in about 500 more acres of exposed shoreline than CP1 and in about the same number of relocation acres (3,337) that would be subject to erosion. This alternative is similar to, but somewhat larger than CP1. Therefore, this impact would be potentially significant. Mitigation for this impact is proposed in Section 7.3.5.

Impact WQ-2 (CP2): Temporary Construction-Related Temperature Effects on Shasta Lake and Its Tributaries That Would Violate Water Quality Standards or Adversely Affect Beneficial Uses Similar to CP1, construction activities associated with enlarging Shasta Dam as well as the relocation actions would result in sizeable areas that would be subject to surface disturbance, including jurisdictional waters within the influence zone of CP2. Efforts to document jurisdictional waters associated with relocation areas are ongoing. This information will be included, if available, in the Final EIS, as well as in the Section 404 permitting package, prior to issuance of a ROD.

Environmental commitments and BMPs for the various construction and relocation activities (e.g., bridge replacement, boat ramp construction, demolition of facilities) have been incorporated into CP2. These activities could include removal of riparian vegetation, thereby exposing water bodies to increased solar radiation for various time periods. A riparian revegetation program will be implemented at all construction and relocation sites as applicable to ensure that shade is quickly reestablished after construction is completed.

As described in Chapter 2, "Alternatives," although the TCD may not be operational for some period of time during construction, project sequencing will ensure that changes to water temperature and associated limnological conditions will be consistent with those that occur periodically under the No-Action Alternative associated with maintenance and outage periods.

Because of the large water surface area of Shasta Lake, coupled with the isolated and discrete nature of the relocation activities on the tributaries, temporary construction-related effects are not expected to modify water temperature in a manner that would have a negative effect on beneficial uses or result in a water quality violation. Therefore, this impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact WQ-3 (CP2): Temporary Construction-Related Metal Effects on Shasta Lake and Its Tributaries That Would Violate Water Quality Standards or Adversely Affect Beneficial Uses This impact is similar to WQ-3 (CP1). There would be no construction activities that would disturb locations known to

contain elevated metal concentrations in either sediments or the water column. Therefore, this impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact WQ-4 (CP2): Long-Term Sediment Effects That Would Violate Water Quality Standards or Adversely Affect Beneficial Uses in Shasta Lake or Its Tributaries This impact is similar to WQ-4 (CP1), except that the exposure of an additional 1,735 acres of shoreline surrounding Shasta Lake would result in a potential for increased wave-related shoreline erosion (see Chapter 4, "Geology, Geomorphology, Minerals, and Soils"). This would be a potentially significant impact. Mitigation for this impact is proposed in Section 7.3.5.

Impact WQ-5 (CP2): Long-Term Temperature Effects That Would Violate Water Quality Standards or Adversely Affect Beneficial Uses in Shasta Lake or Its Tributaries Similar to CP1, this alternative would increase storage on a monthly basis although it would vary by water year. Table 7-39 shows the simulated monthly change in storage for CP2 as a percent increase above the No-Action Alternative. On average, CP2 would provide almost a 9 percent increase in the end-of-month storage on an annual basis.

Table 7-39. Simulated Average Increased End-of-Month Shasta Lake Storage – CP2

Month	Existing Condition (TAF)	CP2 (TAF)	CP2 % Increase
Oct	2,671	263	9.8%
Nov	2,690	265	9.9%
Dec	2,815	284	10.1%
Jan	3,067	288	9.4%
Feb	3,291	299	9.1%
Mar	3,624	301	8.3%
Apr	3,919	295	7.5%
May	3,950	295	7.5%
Jun	3,642	293	8.0%
Jul	3,187	282	8.8%
Aug	2,879	271	9.4%
Sep	2,782	269	9.7%

Source: Common Assumptions Common Modeling Package Version 8D CalSim-II 2005 and 2030 simulations (Node S4+S44)

Note:
Simulation period: 1922–2003

Key:
TAF = thousand acre-feet

Under CP2, existing water temperature requirements would typically be met in most years; therefore, the additional increase in water storage shown in Table 7-39 would primarily be released for water supply purposes. Accordingly, minimal increases in releases from Shasta Dam would be expected in months when Delta exports are constrained, or when flow is not usable for water supply purposes.

Similar to CP1, the increase in storage provided by CP2 fluctuates greatly throughout a year. A key indicator of water temperature benefits of CP2 to the upper Sacramento River between Keswick Dam and Red Bluff is the amount of cold water available in Shasta Lake prior to the water temperature operation season, about May through October. Similar to CP1, the CWP volume in the lake accumulates during the winter and early spring and is not likely to increase after April. Therefore, the expected increase in spring storage for CP2 should also result in an incremental increase in the CWP volume.

The simulated end-of-April volume of water with a temperature lower than 52˚F for the No-Action Alternative and the change in CWP volume for CP2 is shown, by SVI year type, in Table 7-40.

Table 7-40. Simulated Average Volume of Water Less than 52˚F in Shasta Lake at the End of April – CP2

SVI Year Type	Existing Condition (TAF)	CP2 (TAF)	CP2 % Increase
Average of All Years	1,577	152	9.6%
Wet	1,807	237	13.1%
Above Normal	1,721	182	10.6%
Below Normal	1,743	130	7.5%
Dry	1,451	111	7.6%
Critical	928	22	2.4%

Source: Common Assumptions Common Modeling Package Version 8D SRWQM 2005 and 2030 simulations

Note:
Simulation period: 1922-2003
Year types as defined by the Sacramento Valley Index

Key:
SVI = Sacramento Valley Index
TAF = thousand acre-feet

In addition to illustrating the average change in available CWP, Table 7-40 also shows the influence of climatic conditions on these values. The diversity between water year types, coupled with unique combinations of storage and rainfall would continue to influence the ability to manage storage in Shasta Lake to maximize carryover capacity. Although there would be a meaningful increase in active storage and carryover storage of the CWP, this increase is considered a less than significant impact. Mitigation for this impact is not needed, and thus not proposed.

Impact WQ-6 (CP2): Long-Term Metals Effects That Would Violate Water Quality Standards or Adversely Affect Beneficial Uses in Shasta Lake or Its Tributaries Similar to CP1, the increase in storage associated with this alternative would not result in modifying the depth and thickness of the thermocline that persists in Shasta Lake.

Within the Squaw Creek Arm, two depositional features associated with historic copper mining and smelting operations are immediately adjacent to the shoreline of Shasta Lake in the general vicinity of the Bully Hill Mine. As mapped, these two sites appear to have about 7,300 cubic yards of material that could be subjected to shoreline and surficial erosional processes at slightly higher elevations on the features than CP1with a high potential for delivery to Shasta Lake. Under CP2, this impact would be potentially significant. Mitigation for this impact is proposed in Section 7.3.5.

Upper Sacramento River (Shasta Dam to Red Bluff)

Impact WQ-7 (CP2): Temporary Construction-Related Sediment Effects on the Upper Sacramento River That Would Cause Violations of Water Quality Standards or Adversely Affect Beneficial Uses Construction would include ground-disturbing activities that could result in soil erosion and sediment effects on the upper Sacramento River. This impact would be potentially significant.

This impact would be the same as Impact WQ-7 (CP1) and would be potentially significant. Mitigation for this impact is proposed in Section 7.3.5.

Impact WQ-8 (CP2): Temporary Construction-Related Temperature Effects on the Upper Sacramento River That Cause Violations of Water Quality Standards or Adversely Affect Beneficial Uses Construction activities are not anticipated to result in temperature effects on the upper Sacramento River because changes to water temperature in Shasta Lake and subsequent releases to the Sacramento River would be consistent with typical periodic fluctuations. This impact would be less than significant.

This impact would be identical to Impact WQ-8 (CP1). For the same reasons as described for Impact WQ-8 (CP1), this impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact WQ-9 (CP2): Temporary Construction-Related Metal Effects on the Upper Sacramento River That Cause Violations of Water Quality Standards or Adversely Affect Beneficial Uses Construction activities are not anticipated to result in water quality effects on the upper Sacramento River related to metals because construction would not disturb locations of known elevated metal concentrations. This impact would be less than significant.

This impact would be identical to Impact WQ-9 (CP1). For the same reasons described for Impact WQ-9 (CP1), this impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact WQ-10 (CP2): Long-Term Sediment Effects That Cause Violations of Water Quality Standards or Adversely Affect Beneficial Uses in the Upper Sacramento River No long-term water quality impacts are anticipated in the upper Sacramento River in regard to sediment, because modeling results have indicated that CP2 would cause little change in average mean monthly winter flows during some years, which could slightly reduce sediment transport. This impact would be less than significant.

This impact would be similar to Impact WQ-10 (CP1) because the extent of the effect of CP2 on sediment would be similar to but slightly greater than that for CP1 (i.e., CP2 would have greater potential to reduce erosional processes and sediment transport in the upper Sacramento River). For the same reasons as described for Impact WQ-10 (CP1), this impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact WQ-11 (CP2): Long-Term Temperature Effects That Cause Violations of Water Quality Standards or Adversely Affect Beneficial Uses in the Upper Sacramento River Analysis of temperature modeling results indicates that CP2 would improve compliance with the temperature requirements on the Sacramento River because of the increased depth of the cold-water pool in Shasta Lake and the associated enhanced ability to regulate water temperature releases to the upper Sacramento River. Therefore, the impact of CP2 on water quality measured as temperature would be beneficial.

CP2 would increase the ability of Shasta Dam to release cold water and regulate water temperature in the upper Sacramento River, primarily in dry and critically dry years. Raising Shasta Dam 12.5 feet would increase the cold-water pool and benefit seasonal water temperatures along the upper Sacramento River. This section focuses on compliance with water quality standards for temperature. For an analysis of temperature effects on fisheries and aquatic habitat, see Chapter 11, “Fisheries and Aquatic Ecosystems.”

Analysis of temperature modeling results indicates that under both existing and future conditions, CP2 would have a beneficial effect on temperature within the upper Sacramento River, with a slight decrease in average monthly water temperature during summer. Decreased temperatures would improve compliance with the temperature objectives for the upper Sacramento River in the 2004 and 2009 BOs (NMFS 2004, 2009). CP2 would reduce temperature exceedences at Balls Ferry by 15 percent under existing conditions and 19 percent under future conditions. At the Bend Bridge compliance station, CP2 would reduce temperature exceedences by 6 percent under existing conditions and 8 percent under future conditions. Table 7-6 summarizes the temperature modeling results.

Based on this analysis, the impact of CP2 on water quality measured as temperature would be beneficial. Mitigation for this impact is not needed, and thus not proposed.

Impact WQ-12 (CP2): Long-Term Metals Effects That Cause Violations of Water Quality Standards or Adversely Affect Beneficial Uses in the Upper Sacramento River Long-term operation of the project could result in water quality effects on the upper Sacramento River in regard to metals as a result of erosional processes to historic mining and smelting operation features. This impact would be potentially significant.

This impact would be similar to Impact WQ-12 (CP1) because the extent of the effect of CP2 on metals would be similar to but slightly greater than that for CP1. For the same reasons as described for CP1, this impact would be potentially significant. Mitigation for this impact is proposed in Section 7.3.5.

Lower Sacramento River and Delta and CVP/SWP Service Areas
CP2 would differ from the No-Action Alternative primarily through a 443 TAF enlargement of Shasta Lake. The impacts described below are the same as described for CP1.

Impact WQ-13 (CP2): Temporary Construction-Related Sediment Effects on the Extended Study Area That Would Cause Violations of Water Quality Standards Construction is not anticipated to affect water quality conditions in the extended study area. This impact would be less than significant.

This impact would be similar to Impact WQ-13 (CP1). For the same reasons as described for Impact WQ-13 (CP1), this impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact WQ-14 (CP2): Temporary Construction-Related Temperature Effects on the Extended Study Area That Cause Violations of Water Quality Standards or Adversely Affect Beneficial Uses This impact would be similar to Impact WQ-14 (CP1). For the same reasons as described for Impact WQ-14 (CP1), this impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact WQ-15 (CP2): Temporary Construction-Related Metal Effects on the Extended Study Area That Cause Violations of Water Quality Standards or Adversely Affect Beneficial Uses This impact would be similar to Impact WQ-15 (CP1). For the same reasons as described for Impact WQ-15 (CP1), this impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact WQ-16 (CP2): Long-Term Sediment Effects That Cause Violations of Water Quality Standards or Adversely Affect Beneficial Uses in the Extended Study Area Project implementation could affect water quality in the extended study area, but effects would diminish with distance. This impact would be less than significant.

This impact would be similar to Impact WQ-16 (CP1). For the same reasons as described for Impact WQ-16 (CP1), this impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact WQ-17 (CP2): Long-Term Temperature Effects That Cause Violations of Water Quality Standards or Adversely Affect Beneficial Uses in the Extended Study Area This impact would be similar to Impact WQ-17 (CP1). For the same reasons as described for Impact WQ-17 (CP1), this impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact WQ-18 (CP2): Long-Term Metals Effects That Cause Violations of Water Quality Standards or Adversely Affect Beneficial Uses in the Extended Study Area This impact would be similar to Impact WQ-18 (CP1). For the same reasons as described for Impact WQ-18 (CP1), this impact would be potentially significant. Mitigation for this impact is proposed in Section 7.3.5.

Impact WQ-19a (CP2): Delta Salinity on the Sacramento River at Collinsville Impact WQ-19a (CP2) would be similar to Impact WQ-19a (CP1). As shown in Table 7-41, operations for CP2 result in both increases and decreases in salinity; however, none of the increases would be sufficient to change compliance for the Sacramento River at Collinsville. Similarly, on a percentage basis, all increases in salinity would be less than 1 percent; this would be within the range of natural variability. Table 7-42 shows the number of months simulated EC values exceeded the standards for the Sacramento River at Collinsville in the period of simulation. The operation of CP2 would not result in any violation of the salinity standards under both Existing and Future conditions. This impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact WQ-19b (CP2): Delta Salinity on the San Joaquin River at Jersey Point On an average monthly basis, for the basis of comparison, EC would meet the requirements in all months in an average year. Moreover, CP2 would not increase the EC at Jersey Point. This impact would be less than significant.

Impact WQ-19b (CP2) would be similar to Impact WQ-19b (CP1). As shown in Table 7-43, the basis of comparison would meet the requirement on an average basis in both average years and in dry and critical years. Furthermore, all changes during April through August would be less than 1 percent. Table 7-44 shows the number of months simulated EC values exceeded the standards for San Joaquin River at Jersey Point in the period of simulation. CP2 would result in a slight increase in the frequency of violations (2 percent) during August under the Existing Conditions and up to 6 percent during June under the Future Conditions. Overall, frequency of violation of salinity standards for the San Joaquin River at Jersey Point under CP2 would be similar to those under Existing and Future conditions. This impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Table 7-41. Simulated Monthly Average Salinity and Percent Change for the Sacramento River at Collinsville

Month	Existing Condition (2005)				Future Condition (2030)			
	Average All Years		Dry and Critical Years		Average All Years		Dry and Critical Years	
	Existing Condition (mmhos/cm)	CP2 Change (mmhos/cm (%))	Existing Condition (mmhos/cm)	CP2 Change (mmhos/cm (%))	No-Action Alternative (mmhos/cm)	CP2 Change (mmhos/cm (%))	No-Action Alternative (mmhos/cm)	CP2 Change (mmhos/cm (%))
Oct	7.1	0.0 (0.2%)	8.3	0.0 (0.5%)	7.4	0.0 (-0.3%)	8.4	0.0 (-0.4%)
Nov	6.4	0.0 (0.0%)	8.0	0.0 (-0.4%)	6.6	0.0 (-0.2%)	8.1	-0.1 (-0.8%)
Dec	4.4	0.0 (-1.1%)	6.5	-0.1 (-1.6%)	4.5	0.0 (-0.8%)	6.6	-0.1 (-1.7%)
Jan	2.6	0.0 (-0.4%)	4.8	0.0 (-0.3%)	2.7	0.0 (-0.9%)	4.9	-0.1 (-1.7%)
Feb	1.0	0.1 (5.3%)	2.2	0.1 (6.9%)	1.1	0.0 (-2.4%)	2.3	-0.1 (-3.1%)
Mar	0.7	0.0 (2.0%)	1.4	0.0 (2.8%)	0.7	0.0 (-0.5%)	1.4	0.0 (-0.5%)
Apr	0.9	0.0 (0.5%)	1.9	0.0 (0.7%)	1.0	0.0 (-0.3%)	1.9	0.0 (-0.4%)
May	1.5	0.0 (-0.4%)	3.0	0.0 (-0.5%)	1.4	0.0 (-0.4%)	2.9	0.0 (-0.8%)
Jun	2.5	0.0 (-0.1%)	4.5	0.0 (-0.1%)	2.4	0.0 (0.0%)	4.4	-0.1 (-1.4%)
Jul	3.4	0.0 (-0.5%)	5.5	0.0 (-0.4%)	3.2	0.0 (-0.7%)	5.4	-0.1 (-1.2%)
Aug	5.3	-0.1 (-1.0%)	6.7	-0.1 (-1.6%)	5.0	0.0 (-0.4%)	6.6	0.0 (-0.7%)
Sep	6.6	0.0 (-0.3%)	8.4	-0.1 (-1.0%)	6.5	0.0 (-0.6%)	8.1	-0.1 (-1.2%)

Source: Common Assumptions Common Modeling Package, version 8D, DSM2 Existing and Future simulations (Node RSAC081)

Note:
Simulation period: 1922-1994. Change as measured from either Existing Condition or No-Action Alternative. Dry and critical years as defined by the Sacramento Valley Index.

Key:
CP = Comprehensive Plan
mmhos/cm = millimhos per centimeter

Table 7-42. Simulated Number of Months of Exceedence of the Salinity Standard for the Sacramento River at Collinsville

Month	Existing Condition (2005)				Future Condition (2030)			
	Total All Years		Dry and Critical Years		Total All Years		Dry and Critical Years	
	Existing Condition (Number of Months)	CP2 Change (Number of Months (%))	Existing Condition (Number of Months)	CP2 Change (Number of Months (%))	No-Action Alternative (Number of Months)	CP2 Change (Number of Months (%))	No-Action Alternative (Number of Months)	CP2 Change (Number of Months (%))
Oct	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Nov	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Dec	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Jan	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Feb	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Mar	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Apr	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
May	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Jun	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Jul	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Aug	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Sep	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)

Source: Common Assumptions Common Modeling Package, version 8D, DSM2 Existing and Future simulations (Node RSAC081)

Table 7-43. Simulated Monthly Average Salinity and Percent Change for the San Joaquin River at Jersey Point

Month	Existing Condition (2005)				Future Condition (2030)			
	Average All Years		Dry and Critical Years		Average All Years		Dry and Critical Years	
	Existing Condition (mmhos/cm)	CP2 Change (mmhos/cm (%))	Existing Condition (mmhos/cm)	CP2 Change (mmhos/cm (%))	No-Action Alternative (mmhos/cm)	CP2 Change (mmhos/cm (%))	No-Action Alternative (mmhos/cm)	CP2 Change (mmhos/cm (%))
Oct	2.1	0.0 (0.4%)	2.3	0.0 (0.8%)	2.1	0.0 (0.5%)	2.3	0.0 (0.5%)
Nov	1.9	0.0 (1.2%)	2.3	0.0 (1.6%)	2.0	0.0 (0.5%)	2.3	0.0 (0.2%)
Dec	1.5	0.0 (-0.4%)	2.1	0.0 (-1.1%)	1.6	0.0 (-0.2%)	2.1	0.0 (-0.9%)
Jan	1.0	0.0 (0.0%)	1.6	0.0 (0.4%)	1.1	0.0 (-1.0%)	1.7	0.0 (-1.8%)
Feb	0.5	0.0 (4.7%)	0.9	0.1 (7.2%)	0.5	0.0 (0.1%)	0.9	0.0 (-0.1%)
Mar	0.3	0.0 (2.6%)	0.4	0.0 (4.9%)	0.3	0.0 (-0.6%)	0.4	0.0 (-1.3%)
Apr	0.3	0.0 (0.5%)	0.3	0.0 (1.1%)	0.3	0.0 (0.0%)	0.4	0.0 (-0.2%)
May	0.3	0.0 (-0.2%)	0.5	0.0 (-0.2%)	0.3	0.0 (-0.6%)	0.5	0.0 (-1.4%)
Jun	0.5	0.0 (0.9%)	0.9	0.0 (1.3%)	0.5	0.0 (-0.8%)	0.9	0.0 (-2.2%)
Jul	0.7	0.0 (2.8%)	1.3	0.0 (3.5%)	0.7	0.0 (0.9%)	1.3	0.0 (1.0%)
Aug	1.2	0.0 (1.4%)	1.6	0.0 (1.4%)	1.2	0.0 (0.1%)	1.7	0.0 (0.3%)
Sep	1.9	0.0 (0.3%)	2.3	0.0 (-0.3%)	2.0	0.0 (0.2%)	2.4	0.0 (0.1%)

Source: Common Assumptions Common Modeling Package, version 8D, DSM2 Existing and Future simulations (Node RSAN018)

Note:
Simulation period: 1922-1994. Change as measured from either Existing Condition or No-Action Alternative. Dry and critical years as defined by the Sacramento Valley Index.

Key:
CP = Comprehensive Plan
mmhos/cm = millimhos per centimeter

Table 7-44. Simulated Number of Months of Exceedence of the Salinity Standard for the San Joaquin River at Jersey Point

Month	Existing Condition (2005)				Future Condition (2030)			
	Total All Years		Dry and Critical Years		Total All Years		Dry and Critical Years	
	Existing Condition (Number of Months)	CP2 Change (Number of Months (%))	Existing Condition (Number of Months)	CP2 Change (Number of Months (%))	No-Action Alternative (Number of Months)	CP2 Change (Number of Months (%))	No-Action Alternative (Number of Months)	CP2 Change (Number of Months (%))
Oct	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Nov	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Dec	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Jan	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Feb	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Mar	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Apr	0	0.0 (0.0%)	0	0.0 (0.0%)	1	0.0 (0.0%)	1	0.0 (0.0%)
May	0	0.0 (0.0%)	0	0.0 (0.0%)	1	-1.0 (-100.0%)	1	-1.0 (-100.0%)
Jun	17	0.0 (0.0%)	13	0.0 (0.0%)	17	1.0 (5.9%)	13	0.0 (0.0%)
Jul	1	0.0 (0.0%)	1	0.0 (0.0%)	0	1.0 (0.0%)	0	1.0 (0.0%)
Aug	56	1.0 (1.8%)	13	1.0 (7.7%)	58	0.0 (0.0%)	14	0.0 (0.0%)
Sep	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)

Source: Common Assumptions Common Modeling Package, version 8D, DSM2 Existing and Future simulations (Node RSAN018)

Note:
Simulation period: 1922-1994. Change as measured from either Existing Condition or No-Action Alternative. Dry and critical years as defined by the Sacramento Valley Index.

Key:
CP = Comprehensive Plan

Impact WQ-19c (CP2): Delta Salinity on the Sacramento River at Emmaton
On an average monthly basis, for the basis of comparison, EC would meet the requirements in all months on an average annual basis; moreover, CP2 would not increase the EC at Emmaton during this period by more than 0.2 percent. This impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact WQ-19c (CP2) would be similar to Impact WQ-19c (CP1). While Table 7-45 shows EC for all months, the Emmaton water quality requirement is only defined for April 1 through August 15. On an average monthly basis, for the basis of comparison, EC would meet requirements in all months on an average annual basis. Moreover, CP2 would not increase EC at Emmaton during this period by more than 0.2 percent. Table 7-46 shows the number of months simulated EC values exceeded the standards for the Sacramento River at Emmaton in the period of simulation. Operations of CP2 would not result in any violation of salinity standards between October and March. Between April and September, CP2 would result in a decrease in the frequency of violations when

compared to the baseline values under the Existing and Future conditions, except in June and August when there would be a slight increase, under the Future Conditions. Overall, the compliance of salinity standards for the Sacramento River at Emmaton would be very similar to the baseline levels under both Existing and Future conditions.

Table 7-45. Simulated Monthly Average Salinity and Percent Change for the Sacramento River at Emmaton

Month	Existing Condition (2005)				Future Condition (2030)			
	Average All Years		Dry and Critical Years		Average All Years		Dry and Critical Years	
	Existing Condition (mmhos/cm)	CP2 Change (mmhos/cm (%))	Existing Condition (mmhos/cm)	CP2 Change (mmhos/cm (%))	No-Action Alternative (mmhos/cm)	CP2 Change (mmhos/cm (%))	No-Action Alternative (mmhos/cm)	CP2 Change (mmhos/cm (%))
Oct	2.2	0.0 (0.4%)	2.7	0.0 (0.7%)	2.4	0.0 (-0.8%)	2.8	0.0 (-1.1%)
Nov	1.9	0.0 (-0.9%)	2.5	0.0 (-1.5%)	1.9	0.0 (-0.9%)	2.5	0.0 (-1.7%)
Dec	1.2	0.0 (-1.8%)	1.7	0.0 (-2.5%)	1.2	0.0 (-1.5%)	1.8	0.0 (-2.8%)
Jan	0.7	0.0 (-0.8%)	1.2	0.0 (-0.8%)	0.7	0.0 (-1.1%)	1.2	0.0 (-2.0%)
Feb	0.3	0.0 (4.1%)	0.5	0.0 (6.7%)	0.3	0.0 (-4.1%)	0.6	0.0 (-6.8%)
Mar	0.2	0.0 (1.3%)	0.3	0.0 (2.5%)	0.3	0.0 (-1.0%)	0.3	0.0 (-1.8%)
Apr	0.3	0.0 (0.2%)	0.4	0.0 (0.4%)	0.3	0.0 (-0.4%)	0.4	0.0 (-0.8%)
May	0.4	0.0 (-0.5%)	0.7	0.0 (-0.6%)	0.4	0.0 (-0.5%)	0.7	0.0 (-0.8%)
Jun	0.6	0.0 (-0.1%)	1.2	0.0 (0.1%)	0.6	0.0 (-0.5%)	1.1	0.0 (-1.7%)
Jul	0.8	0.0 (-1.3%)	1.5	0.0 (-1.4%)	0.8	0.0 (-1.5%)	1.4	0.0 (-2.0%)
Aug	1.4	0.0 (-2.1%)	2.0	-0.1 (-3.2%)	1.3	0.0 (-0.4%)	1.9	0.0 (-0.7%)
Sep	2.0	0.0 (-0.5%)	2.9	0.0 (-1.4%)	2.0	0.0 (-1.4%)	2.7	-0.1 (-2.4%)

Source: Common Assumptions Common Modeling Package, version 8D, DSM2 Existing and Future simulations (Node RSAC092)

Note:
Simulation period: 1922-1994. Change as measured from either Existing Condition or No-Action Alternative. Dry and critical years as defined by the Sacramento Valley Index.

Key:
CP = Comprehensive Plan
mmhos/cm = millimhos per centimeter

Table 7-46. Simulated Number of Months of Exceedence of the Salinity Standard for the Sacramento River at Emmaton

Month	Existing Condition (2005)				Future Condition (2030)			
	Total All Years		Dry and Critical Years		Total All Years		Dry and Critical Years	
	Existing Condition (Number of Months)	CP2 Change (Number of Months (%))	Existing Condition (Number of Months)	CP2 Change (Number of Months (%))	No-Action Alternative (Number of Months)	CP2 Change (Number of Months (%))	No-Action Alternative (Number of Months)	CP2 Change (Number of Months (%))
Oct	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Nov	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Dec	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Jan	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Feb	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Mar	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Apr	1	0.0 (0.0%)	1	0.0 (0.0%)	1	0.0 (0.0%)	1	0.0 (0.0%)
May	2	0.0 (0.0%)	1	0.0 (0.0%)	3	-1.0 (-33.3%)	2	0.0 (0.0%)
Jun	19	0.0 (0.0%)	13	0.0 (0.0%)	19	1.0 (5.3%)	14	0.0 (0.0%)
Jul	1	0.0 (0.0%)	0	0.0 (0.0%)	1	0.0 (0.0%)	0	0.0 (0.0%)
Aug	51	-6.0 (-11.8%)	9	-4.0 (-44.4%)	41	1.0 (2.4%)	7	0.0 (0.0%)
Sep	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)

Source: Common Assumptions Common Modeling Package, version 8D, DSM2 Existing and Future simulations (Node RSAC092)

Note:
Simulation period: 1922-1994. Change as measured from either Existing Condition or No-Action Alternative. Dry and critical years as defined by the Sacramento Valley Index.

Key:
CP = Comprehensive Plan

Impact WQ-19d (CP2): Delta Salinity on the Old River at Rock Slough On an average annual basis, all months except October through January under both the Existing Condition and Future Condition would be less than 150 mg/L. In dry and critical years, only October and November would exceed the standard under the Existing Condition, and October through February would exceed the standard in the Future Condition. In average annual years, CP2 would not increase chlorides by more than 1.2 percent, and even in that instance, the standard would be met. For dry and critical years, larger increases in chlorides would occur in November and December under the Existing Condition. However, the change in chloride concentration would not affect compliance with the standard; it would already be exceeded under the basis of comparison. This impact would be less than significant.

Impact WQ-19d (CP2) would be similar to Impact WQ-19d (CP1). The standard for chlorides at the Contra Costa Canal is defined by the number of days with less than 150 mg/L chloride. The analysis of modeling output is limited to monthly average chlorides. However, on an average annual basis, all months except October through January under both the Existing Condition and

Future Condition would be less than 150 mg/L. As shown in Table 7-47, in dry and critical years, October through February exceed the standard in both the Existing Condition and Future Condition. In average annual years, CP2 would not increase chlorides by more than 1.2 percent, and even in the month of the largest increase (August under the Existing Condition), the standard would be met. For dry and critical years, larger increases in chlorides occur in November and December under the Existing Condition. However, the change in chloride concentration would not affect compliance with the requirement; it would already be exceeded under the basis of comparison. Table 7-48 shows the number of days simulated chloride values exceeded the standards of 250 mg/L for the Old River at Rock Slough in the period of simulation. On an annual average basis, CP2 would result in fewer violations compared to the Existing Conditions. Dry and Critical years would see a slight increase (2 percent) in violations of chloride standards for CP2 under the Existing Conditions. Overall, CP2 would not alter the compliance level observed under the Existing and Future conditions.

This impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Table 7-47. Simulated Monthly Average Chlorides and Percent Change for the Old River at Rock Slough

Month	Existing Condition (2005)				Future Condition (2030)			
	Average All Years		Dry and Critical Years		Average All Years		Dry and Critical Years	
	Existing Condition (mg/L)	CP2 Change (mg/L (%))	Existing Condition (mg/L)	CP2 Change (mg/L (%))	No-Action Alternative (mg/L)	CP2 Change (mg/L (%))	No-Action Alternative (mg/L)	CP2 Change (mg/L (%))
Oct	175.4	0.6 (0.3%)	195.6	1.9 (1.0%)	178.6	0.1 (0.1%)	197.4	0.3 (0.2%)
Nov	167.5	1.1 (0.7%)	195.8	1.3 (0.7%)	167.1	0.7 (0.4%)	191.3	-0.4 (-0.2%)
Dec	168.0	0.9 (0.5%)	204.2	2.0 (1.0%)	175.9	0.4 (0.2%)	206.4	-0.7 (-0.3%)
Jan	156.2	-0.8 (-0.5%)	195.0	-2.1 (-1.1%)	170.2	-0.9 (-0.5%)	205.6	-2.6 (-1.3%)
Feb	124.9	1.5 (1.2%)	157.9	4.4 (2.8%)	140.9	-0.9 (-0.6%)	176.1	-2.5 (-1.4%)
Mar	80.4	0.8 (0.9%)	85.8	2.0 (2.3%)	83.1	-1.2 (-1.4%)	91.3	-3.7 (-4.1%)
Apr	76.9	0.3 (0.4%)	78.0	0.6 (0.8%)	73.5	-0.3 (-0.4%)	74.6	-1.1 (-1.4%)
May	68.8	-0.2 (-0.2%)	73.9	0.0 (0.0%)	62.9	-0.1 (-0.1%)	71.4	-0.4 (-0.6%)
Jun	61.0	0.0 (0.0%)	82.3	-0.1 (-0.1%)	60.7	-0.3 (-0.5%)	81.5	-1.1 (-1.3%)
Jul	70.1	0.7 (1.0%)	102.0	2.1 (2.1%)	68.7	-0.1 (-0.2%)	101.6	-0.3 (-0.3%)
Aug	88.5	1.3 (1.5%)	133.6	2.7 (2.1%)	90.7	0.3 (0.4%)	133.2	1.3 (1.0%)
Sep	134.6	0.5 (0.4%)	172.7	-0.7 (-0.4%)	145.7	0.3 (0.2%)	178.1	0.0 (0.0%)

*Source: Common Assumptions Common Modeling Package, version 8D, DSM2 Existing and Future simulations (Node CHCCC006) converted to chlorides using the equation EC*0.268-24*

Note:
Simulation period: 1922-1994. Change as measured from either Existing Condition or No-Action Alternative. Dry and critical years as defined by the Sacramento Valley Index.

Key:
CP = Comprehensive Plan
EC = electrical conductivity
mg/L = milligrams per liter

Table 7-48. Simulated Number of Days by Month of Exceedence of the Chloride Standard for the Old River at Rock Slough

Month	Existing Condition (2005)				Future Condition (2030)			
	Total All Years		Dry and Critical Years		Total All Years		Dry and Critical Years	
	Existing Condition (Number of Days)	CP2 Change (Number of Days (%))	Existing Condition (Number of Days)	CP2 Change (Number of Days (%))	No-Action Alternative (Number of Days)	CP2 Change (Number of Days (%))	No-Action Alternative (Number of Days)	CP2 Change (Number of Days (%))
Oct	119	-9.0 (-7.6%)	57	11.0 (19.3%)	149	8.0 (5.4%)	61	7.0 (11.5%)
Nov	176	-28.0 (-15.9%)	107	-17.0 (-15.9%)	152	12.0 (7.9%)	84	3.0 (3.6%)
Dec	332	15.0 (4.5%)	173	18.0 (10.4%)	309	11.0 (3.6%)	151	0.0 (0.0%)
Jan	295	-27.0 (-9.2%)	185	-26.0 (-14.1%)	320	-13.0 (-4.1%)	204	-3.0 (-1.5%)
Feb	102	26.0 (25.5%)	90	26.0 (28.9%)	193	1.0 (0.5%)	148	0.0 (0.0%)
Mar	0	0.0 (0.0%)	0	0.0 (0.0%)	4	0.0 (0.0%)	0	0.0 (0.0%)
Apr	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
May	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Jun	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Jul	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Aug	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Sep	0	2.0 (0.0%)	0	2.0 (0.0%)	12	-8.0 (-66.7%)	12	-8.0 (-66.7%)

Source: Common Assumptions Common Modeling Package, version 8D, DSM2 Existing and Future simulations (Node CHCCC006)

Note:
Simulation period: 1922-1994. Change as measured from either Existing Condition or No-Action Alternative. Dry and critical years as defined by the Sacramento Valley Index.

Key:
CP = Comprehensive Plan

Impact WQ-19e (CP2): Delta Water Quality on the Delta-Mendota Canal at Jones Pumping Plant The water quality requirement on the Delta-Mendota Canal at Jones Pumping Plant has two components, a chloride requirement and an EC requirement. CP2 would not measurably change EC, and the increases in chloride concentration would be less than 1.0 percent. This impact would be less than significant.

Impact WQ-19e (CP2) would be similar to Impact WQ-19e (CP1). Table 7-49 shows simulated chloride concentrations and Table 7-50 shows EC for the Delta-Mendota Canal at Jones Pumping Plant.

The 250 mg/L chloride concentration would not be exceeded on an average annual or dry or critical year basis. Furthermore, chloride concentrations would typically be lower under CP2 than under the basis of comparisons.

Table 7-49. Simulated Monthly Average Chlorides and Percent Change for the Delta-Mendota Canal at the Jones Pumping Plant

Month	Existing Condition (2005)				Future Condition (2030)			
	Average All Years		Dry and Critical Years		Average All Years		Dry and Critical Years	
	Existing Condition (mg/L)	CP2 Change (mg/L (%))	Existing Condition (mg/L)	CP2 Change (mg/L (%))	No-Action Alternative (mg/L)	CP2 Change (mg/L (%))	No-Action Alternative (mg/L)	CP2 Change (mg/L (%))
Oct	113.2	0.3 (0.3%)	124.3	1.3 (1.0%)	112.6	0.1 (0.1%)	123.4	0.3 (0.3%)
Nov	111.5	0.7 (0.6%)	128.1	1.0 (0.8%)	109.8	0.3 (0.3%)	124.8	-0.3 (-0.2%)
Dec	129.3	0.4 (0.3%)	149.6	0.9 (0.6%)	126.3	0.2 (0.1%)	144.3	-0.4 (-0.2%)
Jan	128.2	-0.6 (-0.4%)	156.9	-1.2 (-0.8%)	125.9	0.0 (0.0%)	153.7	-0.3 (-0.2%)
Feb	120.1	-0.3 (-0.2%)	164.3	-0.3 (-0.2%)	117.2	-1.4 (-1.2%)	161.7	-3.5 (-2.1%)
Mar	105.3	0.1 (0.1%)	147.1	0.5 (0.3%)	102.0	-0.2 (-0.2%)	141.9	-0.7 (-0.5%)
Apr	70.5	-0.1 (-0.2%)	97.1	-0.3 (-0.3%)	59.2	-0.6 (-1.1%)	82.1	-1.6 (-2.0%)
May	63.3	0.0 (0.0%)	84.3	-0.1 (-0.2%)	53.3	-0.2 (-0.4%)	75.0	-0.5 (-0.7%)
Jun	61.2	-0.3 (-0.4%)	72.8	-0.7 (-1.0%)	60.9	-0.2 (-0.4%)	77.7	-0.5 (-0.6%)
Jul	61.9	-0.5 (-0.7%)	75.1	0.0 (0.0%)	59.4	-0.7 (-1.2%)	76.4	-1.2 (-1.5%)
Aug	65.4	0.4 (0.7%)	91.8	0.9 (0.9%)	64.5	0.0 (0.0%)	91.6	0.3 (0.4%)
Sep	89.4	0.3 (0.4%)	113.7	-0.3 (-0.3%)	90.9	0.2 (0.2%)	111.4	0.1 (0.1%)

*Source: Common Assumptions Common Modeling Package, version 8D, DSM2 Existing and Future simulations (Node CHCDMC006) converted to chlorides using the equation EC*0.273-43.9)*

Note:
Simulation period: 1922-1994. Change as measured from either Existing Condition or No-Action Alternative. Dry and critical years as defined by the Sacramento Valley Index.

Key:
CP = Comprehensive Plan
EC = electrical conductivity
mg/L = milligrams per liter

Similar to the chloride concentrations, the average annual and dry and critical year averages under the basis of comparison would be under the requirement in all months. CP2 would not measurably change EC, and the increases in chloride concentration would be less than 1.0 percent.

Table 7-49 shows the number of days simulated chloride values exceeded the standards of 250 mg/L for the Delta-Mendota Canal at the Jones Pumping Plant in the period of simulation. As seen in Table 7-49, there would be no additional violations throughout the year except during February. Even in February, chloride values under CP2 would be similar to the baseline values under both Existing and Future conditions.

Table 7-50. Simulated Monthly Average Salinity and Percent Change for the Delta-Mendota Canal at the Jones Pumping Plant

Month	Existing Condition (2005)				Future Condition (2030)			
	Average All Years		Dry and Critical Years		Average All Years		Dry and Critical Years	
	Existing Condition (mmhos/cm)	CP2 Change (mmhos/cm (%))	Existing Condition (mmhos/cm)	CP2 Change (mmhos/cm (%))	No-Action Alternative (mmhos/cm)	CP2 Change (mmhos/cm (%))	No-Action Alternative (mmhos/cm)	CP2 Change (mmhos/cm (%))
Oct	0.6	0.0 (0.2%)	0.6	0.0 (0.7%)	0.6	0.0 (0.1%)	0.6	0.0 (0.2%)
Nov	0.6	0.0 (0.5%)	0.6	0.0 (0.6%)	0.6	0.0 (0.2%)	0.6	0.0 (-0.2%)
Dec	0.6	0.0 (0.2%)	0.7	0.0 (0.5%)	0.6	0.0 (0.1%)	0.7	0.0 (-0.2%)
Jan	0.6	0.0 (-0.3%)	0.7	0.0 (-0.6%)	0.6	0.0 (0.0%)	0.7	0.0 (-0.2%)
Feb	0.6	0.0 (-0.2%)	0.8	0.0 (-0.1%)	0.6	0.0 (-0.8%)	0.8	0.0 (-1.7%)
Mar	0.5	0.0 (0.1%)	0.7	0.0 (0.3%)	0.5	0.0 (-0.2%)	0.7	0.0 (-0.4%)
Apr	0.4	0.0 (-0.1%)	0.5	0.0 (-0.2%)	0.4	0.0 (-0.6%)	0.5	0.0 (-1.3%)
May	0.4	0.0 (0.0%)	0.5	0.0 (-0.1%)	0.4	0.0 (-0.2%)	0.4	0.0 (-0.4%)
Jun	0.4	0.0 (-0.2%)	0.4	0.0 (-0.6%)	0.4	0.0 (-0.2%)	0.4	0.0 (-0.4%)
Jul	0.4	0.0 (-0.4%)	0.4	0.0 (0.0%)	0.4	0.0 (-0.7%)	0.4	0.0 (-1.0%)
Aug	0.4	0.0 (0.4%)	0.5	0.0 (0.6%)	0.4	0.0 (0.0%)	0.5	0.0 (0.2%)
Sep	0.5	0.0 (0.2%)	0.6	0.0 (-0.2%)	0.5	0.0 (0.1%)	0.6	0.0 (0.1%)

Source: Common Assumptions Common Modeling Package, version 8D, DSM2 Existing and Future simulations (Node CHCDMC006)

Note:
Simulation period: 1922-1994. Change as measured from either Existing Condition or No-Action Alternative. Dry and critical years as defined by the Sacramento Valley Index.

Key:
CP = Comprehensive Plan
mmhos/cm = millimhos per centimeter

Table 7-51 shows the number of months simulated EC values exceeded the standards for the Delta-Mendota Canal at the Jones Pumping Plant in the period of simulation. CP2 would not result in any additional violations of the salinity standards except during February. Even in February, CP2 would not change the baseline compliance levels under both Existing and Future conditions. This impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Table 7-51. Simulated Number of Months of Exceedence of the Salinity Standard for the Delta-Mendota Canal at the Jones Pumping Plant

Month	Existing Condition (2005)				Future Condition (2030)			
	Total All Years		Dry and Critical Years		Total All Years		Dry and Critical Years	
	Existing Condition (Number of Months)	CP2 Change (Number of Months (%))	Existing Condition (Number of Months)	CP2 Change (Number of Months (%))	No-Action Alternative (Number of Months)	CP2 Change (Number of Months (%))	No-Action Alternative (Number of Months)	CP2 Change (Number of Months (%))
Oct	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Nov	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Dec	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Jan	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Feb	2	0.0 (0.0%)	2	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Mar	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Apr	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
May	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Jun	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Jul	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Aug	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Sep	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)

Source: Common Assumptions Common Modeling Package, version 8D, DSM2 Existing and Future simulations (Node CHCDMC006)

Note:
Simulation period: 1922-1994. Change as measured from either Existing Condition or No-Action Alternative. Dry and critical years as defined by the Sacramento Valley Index.

Key:
CP = Comprehensive Plan

Impact WQ-19f (CP2): Delta Water Quality in the West Canal at the Mouth of the Clifton Court Forebay The 250-mg/L chloride concentration at the West Canal would not be exceeded on an average annual or dry and critical year basis. Furthermore, chloride concentrations would typically be lower under CP2 than under the basis of comparisons. CP2 would not measurably change EC, and the increases in chloride concentration would be less than 1.0 percent. This impact would be less than significant.

Impact WQ-19f (CP2) would be similar to Impact WQ-19f (CP1). Table 7-52 shows simulated chloride concentrations and Table 7-53 shows EC for the West Canal at the mouth of the Clifton Court Forebay.

The 250 mg/L chloride concentration would not be exceeded on an average annual or dry or critical year basis. Furthermore, chloride concentrations would typically be lower under CP2 than under the basis of comparisons.

Similar to the chloride concentrations, the average annual and dry and critical year averages under the basis of comparison would be under the requirement in

all months. CP2 would not measurably change EC, and the increases in chloride concentration would be less than 1.0 percent.

Table 7-52. Simulated Monthly Average Chlorides and Percent Change for West Canal at the Clifton Court Forebay

Month	Existing Condition (2005)				Future Condition (2030)			
	Average All Years		Dry and Critical Years		Average All Years		Dry and Critical Years	
	Existing Condition (mg/L)	CP2 Change (mg/L (%))	Existing Condition (mg/L)	CP2 Change (mg/L (%))	No-Action Alternative (mg/L)	CP2 Change (mg/L (%))	No-Action Alternative (mg/L)	CP2 Change (mg/L (%))
Oct	111.2	0.4 (0.4%)	123.4	1.4 (1.2%)	113.5	0.0 (0.0%)	125.3	0.2 (0.2%)
Nov	108.3	0.9 (0.8%)	126.8	1.2 (0.9%)	109.7	0.3 (0.3%)	125.7	-0.4 (-0.3%)
Dec	121.2	0.4 (0.3%)	144.9	1.0 (0.7%)	116.3	0.2 (0.2%)	138.9	-0.6 (-0.4%)
Jan	116.4	-0.7 (-0.6%)	148.2	-1.6 (-1.1%)	111.8	-0.1 (-0.1%)	144.4	-0.8 (-0.6%)
Feb	107.2	-0.4 (-0.4%)	150.5	-0.3 (-0.2%)	99.7	-1.8 (-1.8%)	143.7	-4.6 (-3.2%)
Mar	92.2	-0.4 (-0.4%)	129.8	-0.7 (-0.5%)	80.5	-0.1 (-0.1%)	115.7	-0.3 (-0.3%)
Apr	63.0	-0.1 (-0.2%)	87.6	-0.3 (-0.4%)	55.0	-0.6 (-1.1%)	76.1	-1.6 (-2.1%)
May	57.5	0.0 (0.0%)	78.2	-0.2 (-0.2%)	50.7	-0.2 (-0.4%)	72.3	-0.5 (-0.7%)
Jun	52.9	-0.2 (-0.5%)	66.9	-0.8 (-1.2%)	53.7	-0.3 (-0.6%)	71.5	-0.7 (-1.0%)
Jul	53.3	-0.5 (-0.9%)	70.4	0.3 (0.4%)	51.2	-0.7 (-1.5%)	69.8	-0.9 (-1.4%)
Aug	57.2	0.4 (0.7%)	86.1	0.9 (1.1%)	58.8	0.1 (0.1%)	87.6	0.6 (0.7%)
Sep	84.5	0.4 (0.5%)	110.4	-0.3 (-0.3%)	89.6	0.2 (0.3%)	111.5	0.2 (0.2%)

*Source: Common Assumptions Common Modeling Package, version 8D, DSM2 Existing and Future simulations (Node CHSWP003) converted to chlorides using the equation EC*0.273-43.9)*

Note:
Simulation period: 1922-1994. Change as measured from either Existing Condition or No-Action Alternative. Dry and critical years as defined by the Sacramento Valley Index.

Key:
CP = Comprehensive Plan
EC = electrical conductivity
mg/L = milligrams per liter

Table 7-53. Simulated Monthly Average Salinity and Percent Change for West Canal at the Clifton Court Forebay

Month	Existing Condition (2005)				Future Condition (2030)			
	Average All Years		Dry and Critical Years		Average All Years		Dry and Critical Years	
	Existing Condition (mmhos/cm)	CP2 Change (mmhos/cm (%))	Existing Condition (mmhos/cm)	CP2 Change (mmhos/cm (%))	No-Action Alternative (mmhos/cm)	CP2 Change (mmhos/cm (%))	No-Action Alternative (mmhos/cm)	CP2 Change (mmhos/cm (%))
Oct	0.6	0.0 (0.3%)	0.6	0.0 (0.9%)	0.6	0.0 (0.0%)	0.6	0.0 (0.1%)
Nov	0.6	0.0 (0.6%)	0.6	0.0 (0.7%)	0.6	0.0 (0.2%)	0.6	0.0 (-0.2%)
Dec	0.6	0.0 (0.2%)	0.7	0.0 (0.5%)	0.6	0.0 (0.1%)	0.7	0.0 (-0.3%)
Jan	0.6	0.0 (-0.4%)	0.7	0.0 (-0.8%)	0.6	0.0 (-0.1%)	0.7	0.0 (-0.4%)
Feb	0.6	0.0 (-0.3%)	0.7	0.0 (-0.2%)	0.5	0.0 (-1.3%)	0.7	0.0 (-2.4%)
Mar	0.5	0.0 (-0.3%)	0.6	0.0 (-0.4%)	0.5	0.0 (-0.1%)	0.6	0.0 (-0.2%)
Apr	0.4	0.0 (-0.1%)	0.5	0.0 (-0.3%)	0.4	0.0 (-0.6%)	0.4	0.0 (-1.4%)
May	0.4	0.0 (0.0%)	0.4	0.0 (-0.2%)	0.3	0.0 (-0.2%)	0.4	0.0 (-0.4%)
Jun	0.4	0.0 (-0.3%)	0.4	0.0 (-0.7%)	0.4	0.0 (-0.3%)	0.4	0.0 (-0.6%)
Jul	0.4	0.0 (-0.5%)	0.4	0.0 (0.2%)	0.3	0.0 (-0.8%)	0.4	0.0 (-0.8%)
Aug	0.4	0.0 (0.4%)	0.5	0.0 (0.7%)	0.4	0.0 (0.1%)	0.5	0.0 (0.5%)
Sep	0.5	0.0 (0.3%)	0.6	0.0 (-0.2%)	0.5	0.0 (0.2%)	0.6	0.0 (0.1%)

Source: Common Assumptions Common Modeling Package, version 8D, DSM2 Existing and Future simulations (Node CHSWP003)

Note:
Simulation period: 1922-1994. Change as measured from either Existing Condition or No-Action Alternative. Dry and critical years as defined by the Sacramento Valley Index.

Key:
CP = Comprehensive Plan
mmhos/cm = millimhos per centimeter

Table 7-54 shows the number of days simulated chloride values exceeded the standards of 250 mg/L for the West Canal at the Clifton Court Forebay in the period of simulation. As seen in Table 7-54, there would be no additional violations throughout the year except during February. Even in February, CP2 would not change the baseline compliance levels under both Existing and Future conditions.

Table 7-55 shows the number of months simulated EC values exceeded the standards for West Canal at the Clifton Court Forebay in the period of simulation. CP2 would not result in any additional violations of the salinity standards except during February. Even in February, CP2 would not change the baseline compliance levels under both Existing and Future conditions.

This impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Table 7-54. Simulated Number of Days by Month of Exceedence of the Chloride Standard for the West Canal at the Clifton Court Forebay

Month	Existing Condition (2005)				Future Condition (2030)			
	Total All Years		Dry and Critical Years		Total All Years		Dry and Critical Years	
	Existing Condition (Number of Months)	CP2 Change (Number of Months (%))	Existing Condition (Number of Months)	CP2 Change (Number of Months (%))	No-Action Alternative (Number of Months)	CP2 Change (Number of Months (%))	No-Action Alternative (Number of Months)	CP2 Change (Number of Months (%))
Oct	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Nov	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Dec	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Jan	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Feb	22	-5.0 (-22.7%)	22	-5.0 (-22.7%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Mar	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Apr	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
May	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Jun	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Jul	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Aug	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Sep	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)

Source: Common Assumptions Common Modeling Package, version 8D, DSM2 Existing and Future simulations (Node CHSWP003)

Note:
Simulation period: 1922-1994. Change as measured from either Existing Condition or No-Action Alternative. Dry and critical years as defined by the Sacramento Valley Index.

Key:
CP = Comprehensive Plan

Table 7-55. Simulated Number of Months of Exceedence of the Salinity Standard for the West Canal at the Clifton Court Forebay

Month	Existing Condition (2005)				Future Condition (2030)			
	Total All Years		Dry and Critical Years		Total All Years		Dry and Critical Years	
	Existing Condition (Number of Months)	CP2 Change (Number of Months (%))	Existing Condition (Number of Months)	CP2 Change (Number of Months (%))	No-Action Alternative (Number of Months)	CP2 Change (Number of Months (%))	No-Action Alternative (Number of Months)	CP2 Change (Number of Months (%))
Oct	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Nov	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Dec	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Jan	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Feb	2	0.0 (0.0%)	2	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Mar	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Apr	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
May	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Jun	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Jul	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Aug	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Sep	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)

Source: Common Assumptions Common Modeling Package, version 8D, DSM2 Existing and Future simulations (Node CHSWP003)

Note:
Simulation period: 1922-1994. Change as measured from either Existing Condition or No-Action Alternative. Dry and critical years as defined by the Sacramento Valley Index.

Key:
CP = Comprehensive Plan

Impact WQ-19g (CP2): Delta Salinity on the San Joaquin River at Vernalis On an average monthly basis, for the basis of comparison, EC would meet requirements in all months, in both average years and in dry and critical years. Moreover, CP2 would not measurably change the EC on the San Joaquin River at Vernalis. This impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact WQ-19g (CP2) would be similar to Impact WQ-19g (CP1). On an average monthly basis, for the basis of comparison, EC would meet the requirements in all months in both average years and in dry and critical years. Moreover, CP2 would not measurably change EC on the San Joaquin River at Vernalis, as shown in Table 7-56. Table 7-57 shows the number of months simulated EC values exceeded the standards for San Joaquin River at Vernalis in the period of simulation. As seen in Table 7-57, CP2 would not change the baseline compliance levels under both Existing and Future conditions.

Table 7-56. Simulated Monthly Average Salinity and Percent Change for the San Joaquin River at Vernalis

Month	Existing Condition (2005)				Future Condition (2030)			
	Average All Years		Dry and Critical Years		Average All Years		Dry and Critical Years	
	Existing Condition (mmhos/cm)	CP2 Change (mmhos/cm (%))	Existing Condition (mmhos/cm)	CP2 Change (mmhos/cm (%))	No-Action Alternative (mmhos/cm)	CP2 Change (mmhos/cm (%))	No-Action Alternative (mmhos/cm)	CP2 Change (mmhos/cm (%))
Oct	0.6	0.0 (0.0%)	0.6	0.0 (0.0%)	0.5	0.0 (0.0%)	0.6	0.0 (0.0%)
Nov	0.6	0.0 (0.0%)	0.6	0.0 (0.0%)	0.6	0.0 (0.0%)	0.6	0.0 (0.0%)
Dec	0.8	0.0 (0.0%)	0.8	0.0 (0.0%)	0.7	0.0 (0.0%)	0.8	0.0 (0.0%)
Jan	0.7	0.0 (0.0%)	0.9	0.0 (0.0%)	0.7	0.0 (0.0%)	0.8	0.0 (0.0%)
Feb	0.7	0.0 (0.0%)	1.0	0.0 (0.0%)	0.7	0.0 (0.0%)	0.9	0.0 (0.0%)
Mar	0.7	0.0 (0.0%)	1.0	0.0 (0.0%)	0.7	0.0 (0.0%)	0.9	0.0 (0.0%)
Apr	0.4	0.0 (0.0%)	0.6	0.0 (0.0%)	0.4	0.0 (0.0%)	0.5	0.0 (0.0%)
May	0.5	0.0 (0.0%)	0.6	0.0 (0.0%)	0.4	0.0 (0.0%)	0.6	0.0 (0.0%)
Jun	0.6	0.0 (0.0%)	0.7	0.0 (0.0%)	0.5	0.0 (0.0%)	0.6	0.0 (0.0%)
Jul	0.6	0.0 (0.0%)	0.7	0.0 (0.0%)	0.6	0.0 (0.0%)	0.6	0.0 (0.0%)
Aug	0.6	0.0 (0.0%)	0.7	0.0 (0.0%)	0.5	0.0 (0.0%)	0.6	0.0 (0.0%)
Sep	0.5	0.0 (0.0%)	0.6	0.0 (0.0%)	0.5	0.0 (0.0%)	0.6	0.0 (0.0%)

Source: Common Assumptions Common Modeling Package, version 8D, DSM2 Existing and Future simulations (Node RSAN112)

Note:
Simulation period: 1922-1994. Change as measured from either Existing Condition or No-Action Alternative. Dry and critical years as defined by the Sacramento Valley Index.

Key:
CP = Comprehensive Plan
mmhos/cm = millimhos per centimeter

Table 7-57. Simulated Number of Months of Exceedence of the Salinity Standard for the San Joaquin River at Vernalis

Month	Existing Condition (2005)				Future Condition (2030)			
	Total All Years		Dry and Critical Years		Total All Years		Dry and Critical Years	
	Existing Condition (Number of Months)	CP2 Change (Number of Months (%))	Existing Condition (Number of Months)	CP2 Change (Number of Months (%))	No-Action Alternative (Number of Months)	CP2 Change (Number of Months (%))	No-Action Alternative (Number of Months)	CP2 Change (Number of Months (%))
Oct	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Nov	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Dec	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Jan	1	0.0 (0.0%)	1	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Feb	6	0.0 (0.0%)	5	0.0 (0.0%)	1	0.0 (0.0%)	1	0.0 (0.0%)
Mar	10	1.0 (10.0%)	10	1.0 (10.0%)	8	0.0 (0.0%)	8	0.0 (0.0%)
Apr	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
May	1	0.0 (0.0%)	1	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Jun	2	0.0 (0.0%)	2	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Jul	1	0.0 (0.0%)	1	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Aug	4	0.0 (0.0%)	4	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Sep	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)

Source: Common Assumptions Common Modeling Package, version 8D, DSM2 Existing and Future simulations (Node RSAN112)

Note:
Simulation period: 1922-1994. Change as measured from either Existing Condition or No-Action Alternative. Dry and critical years as defined by the Sacramento Valley Index.

Key:
CP = Comprehensive Plan

Impact WQ-19h (CP2): Delta Salinity on the San Joaquin River at Brandt Bridge Impact WQ-19h (CP2) would be the same as Impact WQ-19g (CP2). On an average monthly basis, for the basis of comparison, EC would meet requirements in all months, in both average years and in dry and critical years. Moreover, CP2 would not measurably change EC on the San Joaquin River at Brandt Bridge. This impact would be less than significant.

Impact WQ-19h (CP2) would be similar to Impact WQ-19h (CP1). On an average monthly basis, for the basis of comparison, EC would meet the requirements in all months in both average years and in dry and critical years. Moreover, CP2 would not measurably change EC on the San Joaquin River at Brandt Bridge, as shown in Table 7-58. Table 7-59 shows the number of months simulated EC values exceeded the standards for the San Joaquin River at Brandt Bridge in the period of simulation. CP2 would not change the existing compliance level for salinity standards for the San Joaquin River at Brandt Bridge.

This impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Table 7-58. Simulated Monthly Average Salinity and Percent Change for the San Joaquin River at Brandt Bridge

Month	Existing Condition (2005)				Future Condition (2030)			
	Average All Years		Dry and Critical Years		Average All Years		Dry and Critical Years	
	Existing Condition (mmhos/cm)	CP2 Change (mmhos/cm (%))	Existing Condition (mmhos/cm)	CP2 Change (mmhos/cm (%))	No-Action Alternative (mmhos/cm)	CP2 Change (mmhos/cm (%))	No-Action Alternative (mmhos/cm)	CP2 Change (mmhos/cm (%))
Oct	0.6	0.0 (0.0%)	0.6	0.0 (0.0%)	0.5	0.0 (0.0%)	0.6	0.0 (0.0%)
Nov	0.6	0.0 (0.0%)	0.6	0.0 (0.0%)	0.6	0.0 (0.0%)	0.6	0.0 (0.0%)
Dec	0.7	0.0 (0.0%)	0.8	0.0 (0.0%)	0.7	0.0 (0.0%)	0.8	0.0 (0.0%)
Jan	0.7	0.0 (0.0%)	0.9	0.0 (0.0%)	0.7	0.0 (0.0%)	0.8	0.0 (0.0%)
Feb	0.7	0.0 (0.0%)	1.0	0.0 (0.0%)	0.7	0.0 (0.0%)	0.9	0.0 (0.0%)
Mar	0.7	0.0 (0.0%)	1.0	0.0 (0.0%)	0.7	0.0 (0.0%)	0.9	0.0 (0.0%)
Apr	0.5	0.0 (0.0%)	0.6	0.0 (0.0%)	0.4	0.0 (0.0%)	0.6	0.0 (0.0%)
May	0.5	0.0 (0.0%)	0.6	0.0 (0.0%)	0.4	0.0 (0.0%)	0.6	0.0 (0.0%)
Jun	0.6	0.0 (0.0%)	0.7	0.0 (0.0%)	0.5	0.0 (0.0%)	0.7	0.0 (0.0%)
Jul	0.6	0.0 (0.0%)	0.7	0.0 (0.0%)	0.6	0.0 (0.0%)	0.7	0.0 (0.0%)
Aug	0.6	0.0 (0.0%)	0.7	0.0 (0.0%)	0.5	0.0 (0.0%)	0.6	0.0 (0.0%)
Sep	0.6	0.0 (0.0%)	0.6	0.0 (0.0%)	0.5	0.0 (0.0%)	0.6	0.0 (0.0%)

Source: Common Assumptions Common Modeling Package, version 8D, DSM2 Existing and Future simulations (Node RSAN112)

Note:
Simulation period: 1922-1994. Change as measured from either Existing Condition or No-Action Alternative. Dry and critical years as defined by the Sacramento Valley Index.

Key:
CP = Comprehensive Plan
mmhos/cm = millimhos per centimeter

Table 7-59. Simulated Number of Months of Exceedence of the Salinity Standard for the San Joaquin River at Brandt Bridge

Month	Existing Condition (2005)				Future Condition (2030)			
	Total All Years		Dry and Critical Years		Total All Years		Dry and Critical Years	
	Existing Condition (Number of Months)	CP2 Change (Number of Months (%))	Existing Condition (Number of Months)	CP2 Change (Number of Months (%))	No-Action Alternative (Number of Months)	CP2 Change (Number of Months (%))	No-Action Alternative (Number of Months)	CP2 Change (Number of Months (%))
Oct	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Nov	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Dec	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Jan	1	0.0 (0.0%)	1	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Feb	6	0.0 (0.0%)	5	0.0 (0.0%)	1	0.0 (0.0%)	1	0.0 (0.0%)
Mar	21	0.0 (0.0%)	19	0.0 (0.0%)	14	0.0 (0.0%)	13	0.0 (0.0%)
Apr	7	0.0 (0.0%)	7	0.0 (0.0%)	1	0.0 (0.0%)	1	0.0 (0.0%)
May	1	0.0 (0.0%)	1	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Jun	22	0.0 (0.0%)	20	0.0 (0.0%)	3	0.0 (0.0%)	3	0.0 (0.0%)
Jul	7	0.0 (0.0%)	7	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Aug	4	0.0 (0.0%)	4	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Sep	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)

Source: Common Assumptions Common Modeling Package, version 8D, DSM2 Existing and Future simulations (Node RSAN112)

Note:
Simulation period: 1922-1994. Change as measured from either Existing Condition or No-Action Alternative. Dry and critical years as defined by the Sacramento Valley Index.

Key:
CP = Comprehensive Plan

Impact WQ-19i (CP2): Delta Salinity on the Old River near the Middle River
Impact WQ-19i (CP2) would be similar to Impact WQ-19i (CP1). On an average monthly basis, for the basis of comparison, EC would meet requirements in all months, in both average years and in dry and critical years. Moreover, CP2 would not measurably change EC on the Old River near the Middle River. This impact would be less than significant.

Impact WQ-19i (CP2) would be similar to Impact WQ-19i (CP1). On an average monthly basis, for the basis of comparison, EC would meet the requirements in all months in both average years and in dry and critical years. Moreover, CP2 would not measurably change EC on the Old River near the Middle River, as shown in Table 7-60. Table 7-61 shows the number of months simulated EC values exceeded the standards for the Old River near the Middle River in the period of simulation. As shown in Table 7-61, the compliance of salinity standards for the Old River near the Middle River would not change under CP2 when compared to the Existing Conditions.

This impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Table 7-60. Simulated Monthly Average Salinity and Percent Change for the Old River near Middle River

Month	Existing Condition (2005)				Future Condition (2030)			
	Average All Years		Dry and Critical Years		Average All Years		Dry and Critical Years	
	Existing Condition (mmhos/cm)	CP2 Change (mmhos/cm (%))	Existing Condition (mmhos/cm)	CP2 Change (mmhos/cm (%))	No-Action Alternative (mmhos/cm)	CP2 Change (mmhos/cm (%))	No-Action Alternative (mmhos/cm)	CP2 Change (mmhos/cm (%))
Oct	0.6	0.0 (0.0%)	0.6	0.0 (0.0%)	0.4	0.0 (0.0%)	0.5	0.0 (0.0%)
Nov	0.6	0.0 (0.0%)	0.6	0.0 (0.0%)	0.5	0.0 (0.1%)	0.5	0.0 (-0.2%)
Dec	0.8	0.0 (0.0%)	0.8	0.0 (0.0%)	0.6	0.0 (0.1%)	0.6	0.0 (-0.1%)
Jan	0.7	0.0 (0.0%)	0.9	0.0 (0.0%)	0.6	0.0 (-0.1%)	0.7	0.0 (-0.2%)
Feb	0.7	0.0 (0.0%)	1.0	0.0 (0.0%)	0.6	0.0 (-0.5%)	0.7	0.0 (-1.1%)
Mar	0.7	0.0 (0.0%)	1.0	0.0 (0.0%)	0.5	0.0 (-0.5%)	0.7	0.0 (-1.0%)
Apr	0.5	0.0 (0.0%)	0.6	0.0 (0.0%)	0.4	0.0 (-0.5%)	0.5	0.0 (-1.1%)
May	0.5	0.0 (0.0%)	0.6	0.0 (0.0%)	0.4	0.0 (-0.1%)	0.5	0.0 (-0.3%)
Jun	0.6	0.0 (0.0%)	0.7	0.0 (0.0%)	0.4	0.0 (0.0%)	0.5	0.0 (0.0%)
Jul	0.6	0.0 (0.0%)	0.7	0.0 (0.0%)	0.4	0.0 (-0.5%)	0.4	0.0 (-1.1%)
Aug	0.6	0.0 (0.0%)	0.7	0.0 (0.0%)	0.4	0.0 (0.0%)	0.4	0.0 (0.2%)
Sep	0.6	0.0 (0.0%)	0.6	0.0 (0.0%)	0.4	0.0 (0.1%)	0.4	0.0 (0.0%)

Source: Common Assumptions Common Modeling Package, version 8D, DSM2 Existing and Future simulations (Node RMID041)

Note:
Simulation period: 1922-1994. Change as measured from either Existing Condition or No-Action Alternative. Dry and critical years as defined by the Sacramento Valley Index.

Key:
CP = Comprehensive Plan
mmhos/cm = millimhos per centimeter

Table 7-61. Simulated Number of Months of Exceedence of the Salinity Standard for the Old River near Middle River

Month	Existing Condition (2005)				Future Condition (2030)			
	Total All Years		Dry and Critical Years		Total All Years		Dry and Critical Years	
	Existing Condition (Number of Months)	CP2 Change (Number of Months (%))	Existing Condition (Number of Months)	CP2 Change (Number of Months (%))	No-Action Alternative (Number of Months)	CP2 Change (Number of Months (%))	No-Action Alternative (Number of Months)	CP2 Change (Number of Months (%))
Oct	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Nov	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Dec	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Jan	1	0.0 (0.0%)	1	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Feb	6	0.0 (0.0%)	5	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Mar	20	0.0 (0.0%)	18	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Apr	5	-1.0 (-20.0%)	5	-1.0 (-20.0%)	1	-1.0 (-100.0%)	1	-1.0 (-100.0%)
May	2	0.0 (0.0%)	2	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Jun	22	0.0 (0.0%)	20	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Jul	7	0.0 (0.0%)	7	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Aug	4	0.0 (0.0%)	4	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Sep	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)

Source: Common Assumptions Common Modeling Package, version 8D, DSM2 Existing and Future simulations (Node RMID041)

Note:
Simulation period: 1922-1994. Change as measured from either Existing Condition or No-Action Alternative. Dry and critical years as defined by the Sacramento Valley Index.

Key:
CP = Comprehensive Plan

Impact WQ-19j (CP2): Delta Salinity on the Old River at Tracy Road Bridge
Impact WQ-19j (CP2) would be similar to Impact WQ-19j (CP1). On an average monthly basis, for the basis of comparison, EC would meet requirements in all months, in both average years and in dry and critical years. Moreover, CP2 would not measurably change EC on the Old River at Tracy Road Bridge. This impact would be less than significant.

Impact WQ-19j (CP2) would be similar to Impact WQ-19j (CP1). On an average monthly basis, for the basis of comparison, EC would meet the requirements in all months in both average years and in dry and critical years. Moreover, CP2 would not measurably change EC on the Old River at Tracy Road Bridge, as shown in Table 7-62. Table 7-63 shows the number of months simulated EC values exceeded the standards for the Old River near Tracy Road Bridge in the period of simulation. On an annual average basis, the compliance of salinity standards under CP2 would not change from the Existing Conditions by more than 2 percent. Overall, CP2 would not change the baseline compliance levels under both Existing and Future conditions.

This impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Table 7-62. Simulated Monthly Average Salinity and Percent Change for the Old River at Tracy Road Bridge

Month	Existing Condition (2005)				Future Condition (2030)			
	Average All Years		Dry and Critical Years		Average All Years		Dry and Critical Years	
	Existing Condition (mmhos/cm)	CP2 Change (mmhos/cm (%))	Existing Condition (mmhos/cm)	CP2 Change (mmhos/cm (%))	No-Action Alternative (mmhos/cm)	CP2 Change (mmhos/cm (%))	No-Action Alternative (mmhos/cm)	CP2 Change (mmhos/cm (%))
Oct	0.6	0.0 (-0.1%)	0.6	0.0 (0.0%)	0.6	0.0 (0.0%)	0.6	0.0 (0.2%)
Nov	0.6	0.0 (0.0%)	0.6	0.0 (0.0%)	0.6	0.0 (0.2%)	0.6	0.0 (-0.2%)
Dec	0.8	0.0 (0.0%)	0.8	0.0 (0.0%)	0.6	0.0 (0.1%)	0.7	0.0 (-0.2%)
Jan	0.8	0.0 (0.0%)	0.9	0.0 (0.0%)	0.6	0.0 (-0.1%)	0.7	0.0 (-0.3%)
Feb	0.8	0.0 (0.0%)	1.0	0.0 (0.0%)	0.6	0.0 (-1.1%)	0.7	0.0 (-2.3%)
Mar	0.7	0.0 (0.0%)	1.0	0.0 (0.0%)	0.5	0.0 (0.3%)	0.7	0.0 (0.6%)
Apr	0.5	0.0 (0.0%)	0.7	0.0 (0.0%)	0.4	0.0 (-0.3%)	0.5	0.0 (-0.6%)
May	0.5	0.0 (0.0%)	0.6	0.0 (0.0%)	0.4	0.0 (-0.2%)	0.5	0.0 (-0.5%)
Jun	0.6	0.0 (0.0%)	0.7	0.0 (0.0%)	0.4	0.0 (-0.2%)	0.5	0.0 (-0.4%)
Jul	0.6	0.0 (0.0%)	0.7	0.0 (0.0%)	0.4	0.0 (-0.6%)	0.5	0.0 (-0.9%)
Aug	0.6	0.0 (0.3%)	0.6	0.0 (0.8%)	0.4	0.0 (0.0%)	0.5	0.0 (0.4%)
Sep	0.6	0.0 (0.1%)	0.6	0.0 (0.2%)	0.5	0.0 (0.1%)	0.6	0.0 (0.1%)

Source: Common Assumptions Common Modeling Package, version 8D, DSM2 Existing and Future simulations (Node ROLD059)

Note:
Simulation period: 1922-1994. Change as measured from either Existing Condition or No-Action Alternative. Dry and critical years as defined by the Sacramento Valley Index.

Key:
CP = Comprehensive Plan
mmhos/cm = millimhos per centimeter

Table 7-63. Simulated Number of Months of Exceedence of the Salinity Standard for the Old River at Tracy Road Bridge

Month	Existing Condition (2005)				Future Condition (2030)			
	Total All Years		Dry and Critical Years		Total All Years		Dry and Critical Years	
	Existing Condition (Number of Months)	CP2 Change (Number of Months (%))	Existing Condition (Number of Months)	CP2 Change (Number of Months (%))	No-Action Alternative (Number of Months)	CP2 Change (Number of Months (%))	No-Action Alternative (Number of Months)	CP2 Change (Number of Months (%))
Oct	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Nov	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Dec	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Jan	2	0.0 (0.0%)	1	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Feb	11	0.0 (0.0%)	10	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Mar	21	0.0 (0.0%)	19	0.0 (0.0%)	1	-1.0 (-100.0%)	1	-1.0 (-100.0%)
Apr	23	0.0 (0.0%)	21	0.0 (0.0%)	2	-2.0 (-100.0%)	2	-2.0 (-100.0%)
May	0	1.0 (0.0%)	0	1.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Jun	16	-1.0 (-6.3%)	14	-1.0 (-7.1%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Jul	10	1.0 (10.0%)	8	1.0 (12.5%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Aug	2	0.0 (0.0%)	2	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Sep	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)

Source: Common Assumptions Common Modeling Package, version 8D, DSM2 Existing and Future simulations (Node ROLD059)

Note:
Simulation period: 1922-1994. Change as measured from either Existing Condition or No-Action Alternative. Dry and critical years as defined by the Sacramento Valley Index.

Key:
CP = Comprehensive Plan

Impact WQ-20 (CP2): X2 Position CP2 would not change average monthly X2 in either average years or in dry and critical years by more than 0.1 km under either the Existing Condition or Future Condition. While several months may be out of compliance under the bases of comparison, the change resulting from C2 would not increase the amount out of compliance. This impact would be less than significant.

Impact WQ-20 (CP2) would be similar to Impact WQ-20 (CP1). Table 7-64 shows the simulated monthly average X2 position for CP2 as compared to the Existing Condition and Future Condition baselines. CalSim-II calculates the X2 position on a 1-month delay; the values shown have been corrected to accurately reflect the X2 position for the specified month.

CP2 would not change average monthly X2 in either average years or in dry or critical years by more than 0.1 km under either the Existing Condition or the Future Condition. While several months may be out of compliance under the bases of comparison, the change resulting from CP2 would not increase the amount out of compliance.

This impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Table 7-64. Simulated Monthly Average X2 Position

Month	Existing Condition (2005)				Future Condition (2030)			
	Average All Years		Dry and Critical Years		Average All Years		Dry and Critical Years	
	Existing Condition (km)	CP2 Change (km (%))	Existing Condition (km)	CP2 Change (km (%))	No-Action Alternative (km)	CP2 Change (km (%))	No-Action Alternative (km)	CP2 Change (km (%))
Oct	85.2	0.0 (0.0%)	86.7	0.0 (0.0%)	85.6	0.0 (0.0%)	86.9	0.0 (0.0%)
Nov	82.7	0.0 (0.0%)	85.2	0.0 (0.0%)	83.1	0.0 (0.0%)	85.4	-0.1 (-0.1%)
Dec	77.3	0.0 (0.0%)	83.0	-0.2 (-0.2%)	77.7	0.0 (0.0%)	83.3	-0.2 (-0.2%)
Jan	71.6	0.1 (0.1%)	80.4	0.1 (0.1%)	72.0	0.0 (0.0%)	80.7	-0.1 (-0.1%)
Feb	66.1	0.2 (0.2%)	75.1	0.3 (0.4%)	66.3	0.0 (0.1%)	75.3	0.0 (0.0%)
Mar	65.7	0.1 (0.2%)	74.0	0.2 (0.3%)	65.8	0.1 (0.1%)	74.1	0.1 (0.1%)
Apr	68.1	0.0 (0.1%)	75.5	0.1 (0.1%)	68.1	0.0 (0.0%)	75.6	0.0 (0.0%)
May	71.3	0.0 (0.0%)	78.9	0.0 (0.0%)	71.3	0.0 (0.0%)	78.8	0.0 (0.0%)
Jun	75.2	0.0 (0.0%)	81.3	0.0 (0.0%)	75.2	0.0 (0.0%)	81.2	-0.2 (-0.2%)
Jul	79.2	0.0 (0.0%)	83.9	0.0 (0.0%)	78.8	0.0 (0.0%)	83.7	-0.1 (-0.1%)
Aug	84.1	-0.1 (-0.1%)	85.7	-0.2 (-0.2%)	84.0	0.0 (0.0%)	85.5	-0.1 (-0.1%)
Sep	85.6	0.0 (0.0%)	88.8	0.0 (0.0%)	85.8	-0.1 (-0.1%)	88.5	-0.1 (-0.1%)

Source: Common Assumptions Common Modeling Package version 8D CalSim-II 2005 and 2030 simulations (Node X2_PRV)

Note:
Simulation period: 1922-1994. Change as measured from either Existing Condition or No-Action Alternative. Dry and critical years as defined by the Sacramento Valley Index.

Key:
CP = Comprehensive Plan
km = kilometer
X2 = geographic location of 2 parts per thousand near-bottom salinity isohaline in the Delta, measured in distance upstream from Golden Gate Bridge in Suisun Bay.

CP3 – 18.5-Foot Dam Raise, Anadromous Fish Survival and Water Supply

CP3 is similar to CP1. CP3 would differ from the No-Action Alternative primarily through a 634 TAF enlargement of Shasta Lake. The impacts described below are the same as for CP1. CP3 focuses on the greatest practical enlargement of Shasta Dam and Reservoir consistent with the goals of the 2000 CALFED ROD, and was formulated for the primary purposes of increasing water supply reliability, increasing survival of anadromous fish, and improving water quality. In addition to the common features, CP3 consists of raising Shasta Dam 18.5 feet, an elevation change that would increase the full pool elevation by 20.5 feet and enlarge the total storage space in the reservoir by 634 TAF to 5.19 million acre-feet. This comprehensive plan would help reduce future shortages by increasing the reliability of the water supply in drought and average years. The increased pool depth and volume would also contribute to

improving seasonal water temperatures for anadromous fish on the upper Sacramento River.

Shasta Lake and Vicinity

Impact WQ-1 (CP3): Temporary Construction-Related Sediment Effects on Shasta Lake and Its Tributaries That Would Violate Water Quality Standards or Adversely Affect Beneficial Uses This impact is similar to WQ-1 (CP1). However, the construction-related activities described in Chapter 2, "Alternatives," would result in about 1,270 more acres of exposed shoreline than CP1 and in about the same number of relocation acres (3,337) that would be subject to erosion. This alternative is similar to, but somewhat larger than, CP1. This impact would be potentially significant. Mitigation for this impact is proposed in Section 7.3.5.

Impact WQ-2 (CP3): Temporary Construction-Related Temperature Effects on Shasta Lake and Its Tributaries That Would Violate Water Quality Standards or Adversely Affect Beneficial Uses Similar to CP1, construction activities associated with enlarging Shasta Dam as well as the relocation actions would result in sizeable areas that would be subject to surface disturbance, including jurisdictional waters within the influence zone of CP3. Efforts to document jurisdictional waters associated with relocation areas are ongoing. This information will be included if available in the Final EIS, as well as in the Section 404 permitting package, prior to issuance of a ROD.

Environmental commitments and BMPs for the various construction and relocation activities (e.g., bridge replacement, boat ramp construction, demolition of facilities) have been incorporated into CP3. These activities could include removal of riparian vegetation, thereby exposing water bodies to increased solar radiation for various time periods. A riparian revegetation program will be implemented at all construction and relocation sites as applicable to ensure that shade is quickly reestablished after construction is completed.

As described in Chapter 2, "Alternatives," although the TCD may not be operational for some period of time during construction, project sequencing will ensure that changes to water temperature and associated limnological conditions will be consistent with those that occur periodically under the No-Action Alternative associated with maintenance and outage periods.

Because of the large water surface area of Shasta Lake, coupled with the isolated and discrete nature of the relocation activities on the tributaries, temporary construction-related effects are not expected to modify water temperature in a manner that would have a negative effect on beneficial uses or result in a water quality violation. Therefore, this impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact WQ-3 (CP3): Temporary Construction-Related Metal Effects on Shasta Lake and Its Tributaries That Would Violate Water Quality Standards or Adversely Affect Beneficial Uses This impact is similar to WQ-3 (CP1). There would be no construction activities that would disturb locations known to contain elevated metal concentrations in either sediments or the water column. Therefore, this impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact WQ-4 (CP3): Long-Term Sediment Effects That Would Violate Water Quality Standards or Adversely Affect Beneficial Uses in Shasta Lake or Its Tributaries This impact is similar to WQ4 (CP1), except that the exposure of about 2,498 acres of shoreline surrounding Shasta Lake would result in a potential for increased wave-related shoreline erosion compared to the No-Action Alternative (see Attachment 1 of the *Water Quality Technical Report*). Therefore, this impact is potentially significant. Mitigation for this impact is proposed in Section 7.3.5.

Impact WQ-5 (CP3): Long-Term Temperature Effects That Would Violate Water Quality Standards or Adversely Affect Beneficial Uses in Shasta Lake or Its Tributaries Similar to CP1, this alternative would increase storage on a monthly basis, although it would vary by water year. Table 7-65 illustrates the monthly change in simulated storage for CP3 as a percent increase above the No-Action Alternative. On average, CP3 represents almost a 13-percent increase in the end-of-month storage on an annual basis.

Table 7-65. Simulated Average Increased End-of-Month Shasta Lake Storage – CP3 and CP5

Month	Existing Condition (TAF)	CP3 & CP5 (TAF)	CP3 & CP5 % Increase
Oct	2,671	377	14.1%
Nov	2,690	374	13.9%
Dec	2,815	399	14.2%
Jan	3,067	407	13.3%
Feb	3,291	430	13.1%
Mar	3,624	434	12.0%
Apr	3,919	426	10.9%
May	3,950	424	10.7%
Jun	3,642	418	11.5%
Jul	3,187	407	12.8%
Aug	2,879	390	13.5%
Sep	2,782	386	13.9%

Source: Common Assumptions Common Modeling Package Version 8D CalSim-II 2005 and 2030 simulations (Node S4+S44)

Note:
Simulation period: 1922-2003

Key:
TAF = thousand acre-feet

Under CP3 existing water temperature requirements would typically be met in most years; therefore, the additional increase in water storage shown in Table 7-65 would primarily be released for water supply purposes. Accordingly, minimal increases in releases from Shasta Dam would be expected in months when Delta exports are constrained, or when flow is not usable for water supply purposes.

Similar to CP1, the increase in storage provided by CP3 fluctuates greatly throughout a year. A key indicator of water temperature benefits of CP3 to the upper Sacramento River between Keswick Dam and Red Bluff is the amount of cold water available in Shasta Lake before the water temperature operation season, about May through October. Similar to CP1, the CWP volume in the lake accumulates during winter and early spring and is not likely to increase after April. Therefore, the expected increase in spring storage for CP3 should also result in an incremental increase in the CWP volume.

The simulated end-of-April volume of water with a temperature lower than 52˚F for the No-Action Alternative and the change in CWP volume for CP3 is shown, by SVI, in Table 7-66.

Table 7-66. Simulated Average Volume of Water Less than 52˚F in Shasta Lake at the End of April – CP3 and CP5

SVI Year Type	Existing Condition (TAF)	CP3 & CP5 (TAF)	CP3 & CP5 % Increase
Average of All Years	1,577	220	14.0%
Wet	1,807	349	19.3%
Above Normal	1,721	284	16.5%
Below Normal	1,743	214	12.3%
Dry	1,451	130	9.0%
Critical	928	17	1.8%

Source: Common Assumptions Common Modeling Package Version 8D SRWQM 2005 and 2030 simulations

Note:
Simulation period: 1922-2003
Year types as defined by the Sacramento Valley Index

Key:
SVI = Sacramento Valley Index
TAF = thousand acre-feet

In addition to illustrating the average change in available CWP, Table 7-66 also shows the influence of climatic conditions on these values. The diversity between water year types, coupled with unique combinations of storage and rainfall, would continue to influence the ability to manage storage in Shasta Lake to maximize carryover capacity. Although there is a meaningful increase in active storage and carryover storage of the CWP, this increase is considered a less than-significant impact. Mitigation for this impact is not needed, and thus not proposed.

Impact WQ-6 (CP3): Long-Term Metals Effects That Would Violate Water Quality Standards or Adversely Affect Beneficial Uses in Shasta Lake or Its Tributaries Similar to CP1, the increase in storage associated with this alternative would not result in modifying the depth and thickness of the thermocline that persists in Shasta Lake.

Within the Squaw Creek Arm, two depositional features associated with historic copper mining and smelting operations are immediately adjacent to the shoreline of Shasta Lake in the general vicinity of the Bully Hill Mine. As mapped, these two sites appear to have about 7,300 cubic yards of material that could be subjected to shoreline and surficial erosional processes with an increase in reservoir elevations resultant related to CP3.

Under CP3, this impact would be potentially significant. Mitigation for this impact is proposed in Section 7.3.5.

Upper Sacramento River (Shasta Dam to Red Bluff)
Impact WQ-7 (CP3): Temporary Construction-Related Sediment Effects on the Upper Sacramento River That Would Cause Violations of Water Quality

Standards or Adversely Affect Beneficial Uses Construction would include ground-disturbing activities that could result in soil erosion and sediment effects on the upper Sacramento River. This impact would be potentially significant.

This impact would be the same as Impact WQ-7 (CP1) and would be potentially significant. Mitigation for this impact is proposed in Section 7.3.5.

Impact WQ-8 (CP3): Temporary Construction-Related Temperature Effects on the Upper Sacramento River That Cause Violations of Water Quality Standards or Adversely Affect Beneficial Uses Construction activities are not anticipated to result in temperature effects on the upper Sacramento River because changes to water temperature in Shasta Lake and subsequent releases to the Sacramento River would be consistent with typical periodic fluctuations. This impact would be less than significant.

This impact would be identical to Impact WQ-8 (CP1). For the same reasons as described for Impact WQ-8 (CP1), this impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact WQ-9 (CP3): Temporary Construction-Related Metal Effects on the Upper Sacramento River That Cause Violations of Water Quality Standards or Adversely Affect Beneficial Uses Construction activities are not anticipated to result in water quality effects on the upper Sacramento River related to metals because construction would not disturb locations of known elevated metal concentrations. This impact would be less than significant.

This impact would be identical to Impact WQ-9 (CP1). For the same reasons as described for Impact WQ-9 (CP1), this impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact WQ-10 (CP3): Long-Term Sediment Effects That Cause Violations of Water Quality Standards or Adversely Affect Beneficial Uses in the Upper Sacramento River No long-term water quality impacts are anticipated in the upper Sacramento River in regard to sediment, because modeling results have indicated that CP3 would cause little change in average mean monthly flow, and could cause a decrease in peak flows that are associated with increased sediment transport. This impact would be less than significant.

This impact would be similar to Impact WQ-10 (CP1) because the extent of the effect of CP3 on sediment would be similar to that for CP1. For the same reasons as described for Impact WQ-10 (CP1), this impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact WQ-11 (CP3): Long-Term Temperature Effects That Cause Violations of Water Quality Standards or Adversely Affect Beneficial Uses in the Upper Sacramento River Analysis of temperature modeling results indicates that CP3 would improve compliance with the temperature requirements on the Sacramento River because of the increased depth of the cold-water pool in

Shasta Lake and the associated enhanced ability to regulate water temperature releases to the upper Sacramento River. Therefore, the impact of CP3 on water quality measured as temperature would be beneficial.

CP3 would increase the ability of Shasta Dam to release cold water and regulate water temperature in the upper Sacramento River, primarily in dry and critically dry years. Raising Shasta Dam 18.5 feet would increase the cold-water pool and benefit seasonal water temperatures along the upper Sacramento River. This section focuses on compliance with water quality standards for temperature. For an analysis of temperature effects on fisheries and aquatic habitat, see Chapter 11, "Fisheries and Aquatic Resources."

Analysis of temperature modeling results indicates that CP3 would have a beneficial effect on temperature within the upper Sacramento River, with a slight decrease in average monthly water temperature during summer under both existing and future conditions. Decreased temperatures would improve compliance with the temperature objectives for the upper Sacramento River in the 2004 BO. CP3 would reduce temperature exceedences at Balls Ferry by 18 percent under existing conditions and 24 percent under future conditions. At the Bend Bridge compliance station, CP3 would reduce temperature exceedences by 8 percent under existing conditions and 11 percent under future conditions. Table 7-6 summarizes the temperature modeling results.

Based on this analysis, the impact of CP3 on water quality measured as temperature would be beneficial. Mitigation for this impact is not needed, and thus not proposed.

Impact WQ-12 (CP3): Long-Term Metals Effects That Cause Violations of Water Quality Standards or Adversely Affect Beneficial Uses in the Upper Sacramento River Long-term operation of the project could result in water quality effects on the upper Sacramento River in regard to metals as a result of erosional processes to historic mining and smelting operation features. This impact would be potentially significant.

This impact would be similar to Impact WQ-12 (CP3) because the extent of the effect of CP3 on metals would be similar to that for CP1. For the same reasons as described for Impact WQ-12 (CP1), this impact would be potentially significant. Mitigation for this impact is proposed in Section 7.3.5.

Lower Sacramento River and Delta and CVP/SWP Service Areas
Impact WQ-13 (CP3): Temporary Construction-Related Sediment Effects on the Extended Study Area That Would Cause Violations of Water Quality Standards or Adversely Affect Beneficial Uses Construction is not anticipated to affect water quality conditions in the extended study area. This impact would be less than significant.

This impact would be similar to Impact WQ-13 (CP1). For the same reasons described for Impact WQ-13 (CP1), this impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact WQ-14 (CP3): Temporary Construction-Related Temperature Effects on the Extended Study Area That Cause Violations of Water Quality Standards or Adversely Affect Beneficial Uses This impact would be similar to Impact WQ-14 (CP1). For the same reasons described for Impact WQ-14 (CP1), this impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact WQ-15 (CP3): Temporary Construction-Related Metal Effects on the Extended Study Area That Cause Violations of Water Quality Standards or Adversely Affect Beneficial Uses This impact would be similar to Impact WQ-15 (CP1). For the same reasons described for Impact WQ-15 (CP1), this impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact WQ-16 (CP3): Long-Term Sediment Effects That Cause Violations of Water Quality Standards or Adversely Affect Beneficial Uses in the Extended Study Area Project implementation could affect water quality in the extended study area, but effects would diminish with distance. This impact would be less than significant.

This impact would be similar to Impact WQ-16 (CP1). For the same reasons as described for Impact WQ-16 (CP1), this impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact WQ-17 (CP3): Long-Term Temperature Effects That Cause Violations of Water Quality Standards or Adversely Affect Beneficial Uses in the Extended Study Area This impact would be similar to Impact WQ-17 (CP1). For the same reasons as described for Impact WQ-17 (CP1), this impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact WQ-18 (CP3): Long-Term Metals Effects That Cause Violations of Water Quality Standards or Adversely Affect Beneficial Uses in the Extended Study Area This impact would be similar to Impact WQ-18 (CP1). For the same reasons as described for Impact WQ-18 (CP1), this impact would be potentially significant. Mitigation for this impact is proposed in Section 7.3.5.

Impact WQ-19a (CP3): Delta Salinity on the Sacramento River at Collinsville Operations for CP3 would result in both increases and decreases in salinity; however, none of the increases would be sufficient to change compliance for the Sacramento River at Collinsville. Similarly, on a percentage basis, all increases in salinity would be less than 10 percent; this would be within the range of natural variability. This impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact WQ-19a (CP3) would be similar to Impact WQ-19a (CP1). As shown in Table 7-67, operations for CP3 would result in both increases and decreases in salinity; however, none of the increases would be sufficient to change compliance for the Sacramento River at Collinsville. Similarly, on a percentage basis, all increases in salinity would be less than 1 percent; this would be within the range of natural variability. Table 7-68 shows the number of months simulated EC values exceeded the standards for the Sacramento River at Collinsville in the period of simulation. The operation of CP3 would not result in any violation of the salinity standards under both Existing and Future conditions.

Table 7-67. Simulated Monthly Average Salinity and Percent Change for the Sacramento River at Collinsville

Month	Existing Condition (2005)				Future Condition (2030)			
	Average All Years		Dry and Critical Years		Average All Years		Dry and Critical Years	
	Existing Condition (mmhos/cm)	CP3 Change (mmhos/cm (%))	Existing Condition (mmhos/cm)	CP3 Change (mmhos/cm (%))	No-Action Alternative (mmhos/cm)	CP3 Change (mmhos/cm (%))	No-Action Alternative (mmhos/cm)	CP3 Change (mmhos/cm (%))
Oct	7.1	0.0 (0.3%)	8.3	0.1 (0.6%)	7.4	0.0 (-0.5%)	8.4	0.0 (-0.3%)
Nov	6.4	0.0 (-0.1%)	8.0	0.0 (-0.3%)	6.6	0.0 (-0.3%)	8.1	-0.1 (-0.7%)
Dec	4.4	-0.1 (-1.5%)	6.5	-0.2 (-2.6%)	4.5	-0.1 (-1.3%)	6.6	-0.2 (-2.6%)
Jan	2.6	0.0 (-0.8%)	4.8	0.0 (-0.8%)	2.7	0.0 (-1.5%)	4.9	-0.1 (-2.3%)
Feb	1.0	0.1 (8.6%)	2.2	0.2 (10.7%)	1.1	0.0 (-2.7%)	2.3	-0.1 (-3.5%)
Mar	0.7	0.0 (3.9%)	1.4	0.1 (5.0%)	0.7	0.0 (-0.7%)	1.4	0.0 (-0.9%)
Apr	0.9	0.0 (0.2%)	1.9	0.0 (0.3%)	1.0	0.0 (-0.3%)	1.9	0.0 (-0.5%)
May	1.5	0.0 (-0.6%)	3.0	0.0 (-0.7%)	1.4	0.0 (-0.5%)	2.9	0.0 (-0.9%)
Jun	2.5	0.0 (-0.7%)	4.5	0.0 (-1.0%)	2.4	0.0 (-0.3%)	4.4	-0.1 (-1.6%)
Jul	3.4	0.0 (-1.0%)	5.5	-0.1 (-1.1%)	3.2	0.0 (-1.0%)	5.4	-0.1 (-1.4%)
Aug	5.3	-0.1 (-1.2%)	6.7	-0.1 (-2.1%)	5.0	0.0 (-0.5%)	6.6	-0.1 (-1.0%)
Sep	6.6	0.0 (-0.3%)	8.4	-0.1 (-1.2%)	6.5	0.0 (-0.7%)	8.1	-0.1 (-1.7%)

Source: Common Assumptions Common Modeling Package, version 8D, DSM2 Existing and Future simulations (Node RSAC081)

Note:
Simulation period: 1922-1994. Change as measured from either Existing Condition or No-Action Alternative. Dry and critical years as defined by the Sacramento Valley Index.

Key:
CP = Comprehensive Plan
mmhos/cm = millimhos per centimeter

Table 7-68. Simulated Number of Months of Exceedence of the Salinity Standard for the Old River at Tracy Road Bridge

Month	Existing Condition (2005)				Future Condition (2030)			
	Total All Years		Dry and Critical Years		Total All Years		Dry and Critical Years	
	Existing Condition (Number of Months)	CP3 Change (Number of Months (%))	Existing Condition (Number of Months)	CP3 Change (Number of Months (%))	No-Action Alternative (Number of Months)	CP3 Change (Number of Months (%))	No-Action Alternative (Number of Months)	CP3 Change (Number of Months (%))
Oct	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Nov	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Dec	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Jan	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Feb	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Mar	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Apr	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
May	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Jun	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Jul	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Aug	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Sep	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)

Source: Common Assumptions Common Modeling Package, version 8D, DSM2 Existing and Future simulations (Node RSAC081)

Note:
Simulation period: 1922-1994. Change as measured from either Existing Condition or No-Action Alternative. Dry and critical years as defined by the Sacramento Valley Index.

Key:
CP = Comprehensive Plan

Impact WQ-19b (CP3): Delta Salinity on the San Joaquin River at Jersey Point
On an average monthly basis, for the basis of comparison, EC would meet the requirements in all months in an average year. Moreover, CP3 would not increase the EC at Jersey Point. This impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact WQ-19b (CP3) would be similar to Impact WQ-19b (CP1). As shown in Table 7-69, the basis of comparison would meet the requirement on an average basis in both average years and in dry and critical years. Furthermore, all changes during April through August would be less than 1 percent. Table 7-70 shows the number of months simulated EC values exceeded the standards for the San Joaquin River at Jersey Point in the period of simulation. CP3 would result in a slight increase in the frequency of violations (2 percent) during August under the Existing Conditions. Overall, frequency of violation of salinity standards for the San Joaquin River at Jersey Point under CP3 would be similar to those under Existing and Future conditions.

This impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Table 7-69. Simulated Monthly Average Salinity and Percent Change for the San Joaquin River at Jersey Point

Month	Existing Condition (2005)				Future Condition (2030)			
	Average All Years		Dry and Critical Years		Average All Years		Dry and Critical Years	
	Existing Condition (mmhos/cm)	CP3 Change (mmhos/cm (%))	Existing Condition (mmhos/cm)	CP3 Change (mmhos/cm (%))	No-Action Alternative (mmhos/cm)	CP3 Change (mmhos/cm (%))	No-Action Alternative (mmhos/cm)	CP3 Change (mmhos/cm (%))
Oct	2.1	0.0 (0.6%)	2.3	0.0 (1.1%)	2.1	0.0 (0.4%)	2.3	0.0 (0.8%)
Nov	1.9	0.0 (1.1%)	2.3	0.1 (2.3%)	2.0	0.0 (0.6%)	2.3	0.0 (0.8%)
Dec	1.5	0.0 (-0.4%)	2.1	0.0 (-1.2%)	1.6	0.0 (-0.3%)	2.1	0.0 (-0.7%)
Jan	1.0	0.0 (-0.1%)	1.6	0.0 (0.2%)	1.1	0.0 (-1.6%)	1.7	0.0 (-2.4%)
Feb	0.5	0.0 (6.4%)	0.9	0.1 (10.2%)	0.5	0.0 (-0.1%)	0.9	0.0 (-0.3%)
Mar	0.3	0.0 (3.3%)	0.4	0.0 (6.2%)	0.3	0.0 (-0.5%)	0.4	0.0 (-1.1%)
Apr	0.3	0.0 (0.5%)	0.3	0.0 (0.9%)	0.3	0.0 (-0.1%)	0.4	0.0 (-0.3%)
May	0.3	0.0 (-0.4%)	0.5	0.0 (-0.7%)	0.3	0.0 (-0.6%)	0.5	0.0 (-1.2%)
Jun	0.5	0.0 (0.0%)	0.9	0.0 (-0.1%)	0.5	0.0 (-1.3%)	0.9	0.0 (-2.7%)
Jul	0.7	0.0 (1.8%)	1.3	0.0 (2.1%)	0.7	0.0 (1.1%)	1.3	0.0 (1.2%)
Aug	1.2	0.0 (1.2%)	1.6	0.0 (0.9%)	1.2	0.0 (0.0%)	1.7	0.0 (0.3%)
Sep	1.9	0.0 (0.3%)	2.3	0.0 (-0.4%)	2.0	0.0 (0.2%)	2.4	0.0 (0.1%)

Source: Common Assumptions Common Modeling Package, version 8D, DSM2 Existing and Future simulations (Node RSAN018)

Note:
Simulation period: 1922-1994. Change as measured from either Existing Condition or No-Action Alternative. Dry and critical years as defined by the Sacramento Valley Index.

Key:
CP = Comprehensive Plan
mmhos/cm = millimhos per centimeter

Table 7-70. Simulated Number of Months of Exceedence of the Salinity Standard for the San Joaquin River at Jersey Point

Month	Existing Condition (2005)				Future Condition (2030)			
	Total All Years		Dry and Critical Years		Total All Years		Dry and Critical Years	
	Existing Condition (Number of Months)	CP3 Change (Number of Months (%))	Existing Condition (Number of Months)	CP3 Change (Number of Months (%))	No-Action Alternative (Number of Months)	CP3 Change (Number of Months (%))	No-Action Alternative (Number of Months)	CP3 Change (Number of Months (%))
Oct	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Nov	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Dec	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Jan	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Feb	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Mar	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Apr	0	0.0 (0.0%)	0	0.0 (0.0%)	1	0.0 (0.0%)	1	0.0 (0.0%)
May	0	0.0 (0.0%)	0	0.0 (0.0%)	1	-1.0 (-100.0%)	1	-1.0 (-100.0%)
Jun	17	0.0 (0.0%)	13	0.0 (0.0%)	17	0.0 (0.0%)	13	0.0 (0.0%)
Jul	1	1.0 (100.0%)	1	1.0 (100.0%)	0	1.0 (0.0%)	0	1.0 (0.0%)
Aug	56	1.0 (1.8%)	13	1.0 (7.7%)	58	0.0 (0.0%)	14	0.0 (0.0%)
Sep	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)

Source: Common Assumptions Common Modeling Package, version 8D, DSM2 Existing and Future simulations (Node RSAN018)

Note:
Simulation period: 1922-1994. Change as measured from either Existing Condition or No-Action Alternative. Dry and critical years as defined by the Sacramento Valley Index.

Key:
CP = Comprehensive Plan

Impact WQ-19c (CP3): Delta Salinity on the Sacramento River at Emmaton
On an average monthly basis, for the basis of comparison, EC would meet the requirements in all months on an average annual basis; moreover, CP3 would not increase the EC at Emmaton during this period by more than 0.2 percent. This impact would be less than significant.

Impact WQ-19c (CP3) would be similar to Impact WQ-19c (CP1). While Table 7-71 shows EC for all months, the Emmaton water quality requirement is only defined for April 1 through August 15. On an average monthly basis, for the basis of comparison, EC would meet the requirements in all months on an average annual basis. Moreover, CP3 would not increase EC at Emmaton during this period by more than 0.2 percent. Table 7-72 shows the number of months simulated EC values exceeded the standards for the Sacramento River at Emmaton in the period of simulation. Operations of CP3 would not result in any violation of salinity standards between October and March. Between April and September, CP3 would result in a decrease in the frequency of violations when compared to the baseline values under the Existing and Future conditions. Overall, the compliance of salinity standards for the Sacramento River at

Emmaton would be very similar to the baseline levels under both Existing and Future conditions.

This impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Table 7-71. Simulated Monthly Average Salinity and Percent Change for the Sacramento River at Emmaton

Month	Existing Condition (2005)				Future Condition (2030)			
	Average All Years		Dry and Critical Years		Average All Years		Dry and Critical Years	
	Existing Condition (mmhos/cm)	CP3 Change (mmhos/cm (%))	Existing Condition (mmhos/cm)	CP3 Change (mmhos/cm (%))	No-Action Alternative (mmhos/cm)	CP3 Change (mmhos/cm (%))	No-Action Alternative (mmhos/cm)	CP3 Change (mmhos/cm (%))
Oct	2.2	0.0 (0.2%)	2.7	0.0 (0.8%)	2.4	0.0 (-1.2%)	2.8	0.0 (-1.0%)
Nov	1.9	0.0 (-0.8%)	2.5	0.0 (-1.6%)	1.9	0.0 (-1.0%)	2.5	0.0 (-1.6%)
Dec	1.2	0.0 (-2.5%)	1.7	-0.1 (-4.3%)	1.2	0.0 (-2.4%)	1.8	-0.1 (-4.4%)
Jan	0.7	0.0 (-1.1%)	1.2	0.0 (-1.3%)	0.7	0.0 (-1.7%)	1.2	0.0 (-2.7%)
Feb	0.3	0.0 (6.6%)	0.5	0.1 (10.6%)	0.3	0.0 (-4.3%)	0.6	0.0 (-7.1%)
Mar	0.2	0.0 (2.3%)	0.3	0.0 (4.3%)	0.3	0.0 (-1.2%)	0.3	0.0 (-2.3%)
Apr	0.3	0.0 (-0.2%)	0.4	0.0 (-0.4%)	0.3	0.0 (-0.5%)	0.4	0.0 (-1.0%)
May	0.4	0.0 (-0.2%)	0.7	0.0 (-0.3%)	0.4	0.0 (-0.7%)	0.7	0.0 (-1.2%)
Jun	0.6	0.0 (-1.6%)	1.2	0.0 (-2.1%)	0.6	0.0 (-0.9%)	1.1	0.0 (-2.1%)
Jul	0.8	0.0 (-1.9%)	1.5	0.0 (-2.1%)	0.8	0.0 (-1.9%)	1.4	0.0 (-2.4%)
Aug	1.4	0.0 (-2.3%)	2.0	-0.1 (-3.4%)	1.3	0.0 (-0.5%)	1.9	0.0 (-0.9%)
Sep	2.0	0.0 (-0.5%)	2.9	0.0 (-1.7%)	2.0	0.0 (-1.7%)	2.7	-0.1 (-3.3%)

Source: Common Assumptions Common Modeling Package, version 8D, DSM2 Existing and Future simulations (Node RSAC092)

Note:
Simulation period: 1922-1994. Change as measured from either Existing Condition or No-Action Alternative. Dry and critical years as defined by the Sacramento Valley Index.

Key:
CP = Comprehensive Plan
mmhos/cm = millimhos per centimeter

Table 7-72. Simulated Number of Months of Exceedence of the Salinity Standard for the Sacramento River at Emmaton

Month	Existing Condition (2005)				Future Condition (2030)			
	Total All Years		Dry and Critical Years		Total All Years		Dry and Critical Years	
	Existing Condition (Number of Months)	CP3 Change (Number of Months (%))	Existing Condition (Number of Months)	CP3 Change (Number of Months (%))	No-Action Alternative (Number of Months)	CP3 Change (Number of Months (%))	No-Action Alternative (Number of Months)	CP3 Change (Number of Months (%))
Oct	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Nov	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Dec	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Jan	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Feb	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Mar	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Apr	1	0.0 (0.0%)	1	0.0 (0.0%)	1	0.0 (0.0%)	1	0.0 (0.0%)
May	2	0.0 (0.0%)	1	0.0 (0.0%)	3	-1.0 (-33.3%)	2	-1.0 (-50.0%)
Jun	19	0.0 (0.0%)	13	0.0 (0.0%)	19	1.0 (5.3%)	14	0.0 (0.0%)
Jul	1	-1.0 (-100.0%)	0	0.0 (0.0%)	1	-1.0 (-100.0%)	0	0.0 (0.0%)
Aug	51	-5.0 (-9.8%)	9	-3.0 (-33.3%)	41	0.0 (0.0%)	7	-1.0 (-14.3%)
Sep	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)

Source: Common Assumptions Common Modeling Package, version 8D, DSM2 Existing and Future simulations (Node RSAC092)

Note:
Simulation period: 1922-1994. Change as measured from either Existing Condition or No-Action Alternative. Dry and critical years as defined by the Sacramento Valley Index.

Key:
CP = Comprehensive Plan

Impact WQ-19d (CP3): Delta Salinity on the Old River at Rock Slough On an average annual basis, all months except October through January under both the Existing Condition and Future Condition would be less than 150 mg/L. In dry and critical years, only October and November would exceed the standard under the Existing Condition, and October through February would exceed the standard in the Future Condition. In average annual years, CP3 would not increase chlorides by more than 1.2 percent, and even in that instance, the standard would be met. For dry and critical years, larger increases in chlorides would occur in November and December under the Existing Condition. However, the change in chloride concentration would not affect compliance with the standard; it would already be exceeded under the basis of comparison. This impact would be less than significant.

Impact WQ-19d (CP3) would be similar to Impact WQ-19d (CP1). The standard for chlorides at the Contra Costa Canal is defined by number of days with less than 150 mg/L chloride. The analysis of modeling output is limited to the monthly average chlorides. However, on an average annual basis, all months except October through January under both the Existing Condition and Future Condition, and September in dry and critical years, would be less than 150

mg/L. As shown in Table 7-73, in dry and critical years, October through February exceed the standard in both the Existing Condition and Future Condition. In average annual years, CP3 would not increase chlorides by more than 1.2 percent; however, in the month of the largest increase (September under the Existing Condition and Future Condition), the standard would be exceeded. For dry and critical years, larger increases in chlorides occur in November and December under Existing Condition. However, the change in chloride concentration would not affect compliance with the standard; it would already be exceeded under the basis of comparison. Table 7-74 shows the number of days simulated chloride values exceeded the standards of 250 mg/L for the Old River at Rock Slough in the period of simulation. Dry and critical years would see a slight increase (2 percent) in violations of chloride standards for CP3 under the Existing Conditions. Overall, CP3 would not alter the compliance level observed under both Existing and Future conditions.

This impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Table 7-73. Simulated Monthly Average Chlorides and Percent Change for the Old River at Rock Slough

Month	Existing Condition (2005)				Future Condition (2030)			
	Average All Years		Dry and Critical Years		Average All Years		Dry and Critical Years	
	Existing Condition (mg/L)	CP3 Change (mg/L (%))	Existing Condition (mg/L)	CP3 Change (mg/L (%))	No-Action Alternative (mg/L)	CP3 Change (mg/L (%))	No-Action Alternative (mg/L)	CP3 Change (mg/L (%))
Oct	175.4	0.8 (0.5%)	195.6	2.2 (1.1%)	178.6	-0.2 (-0.1%)	197.4	0.8 (0.4%)
Nov	167.5	1.1 (0.7%)	195.8	1.8 (0.9%)	167.1	0.4 (0.2%)	191.3	0.2 (0.1%)
Dec	168.0	0.7 (0.4%)	204.2	2.5 (1.2%)	175.9	0.3 (0.2%)	206.4	0.0 (0.0%)
Jan	156.2	-0.7 (-0.4%)	195.0	-2.4 (-1.2%)	170.2	-1.2 (-0.7%)	205.6	-2.8 (-1.4%)
Feb	124.9	2.1 (1.7%)	157.9	6.0 (3.8%)	140.9	-1.5 (-1.1%)	176.1	-3.2 (-1.8%)
Mar	80.4	1.6 (2.1%)	85.8	4.0 (4.7%)	83.1	-1.2 (-1.4%)	91.3	-3.6 (-4.0%)
Apr	76.9	0.7 (1.0%)	78.0	1.4 (1.8%)	73.5	-0.3 (-0.4%)	74.6	-1.0 (-1.4%)
May	68.8	0.0 (-0.1%)	73.9	0.1 (0.1%)	62.9	-0.2 (-0.4%)	71.4	-0.6 (-0.8%)
Jun	61.0	-0.2 (-0.3%)	82.3	-0.7 (-0.8%)	60.7	-0.4 (-0.6%)	81.5	-1.2 (-1.5%)
Jul	70.1	0.2 (0.3%)	102.0	0.9 (0.8%)	68.7	-0.2 (-0.3%)	101.6	-0.4 (-0.4%)
Aug	88.5	1.0 (1.2%)	133.6	2.0 (1.5%)	90.7	0.6 (0.6%)	133.2	2.1 (1.5%)
Sep	134.6	0.6 (0.5%)	172.7	-0.7 (-0.4%)	145.7	0.3 (0.2%)	178.1	0.1 (0.1%)

*Source: Common Assumptions Common Modeling Package, version 8D, DSM2 Existing and Future simulations (Node CHCCC006) converted to chlorides using the equation EC*0.268-24*

Note:
Simulation period: 1922-1994. Change as measured from either Existing Condition or No-Action Alternative. Dry and critical years as defined by the Sacramento Valley Index.

Key:
CP = Comprehensive Plan
EC = electrical conductivity
mg/L = milligrams per liter

Table 7-74. Simulated Number of Days by Month of Exceedence of the Chloride Standard for the Old River at Rock Slough

Month	Existing Condition (2005)				Future Condition (2030)			
	Total All Years		Dry and Critical Years		Total All Years		Dry and Critical Years	
	Existing Condition (Number of Days)	CP3 Change (Number of Days (%))	Existing Condition (Number of Days)	CP3 Change (Number of Days (%))	No-Action Alternative (Number of Days)	CP3 Change (Number of Days (%))	No-Action Alternative (Number of Days)	CP3 Change (Number of Days (%))
Oct	119	2.0 (1.7%)	57	5.0 (8.8%)	149	-14.0 (-9.4%)	61	2.0 (3.3%)
Nov	176	-19.0 (-10.8%)	107	-16.0 (-15.0%)	152	13.0 (8.6%)	84	5.0 (6.0%)
Dec	332	16.0 (4.8%)	173	23.0 (13.3%)	309	17.0 (5.5%)	151	12.0 (7.9%)
Jan	295	-24.0 (-8.1%)	185	-27.0 (-14.6%)	320	-18.0 (-5.6%)	204	-7.0 (-3.4%)
Feb	102	25.0 (24.5%)	90	29.0 (32.2%)	193	-9.0 (-4.7%)	148	-9.0 (-6.1%)
Mar	0	0.0 (0.0%)	0	0.0 (0.0%)	4	0.0 (0.0%)	0	0.0 (0.0%)
Apr	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
May	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Jun	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Jul	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Aug	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Sep	0	2.0 (0.0%)	0	2.0 (0.0%)	12	-6.0 (-50.0%)	12	-6.0 (-50.0%)

Source: Common Assumptions Common Modeling Package, version 8D, DSM2 Existing and Future simulations (Node CHCCC006)

Note:
Simulation period: 1922-1994. Change as measured from either Existing Condition or No-Action Alternative. Dry and critical years as defined by the Sacramento Valley Index.

Key:
CP = Comprehensive Plan

Impact WQ-19e (CP3): Delta Water Quality on the Delta-Mendota Canal at Jones Pumping Plant The water quality requirement on the Delta-Mendota Canal at Jones Pumping Plant has two components, a chloride requirement and an EC requirement. CP3 would not measurably change EC, and the increases in chloride concentration would be less than 1.0 percent. This impact would be less than significant.

Impact WQ-19e (CP3) would be similar to Impact WQ-19e (CP1). Table 7-75 shows the simulated chloride concentrations and Table 7-76 shows EC for the Delta-Mendota Canal at Jones Pumping Plant.

The 250-mg/L chloride concentration would be not exceeded on an average annual or dry critical year basis. Furthermore, chloride concentrations would typically be lower under CP3 than under the basis of comparisons.

Table 7-77 shows the number of days simulated chloride values exceeded the standards of 250 mg/L for the Delta-Mendota Canal at the Jones Pumping Plant in the period of simulation. As seen in Table 7-77, there would be no additional

violations throughout the year except during February. Even in February, chloride values under CP3 would be similar to the baseline values under both Existing and Future conditions.

Table 7-75. Simulated Monthly Average Chlorides and Percent Change for the Delta-Mendota Canal at the Jones Pumping Plant

Month	Existing Condition (2005)				Future Condition (2030)			
	Average All Years		Dry and Critical Years		Average All Years		Dry and Critical Years	
	Existing Condition (mg/L)	CP3 Change (mg/L (%))	Existing Condition (mg/L)	CP3 Change (mg/L (%))	No-Action Alternative (mg/L)	CP3 Change (mg/L (%))	No-Action Alternative (mg/L)	CP3 Change (mg/L (%))
Oct	113.2	0.5 (0.5%)	124.3	1.4 (1.1%)	112.6	0.0 (0.0%)	123.4	0.6 (0.5%)
Nov	111.5	0.7 (0.6%)	128.1	1.2 (0.9%)	109.8	0.2 (0.1%)	124.8	0.1 (0.1%)
Dec	129.3	0.3 (0.3%)	149.6	1.3 (0.9%)	126.3	0.1 (0.1%)	144.3	0.0 (0.0%)
Jan	128.2	-0.5 (-0.4%)	156.9	-1.2 (-0.8%)	125.9	-0.1 (-0.1%)	153.7	-0.4 (-0.3%)
Feb	120.1	0.2 (0.2%)	164.3	0.9 (0.5%)	117.2	-1.6 (-1.3%)	161.7	-3.6 (-2.2%)
Mar	105.3	0.6 (0.6%)	147.1	1.2 (0.8%)	102.0	-0.5 (-0.5%)	141.9	-1.6 (-1.1%)
Apr	70.5	0.0 (0.0%)	97.1	-0.2 (-0.2%)	59.2	-0.7 (-1.2%)	82.1	-1.7 (-2.1%)
May	63.3	0.0 (0.0%)	84.3	-0.1 (-0.1%)	53.3	-0.3 (-0.6%)	75.0	-0.7 (-0.9%)
Jun	61.2	-0.4 (-0.6%)	72.8	-1.0 (-1.3%)	60.9	-0.3 (-0.6%)	77.7	-0.9 (-1.1%)
Jul	61.9	-0.8 (-1.2%)	75.1	-0.9 (-1.2%)	59.4	-1.0 (-1.6%)	76.4	-1.5 (-2.0%)
Aug	65.4	0.1 (0.2%)	91.8	0.3 (0.4%)	64.5	0.0 (0.1%)	91.6	0.6 (0.7%)
Sep	89.4	0.4 (0.4%)	113.7	-0.4 (-0.3%)	90.9	0.2 (0.3%)	111.4	0.3 (0.3%)

*Source: Common Assumptions Common Modeling Package, version 8D, DSM2 Existing and Future simulations (Node CHCDMC006) converted to chlorides using the equation EC*0.273-43.9)*

Note:
Simulation period: 1922-1994. Change as measured from either Existing Condition or No-Action Alternative. Dry and critical years as defined by the Sacramento Valley Index.

Key:
CP = Comprehensive Plan
EC = electrical conductivity
mg/L = milligrams per liter

Table 7-76. Simulated Monthly Average Salinity and Percent Change for the Delta-Mendota Canal at the Jones Pumping Plant

Month	Existing Condition (2005)				Future Condition (2030)			
	Average All Years		Dry and Critical Years		Average All Years		Dry and Critical Years	
	Existing Condition (mmhos/cm)	CP3 Change (mmhos/cm (%))	Existing Condition (mmhos/cm)	CP3 Change (mmhos/cm (%))	No-Action Alternative (mmhos/cm)	CP3 Change (mmhos/cm (%))	No-Action Alternative (mmhos/cm)	CP3 Change (mmhos/cm (%))
Oct	0.6	0.0 (0.3%)	0.6	0.0 (0.8%)	0.6	0.0 (0.0%)	0.6	0.0 (0.3%)
Nov	0.6	0.0 (0.4%)	0.6	0.0 (0.7%)	0.6	0.0 (0.1%)	0.6	0.0 (0.0%)
Dec	0.6	0.0 (0.2%)	0.7	0.0 (0.7%)	0.6	0.0 (0.1%)	0.7	0.0 (0.0%)
Jan	0.6	0.0 (-0.3%)	0.7	0.0 (-0.6%)	0.6	0.0 (-0.1%)	0.7	0.0 (-0.2%)
Feb	0.6	0.0 (0.1%)	0.8	0.0 (0.4%)	0.6	0.0 (-1.0%)	0.8	0.0 (-1.8%)
Mar	0.5	0.0 (0.4%)	0.7	0.0 (0.6%)	0.5	0.0 (-0.4%)	0.7	0.0 (-0.8%)
Apr	0.4	0.0 (0.0%)	0.5	0.0 (-0.2%)	0.4	0.0 (-0.7%)	0.5	0.0 (-1.4%)
May	0.4	0.0 (0.0%)	0.5	0.0 (0.0%)	0.4	0.0 (-0.3%)	0.4	0.0 (-0.6%)
Jun	0.4	0.0 (-0.3%)	0.4	0.0 (-0.8%)	0.4	0.0 (-0.3%)	0.4	0.0 (-0.7%)
Jul	0.4	0.0 (-0.7%)	0.4	0.0 (-0.8%)	0.4	0.0 (-0.9%)	0.4	0.0 (-1.2%)
Aug	0.4	0.0 (0.1%)	0.5	0.0 (0.2%)	0.4	0.0 (0.0%)	0.5	0.0 (0.5%)
Sep	0.5	0.0 (0.3%)	0.6	0.0 (-0.2%)	0.5	0.0 (0.2%)	0.6	0.0 (0.2%)

Source: Common Assumptions Common Modeling Package, version 8D, DSM2 Existing and Future simulations (Node CHCDMC006)

Note:
Simulation period: 1922-1994. Change as measured from either Existing Condition or No-Action Alternative. Dry and critical years as defined by the Sacramento Valley Index.

Key:
CP = Comprehensive Plan
mmhos/cm = millimhos per centimeter

Table 7-77. Simulated Number of Days by Month of Exceedence of the Chloride Standard for the Delta-Mendota Canal at the Jones Pumping Plant

Month	Existing Condition (2005)				Future Condition (2030)			
	Total All Years		Dry and Critical Years		Total All Years		Dry and Critical Years	
	Existing Condition (Number of Days)	CP3 Change (Number of Days (%))	Existing Condition (Number of Days)	CP3 Change (Number of Days (%))	No-Action Alternative (Number of Days)	CP3 Change (Number of Days (%))	No-Action Alternative (Number of Days)	CP3 Change (Number of Days (%))
Oct	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Nov	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Dec	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Jan	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Feb	36	1.0 (2.8%)	36	1.0 (2.8%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Mar	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Apr	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
May	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Jun	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Jul	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Aug	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Sep	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)

Source: Common Assumptions Common Modeling Package, version 8D, DSM2 Existing and Future simulations (Node CHCDMC006)

Note:
Simulation period: 1922-1994. Change as measured from either Existing Condition or No-Action Alternative. Dry and critical years as defined by the Sacramento Valley Index.

Key:
CP = Comprehensive Plan

Table 7-78 shows the number of months simulated EC values exceeded the standards for the Delta-Mendota Canal at the Jones Pumping Plant in the period of simulation. CP3 would not result in any additional violations of the salinity standards except during February. Even in February, CP3 would not change the baseline compliance levels under both Existing and Future conditions.

Similar to the chloride concentrations, the average annual and dry and critical year averages under the basis of comparison would be under the requirement in all months. CP3 would not measurably change EC, and the increases in chloride concentration would be less than 1.0 percent.

This impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Table 7-78. Simulated Number of Months of Exceedence of the Salinity Standard for the Delta-Mendota Canal at the Jones Pumping Plant

Month	Existing Condition (2005)				Future Condition (2030)			
	Total All Years		Dry and Critical Years		Total All Years		Dry and Critical Years	
	Existing Condition (Number of Months)	CP3 Change (Number of Months (%))	Existing Condition (Number of Months)	CP3 Change (Number of Months (%))	No-Action Alternative (Number of Months)	CP3 Change (Number of Months (%))	No-Action Alternative (Number of Months)	CP3 Change (Number of Months (%))
Oct	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Nov	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Dec	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Jan	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Feb	2	0.0 (0.0%)	2	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Mar	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Apr	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
May	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Jun	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Jul	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Aug	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Sep	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)

Source: Common Assumptions Common Modeling Package, version 8D, DSM2 Existing and Future simulations (Node CHCDMC006)

Note:
Simulation period: 1922-1994. Change as measured from either Existing Condition or No-Action Alternative. Dry and critical years as defined by the Sacramento Valley Index.

Key:
CP = Comprehensive Plan

Impact WQ-19f (CP3): Delta Water Quality in the West Canal at the Mouth of the Clifton Court Forebay The 250 mg/L chloride concentration at the West Canal would not be exceeded on an average annual or dry and critical year basis. Furthermore, chloride concentrations would typically be lower under CP3 than under the basis of comparisons. CP3 would not measurably change EC, and the increases in chloride concentration would be less than 1.0 percent. This impact would be less than significant.

Impact WQ-19f (CP3) would be similar to Impact WQ-19f (CP1). Table 7-79 shows the simulated chloride concentrations and Table 7-80 shows EC for the West Canal at the mouth of the Clifton Court Forebay.

The 250 mg/L chloride concentration would be not exceeded on an average annual or dry or critical year basis. Furthermore, chloride concentrations would typically be lower under CP3 than under the basis of comparisons.

Table 7-79. Simulated Monthly Average Chlorides and Percent Change for West Canal at Clifton Court Forebay

Month	Existing Condition (2005)				Future Condition (2030)			
	Average All Years		Dry and Critical Years		Average All Years		Dry and Critical Years	
	Existing Condition (mg/L)	CP3 Change (mg/L (%))	Existing Condition (mg/L)	CP3 Change (mg/L (%))	No-Action Alternative (mg/L)	CP3 Change (mg/L (%))	No-Action Alternative (mg/L)	CP3 Change (mg/L (%))
Oct	111.2	0.6 (0.5%)	123.4	1.6 (1.3%)	113.5	-0.1 (-0.1%)	125.3	0.4 (0.3%)
Nov	108.3	0.8 (0.8%)	126.8	1.5 (1.1%)	109.7	0.2 (0.2%)	125.7	0.1 (0.1%)
Dec	121.2	0.3 (0.3%)	144.9	1.2 (0.9%)	116.3	0.1 (0.1%)	138.9	-0.1 (-0.1%)
Jan	116.4	-0.6 (-0.5%)	148.2	-1.7 (-1.2%)	111.8	-0.4 (-0.3%)	144.4	-1.0 (-0.7%)
Feb	107.2	-0.1 (-0.1%)	150.5	0.2 (0.1%)	99.7	-2.0 (-2.0%)	143.7	-4.6 (-3.2%)
Mar	92.2	0.2 (0.2%)	129.8	0.4 (0.3%)	80.5	-0.6 (-0.7%)	115.7	-1.5 (-1.3%)
Apr	63.0	0.1 (0.2%)	87.6	0.1 (0.1%)	55.0	-0.7 (-1.2%)	76.1	-1.7 (-2.2%)
May	57.5	0.1 (0.1%)	78.2	-0.1 (-0.1%)	50.7	-0.3 (-0.6%)	72.3	-0.7 (-1.0%)
Jun	52.9	-0.4 (-0.7%)	66.9	-1.1 (-1.7%)	53.7	-0.4 (-0.8%)	71.5	-1.1 (-1.5%)
Jul	53.3	-0.8 (-1.5%)	70.4	-0.6 (-0.9%)	51.2	-1.1 (-2.1%)	69.8	-1.2 (-1.7%)
Aug	57.2	0.2 (0.3%)	86.1	0.5 (0.6%)	58.8	0.1 (0.3%)	87.6	1.0 (1.1%)
Sep	84.5	0.4 (0.5%)	110.4	-0.5 (-0.4%)	89.6	0.3 (0.3%)	111.5	0.3 (0.3%)

*Source: Common Assumptions Common Modeling Package, version 8D, DSM2 Existing and Future simulations (Node CHSWP003) converted to chlorides using the equation EC*0.273-43.9)*

Note:
Simulation period: 1922-1994. Change as measured from either Existing Condition or No-Action Alternative. Dry and critical years as defined by the Sacramento Valley Index.

Key:
CP = Comprehensive Plan
EC = electrical conductivity
mg/L = milligrams per liter

Table 7-80. Simulated Monthly Average Salinity and Percent Change for the West Canal at the Clifton Court Forebay

Month	Existing Condition (2005)				Future Condition (2030)			
	Average All Years		Dry and Critical Years		Average All Years		Dry and Critical Years	
	Existing Condition (mmhos/cm)	CP3 Change (mmhos/cm (%))	Existing Condition (mmhos/cm)	CP3 Change (mmhos/cm (%))	No-Action Alternative (mmhos/cm)	CP3 Change (mmhos/cm (%))	No-Action Alternative (mmhos/cm)	CP3 Change (mmhos/cm (%))
Oct	0.6	0.0 (0.4%)	0.6	0.0 (0.9%)	0.6	0.0 (-0.1%)	0.6	0.0 (0.2%)
Nov	0.6	0.0 (0.5%)	0.6	0.0 (0.9%)	0.6	0.0 (0.1%)	0.6	0.0 (0.1%)
Dec	0.6	0.0 (0.2%)	0.7	0.0 (0.7%)	0.6	0.0 (0.1%)	0.7	0.0 (-0.1%)
Jan	0.6	0.0 (-0.4%)	0.7	0.0 (-0.9%)	0.6	0.0 (-0.2%)	0.7	0.0 (-0.5%)
Feb	0.6	0.0 (-0.1%)	0.7	0.0 (0.1%)	0.5	0.0 (-1.4%)	0.7	0.0 (-2.5%)
Mar	0.5	0.0 (0.2%)	0.6	0.0 (0.2%)	0.5	0.0 (-0.5%)	0.6	0.0 (-0.9%)
Apr	0.4	0.0 (0.1%)	0.5	0.0 (0.1%)	0.4	0.0 (-0.7%)	0.4	0.0 (-1.4%)
May	0.4	0.0 (0.1%)	0.4	0.0 (0.0%)	0.3	0.0 (-0.3%)	0.4	0.0 (-0.6%)
Jun	0.4	0.0 (-0.4%)	0.4	0.0 (-1.0%)	0.4	0.0 (-0.4%)	0.4	0.0 (-0.9%)
Jul	0.4	0.0 (-0.8%)	0.4	0.0 (-0.5%)	0.3	0.0 (-1.1%)	0.4	0.0 (-1.1%)
Aug	0.4	0.0 (0.2%)	0.5	0.0 (0.4%)	0.4	0.0 (0.1%)	0.5	0.0 (0.7%)
Sep	0.5	0.0 (0.3%)	0.6	0.0 (-0.3%)	0.5	0.0 (0.2%)	0.6	0.0 (0.2%)

Source: Common Assumptions Common Modeling Package, version 8D, DSM2 Existing and Future simulations (Node CHSWP003)

Note:
Simulation period: 1922-1994. Change as measured from either Existing Condition or No-Action Alternative. Dry and critical years as defined by the Sacramento Valley Index.

Key:
CP = Comprehensive Plan
mmhos/cm = millimhos per centimeter

Table 7-81 shows the number of days simulated chloride values exceeded the standards of 250 mg/L for the West Canal at the Clifton Court Forebay in the period of simulation. As seen in Table 7-81, there would be no additional violations throughout the year except during February. Even in February, CP3 would not change the baseline compliance levels under both Existing and Future conditions.

Table 7-82 shows the number of months simulated EC values exceeded the standards for the West Canal at the Clifton Court Forebay in the period of simulation. CP3 would not result in any additional violations of the salinity standards except during February. Even in February, CP3 would not change the baseline compliance levels under both Existing and Future conditions. Similar to the chloride concentrations, the average annual and dry and critical year averages under the basis of comparison would be under the requirement in all months. CP3 would not measurably change EC, and the increases in chloride concentration would be less than 1.0 percent.

This impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Table 7-81. Simulated Number of Days by Month of Exceedence of the Chloride Standard for the West Canal at the Clifton Court Forebay

Month	Existing Condition (2005)				Future Condition (2030)			
	Total All Years		Dry and Critical Years		Total All Years		Dry and Critical Years	
	Existing Condition (Number of Days)	CP3 Change (Number of Days (%))	Existing Condition (Number of Days)	CP3 Change (Number of Days (%))	No-Action Alternative (Number of Days)	CP3 Change (Number of Days (%))	No-Action Alternative (Number of Days)	CP3 Change (Number of Days (%))
Oct	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Nov	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Dec	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Jan	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Feb	22	-5.0 (-22.7%)	22	-5.0 (-22.7%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Mar	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Apr	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
May	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Jun	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Jul	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Aug	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Sep	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)

Source: Common Assumptions Common Modeling Package, version 8D, DSM2 Existing and Future simulations (Node CHSWP003)

Note:
Simulation period: 1922-1994. Change as measured from either Existing Condition or No-Action Alternative. Dry and critical years as defined by the Sacramento Valley Index.

Key:
CP = Comprehensive Plan

Table 7-82. Simulated Number of Months of Exceedence of the Salinity Standard for the West Canal at the Clifton Court Forebay

Month	Existing Condition (2005)				Future Condition (2030)			
	Total All Years		Dry and Critical Years		Total All Years		Dry and Critical Years	
	Existing Condition (Number of Months)	CP3 Change (Number of Months (%))	Existing Condition (Number of Months)	CP3 Change (Number of Months (%))	No-Action Alternative (Number of Months)	CP3 Change (Number of Months (%))	No-Action Alternative (Number of Months)	CP3 Change (Number of Months (%))
Oct	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Nov	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Dec	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Jan	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Feb	2	0.0 (0.0%)	2	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Mar	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Apr	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
May	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Jun	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Jul	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Aug	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Sep	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)

Source: Common Assumptions Common Modeling Package, version 8D, DSM2 Existing and Future simulations (Node CHSWP003)

Note:
Simulation period: 1922-1994. Change as measured from either Existing Condition or No-Action Alternative. Dry and critical years as defined by the Sacramento Valley Index.

Key:
CP = Comprehensive Plan

Impact WQ-19g (CP3): Delta Salinity on the San Joaquin River at Vernalis On an average monthly basis, for the basis of comparison, EC would meet requirements in all months, in both average years and in dry and critical years. Moreover, CP3 would not measurably change the EC on the San Joaquin River at Vernalis. This impact would be less than significant.

Impact WQ-19g (CP3) would be similar to Impact WQ-19g (CP1). On an average monthly basis, for the basis of comparison, EC would meet the requirements in all months in both average years and in dry and critical years. Moreover, CP3 would not measurably change EC on the San Joaquin River at Vernalis, as shown in Table 7-83. Table 7-84 shows the number of months simulated EC values exceeded the standards for the San Joaquin River at Vernalis in the period of simulation. As seen in Table 7-84, CP3 would not change the baseline compliance levels under both Existing and Future conditions.

This impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Table 7-83. Simulated Monthly Average Salinity and Percent Change for the San Joaquin River at Vernalis

Month	Existing Condition (2005)				Future Condition (2030)			
	Average All Years		Dry and Critical Years		Average All Years		Dry and Critical Years	
	Existing Condition (mmhos/cm)	CP3 Change (mmhos/cm (%))	Existing Condition (mmhos/cm)	CP3 Change (mmhos/cm (%))	No-Action Alternative (mmhos/cm)	CP3 Change (mmhos/cm (%))	No-Action Alternative (mmhos/cm)	CP3 Change (mmhos/cm (%))
Oct	0.6	0.0 (0.0%)	0.6	0.0 (0.0%)	0.5	0.0 (0.0%)	0.6	0.0 (0.0%)
Nov	0.6	0.0 (0.0%)	0.6	0.0 (0.0%)	0.6	0.0 (0.0%)	0.6	0.0 (0.0%)
Dec	0.8	0.0 (0.0%)	0.8	0.0 (0.0%)	0.7	0.0 (0.0%)	0.8	0.0 (0.0%)
Jan	0.7	0.0 (0.0%)	0.9	0.0 (0.0%)	0.7	0.0 (0.0%)	0.8	0.0 (0.0%)
Feb	0.7	0.0 (0.0%)	1.0	0.0 (0.0%)	0.7	0.0 (0.0%)	0.9	0.0 (0.0%)
Mar	0.7	0.0 (0.0%)	1.0	0.0 (0.0%)	0.7	0.0 (0.0%)	0.9	0.0 (0.0%)
Apr	0.4	0.0 (0.0%)	0.6	0.0 (0.0%)	0.4	0.0 (0.0%)	0.5	0.0 (0.0%)
May	0.5	0.0 (0.0%)	0.6	0.0 (0.0%)	0.4	0.0 (0.0%)	0.6	0.0 (0.0%)
Jun	0.6	0.0 (0.0%)	0.7	0.0 (0.0%)	0.5	0.0 (0.0%)	0.6	0.0 (0.0%)
Jul	0.6	0.0 (0.0%)	0.7	0.0 (0.0%)	0.6	0.0 (0.0%)	0.6	0.0 (0.0%)
Aug	0.6	0.0 (0.0%)	0.7	0.0 (0.0%)	0.5	0.0 (0.0%)	0.6	0.0 (0.0%)
Sep	0.5	0.0 (0.0%)	0.6	0.0 (0.0%)	0.5	0.0 (0.0%)	0.6	0.0 (0.0%)

Source: Common Assumptions Common Modeling Package, version 8D, DSM2 Existing and Future simulations (Node RSAN112)

Note:
Simulation period: 1922-1994. Change as measured from either Existing Condition or No-Action Alternative. Dry and critical years as defined by the Sacramento Valley Index.

Key:
CP = Comprehensive Plan
mmhos/cm = millimhos per centimeter

Table 7-84. Simulated Number of Months of Exceedence of the Salinity Standard for the San Joaquin River at Vernalis

Month	Existing Condition (2005)				Future Condition (2030)			
	Total All Years		Dry and Critical Years		Total All Years		Dry and Critical Years	
	Existing Condition (Number of Months)	CP3 Change (Number of Months (%))	Existing Condition (Number of Months)	CP3 Change (Number of Months (%))	No-Action Alternative (Number of Months)	CP3 Change (Number of Months (%))	No-Action Alternative (Number of Months)	CP3 Change (Number of Months (%))
Oct	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Nov	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Dec	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Jan	1	0.0 (0.0%)	1	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Feb	6	0.0 (0.0%)	5	0.0 (0.0%)	1	0.0 (0.0%)	1	0.0 (0.0%)
Mar	10	1.0 (10.0%)	10	1.0 (10.0%)	8	0.0 (0.0%)	8	0.0 (0.0%)
Apr	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
May	1	0.0 (0.0%)	1	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Jun	2	0.0 (0.0%)	2	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Jul	1	0.0 (0.0%)	1	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Aug	4	0.0 (0.0%)	4	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Sep	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)

Source: Common Assumptions Common Modeling Package, version 8D, DSM2 Existing and Future simulations (Node RSAN112)

Note:
Simulation period: 1922-1994. Change as measured from either Existing Condition or No-Action Alternative. Dry and critical years as defined by the Sacramento Valley Index.

Key:
CP = Comprehensive Plan

Impact WQ-19h (CP3): Delta Salinity on the San Joaquin River at Brandt Bridge Impact WQ-19h (CP3) would be the same as Impact WQ-19g (CP3). On an average monthly basis, for the basis of comparison, EC would meet requirements in all months, in both average years and in dry and critical years. Moreover, CP3 would not measurably change EC on the San Joaquin River at Brandt Bridge. This impact would be less than significant.

Impact WQ-19h (CP3) would be similar to Impact WQ-19h (CP1). On an average monthly basis, for the basis of comparison, EC would meet the requirements in all months in both average years and in dry and critical years. Moreover, CP3 would not measurably change EC on the San Joaquin River at Brandt Bridge, as shown in Table 7-85. Table 7-86 shows the number of months simulated EC values exceeded the standards for the San Joaquin River at Brandt Bridge in the period of simulation. CP3 would not change the Existing compliance level for salinity standards for the San Joaquin River at Brandt Bridge. This impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Table 7-85. Simulated Monthly Average Salinity and Percent Change for the San Joaquin River at Brandt Bridge

Month	Existing Condition (2005)				Future Condition (2030)			
	Average All Years		Dry and Critical Years		Average All Years		Dry and Critical Years	
	Existing Condition (mmhos/cm)	CP3 Change (mmhos/cm (%))	Existing Condition (mmhos/cm)	CP3 Change (mmhos/cm (%))	No-Action Alternative (mmhos/cm)	CP3 Change (mmhos/cm (%))	No-Action Alternative (mmhos/cm)	CP3 Change (mmhos/cm (%))
Oct	0.6	0.0 (0.0%)	0.6	0.0 (0.0%)	0.5	0.0 (0.0%)	0.6	0.0 (0.0%)
Nov	0.6	0.0 (0.0%)	0.6	0.0 (0.0%)	0.6	0.0 (0.0%)	0.6	0.0 (0.0%)
Dec	0.7	0.0 (0.0%)	0.8	0.0 (0.0%)	0.7	0.0 (0.0%)	0.8	0.0 (0.0%)
Jan	0.7	0.0 (0.0%)	0.9	0.0 (0.0%)	0.7	0.0 (0.0%)	0.8	0.0 (0.0%)
Feb	0.7	0.0 (0.0%)	1.0	0.0 (0.0%)	0.7	0.0 (0.0%)	0.9	0.0 (0.0%)
Mar	0.7	0.0 (0.0%)	1.0	0.0 (0.0%)	0.7	0.0 (0.0%)	0.9	0.0 (0.0%)
Apr	0.5	0.0 (0.0%)	0.6	0.0 (0.0%)	0.4	0.0 (0.0%)	0.6	0.0 (0.0%)
May	0.5	0.0 (0.0%)	0.6	0.0 (0.0%)	0.4	0.0 (0.0%)	0.6	0.0 (0.0%)
Jun	0.6	0.0 (0.0%)	0.7	0.0 (0.0%)	0.5	0.0 (0.0%)	0.7	0.0 (0.0%)
Jul	0.6	0.0 (0.0%)	0.7	0.0 (0.0%)	0.6	0.0 (0.0%)	0.7	0.0 (-0.1%)
Aug	0.6	0.0 (0.0%)	0.7	0.0 (0.0%)	0.5	0.0 (0.0%)	0.6	0.0 (0.0%)
Sep	0.6	0.0 (0.0%)	0.6	0.0 (0.0%)	0.5	0.0 (0.0%)	0.6	0.0 (0.0%)

Source: Common Assumptions Common Modeling Package, version 8D, DSM2 Existing and Future simulations (Node RSAN112)

Note:
Simulation period: 1922-1994. Change as measured from either Existing Condition or No-Action Alternative. Dry and critical years as defined by the Sacramento Valley Index.

Key:
CP = Comprehensive Plan
mmhos/cm = millimhos per centimeter

Table 7-86. Simulated Number of Months of Exceedence of the Salinity Standard for the San Joaquin River at Brandt Bridge

Month	Existing Condition (2005)				Future Condition (2030)			
	Total All Years		Dry and Critical Years		Total All Years		Dry and Critical Years	
	Existing Condition (Number of Months)	CP3 Change (Number of Months (%))	Existing Condition (Number of Months)	CP3 Change (Number of Months (%))	No-Action Alternative (Number of Months)	CP3 Change (Number of Months (%))	No-Action Alternative (Number of Months)	CP3 Change (Number of Months (%))
Oct	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Nov	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Dec	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Jan	1	0.0 (0.0%)	1	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Feb	6	0.0 (0.0%)	5	0.0 (0.0%)	1	0.0 (0.0%)	1	0.0 (0.0%)
Mar	21	0.0 (0.0%)	19	0.0 (0.0%)	14	0.0 (0.0%)	13	0.0 (0.0%)
Apr	7	0.0 (0.0%)	7	0.0 (0.0%)	1	0.0 (0.0%)	1	0.0 (0.0%)
May	1	0.0 (0.0%)	1	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Jun	22	0.0 (0.0%)	20	0.0 (0.0%)	3	0.0 (0.0%)	3	0.0 (0.0%)
Jul	7	0.0 (0.0%)	7	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Aug	4	0.0 (0.0%)	4	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Sep	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)

Source: Common Assumptions Common Modeling Package, version 8D, DSM2 Existing and Future simulations (Node RSAN112)

Note:
Simulation period: 1922-1994. Change as measured from either Existing Condition or No-Action Alternative. Dry and critical years as defined by the Sacramento Valley Index.

Key:
CP = Comprehensive Plan

Impact WQ-19i (CP3): Delta Salinity on the Old River near the Middle River
Impact WQ-19i (CP3) would be similar to Impact WQ-19i (CP1). On an average monthly basis, for the basis of comparison, EC would meet requirements in all months, in both average years and in dry and critical years. Moreover, CP3 would not measurably change EC on the Old River near the Middle River. This impact would be less than significant.

Impact WQ-19i (CP3) would be similar to Impact WQ-19i (CP1). On an average monthly basis, for the basis of comparison, EC would meet the requirements in all months in both average years and in dry and critical years. Moreover, CP3 would not measurably change EC on the Old River near the Middle River, as shown in Table 7-87. Table 7-88 shows the number of months simulated EC values exceeded the standards for the Old River near the Middle River in the period of simulation. As shown in Table 7-88, the compliance of salinity standards for the Old River near the Middle River would not change under CP3 when compared to the Existing Conditions.

This impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Table 7-87. Simulated Monthly Average Salinity and Percent Change for the Old River near the Middle River

Month	Existing Condition (2005)				Future Condition (2030)			
	Average All Years		Dry and Critical Years		Average All Years		Dry and Critical Years	
	Existing Condition (mmhos/cm)	CP3 Change (mmhos/cm (%))	Existing Condition (mmhos/cm)	CP3 Change (mmhos/cm (%))	No-Action Alternative (mmhos/cm)	CP3 Change (mmhos/cm (%))	No-Action Alternative (mmhos/cm)	CP3 Change (mmhos/cm (%))
Oct	0.6	0.0 (0.0%)	0.6	0.0 (0.0%)	0.4	0.0 (-0.1%)	0.5	0.0 (0.1%)
Nov	0.6	0.0 (0.0%)	0.6	0.0 (0.0%)	0.5	0.0 (0.0%)	0.5	0.0 (-0.2%)
Dec	0.8	0.0 (0.0%)	0.8	0.0 (0.0%)	0.6	0.0 (0.1%)	0.6	0.0 (0.1%)
Jan	0.7	0.0 (0.0%)	0.9	0.0 (0.0%)	0.6	0.0 (-0.2%)	0.7	0.0 (-0.3%)
Feb	0.7	0.0 (0.0%)	1.0	0.0 (0.0%)	0.6	0.0 (-0.6%)	0.7	0.0 (-1.3%)
Mar	0.7	0.0 (0.0%)	1.0	0.0 (0.0%)	0.5	0.0 (-0.4%)	0.7	0.0 (-1.0%)
Apr	0.5	0.0 (0.0%)	0.6	0.0 (0.0%)	0.4	0.0 (-0.6%)	0.5	0.0 (-1.2%)
May	0.5	0.0 (0.0%)	0.6	0.0 (0.0%)	0.4	0.0 (-0.2%)	0.5	0.0 (-0.3%)
Jun	0.6	0.0 (0.0%)	0.7	0.0 (0.0%)	0.4	0.0 (0.0%)	0.5	0.0 (-0.1%)
Jul	0.6	0.0 (0.0%)	0.7	0.0 (0.0%)	0.4	0.0 (-0.7%)	0.4	0.0 (-1.6%)
Aug	0.6	0.0 (0.0%)	0.7	0.0 (0.0%)	0.4	0.0 (0.1%)	0.4	0.0 (0.4%)
Sep	0.6	0.0 (0.0%)	0.6	0.0 (0.0%)	0.4	0.0 (0.1%)	0.4	0.0 (0.1%)

Source: Common Assumptions Common Modeling Package, version 8D, DSM2 Existing and Future simulations (Node RMID041)

Note:
Simulation period: 1922-1994. Change as measured from either Existing Condition or No-Action Alternative. Dry and critical years as defined by the Sacramento Valley Index.

Key:
CP = Comprehensive Plan
mmhos/cm = millimhos per centimeter

Table 7-88. Simulated Number of Months of Exceedence of the Salinity Standard for the Old River near the Middle River

Month	Existing Condition (2005)				Future Condition (2030)			
	Total All Years		Dry and Critical Years		Total All Years		Dry and Critical Years	
	Existing Condition (Number of Months)	CP3 Change (Number of Months (%))	Existing Condition (Number of Months)	CP3 Change (Number of Months (%))	No-Action Alternative (Number of Months)	CP3 Change (Number of Months (%))	No-Action Alternative (Number of Months)	CP3 Change (Number of Months (%))
Oct	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Nov	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Dec	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Jan	1	0.0 (0.0%)	1	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Feb	6	0.0 (0.0%)	5	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Mar	20	0.0 (0.0%)	18	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Apr	5	0.0 (0.0%)	5	0.0 (0.0%)	1	-1.0 (-100.0%)	1	-1.0 (-100.0%)
May	2	0.0 (0.0%)	2	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Jun	22	0.0 (0.0%)	20	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Jul	7	0.0 (0.0%)	7	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Aug	4	0.0 (0.0%)	4	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Sep	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)

Source: Common Assumptions Common Modeling Package, version 8D, DSM2 Existing and Future simulations (Node RMID041)

Note:
Simulation period: 1922-1994. Change as measured from either Existing Condition or No-Action Alternative. Dry and critical years as defined by the Sacramento Valley Index.

Key:
CP = Comprehensive Plan

Impact WQ-19j (CP3): Delta Salinity on the Old River at Tracy Road Bridge
Impact WQ-19j (CP3) would be similar to Impact WQ-19j (CP1). On an average monthly basis, for the basis of comparison, EC would meet requirements in all months, in both average years and in dry and critical years. Moreover, CP3 would not measurably change EC on the Old River at Tracy Road Bridge. This impact would be less than significant.

Impact WQ-19j (CP3) would be similar to Impact WQ-19j (CP1). On an average monthly basis, for the basis of comparison, EC would meet the requirements in all months in both average years and in dry and critical years. Moreover, CP3 would not measurably change EC on the Old River at Tracy Road Bridge, as shown in Table 7-89. Table 7-90 shows the number of months simulated EC values exceeded the standards for the Old River near Tracy Road Bridge in the period of simulation. On an annual average basis, the compliance of salinity standards under CP3 would not change from the Existing Conditions by more than 2 percent. Overall, CP3 would not change the baseline compliance levels under both Existing and Future conditions.

This impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Table 7-89. Simulated Monthly Average Salinity and Percent Change for the Old River at Tracy Road Bridge

Month	Existing Condition (2005)				Future Condition (2030)			
	Average All Years		Dry and Critical Years		Average All Years		Dry and Critical Years	
	Existing Condition (mmhos/cm)	CP3 Change (mmhos/cm (%))	Existing Condition (mmhos/cm)	CP3 Change (mmhos/cm (%))	No-Action Alternative (mmhos/cm)	CP3 Change (mmhos/cm (%))	No-Action Alternative (mmhos/cm)	CP3 Change (mmhos/cm (%))
Oct	0.6	0.0 (0.0%)	0.6	0.0 (0.0%)	0.6	0.0 (0.0%)	0.6	0.0 (0.4%)
Nov	0.6	0.0 (0.0%)	0.6	0.0 (0.0%)	0.6	0.0 (0.1%)	0.6	0.0 (0.0%)
Dec	0.8	0.0 (0.0%)	0.8	0.0 (0.0%)	0.6	0.0 (0.1%)	0.7	0.0 (0.2%)
Jan	0.8	0.0 (0.0%)	0.9	0.0 (0.0%)	0.6	0.0 (-0.2%)	0.7	0.0 (-0.4%)
Feb	0.8	0.0 (0.0%)	1.0	0.0 (0.0%)	0.6	0.0 (-1.1%)	0.7	0.0 (-2.3%)
Mar	0.7	0.0 (0.0%)	1.0	0.0 (0.0%)	0.5	0.0 (0.2%)	0.7	0.0 (0.1%)
Apr	0.5	0.0 (0.0%)	0.7	0.0 (0.0%)	0.4	0.0 (-0.3%)	0.5	0.0 (-0.7%)
May	0.5	0.0 (0.0%)	0.6	0.0 (0.0%)	0.4	0.0 (-0.3%)	0.5	0.0 (-0.6%)
Jun	0.6	0.0 (0.1%)	0.7	0.0 (0.3%)	0.4	0.0 (-0.4%)	0.5	0.0 (-0.7%)
Jul	0.6	0.0 (-0.2%)	0.7	0.0 (-0.4%)	0.4	0.0 (-0.9%)	0.5	0.0 (-1.2%)
Aug	0.6	0.0 (0.0%)	0.6	0.0 (0.1%)	0.4	0.0 (0.1%)	0.5	0.0 (0.7%)
Sep	0.6	0.0 (0.0%)	0.6	0.0 (0.0%)	0.5	0.0 (0.2%)	0.6	0.0 (0.3%)

Source: Common Assumptions Common Modeling Package, version 8D, DSM2 Existing and Future simulations (Node ROLD059)

Note:
Simulation period: 1922-1994. Change as measured from either Existing Condition or No-Action Alternative. Dry and critical years as defined by the Sacramento Valley Index.

Key:
CP = Comprehensive Plan
mmhos/cm = millimhos per centimeter

Table 7-90. Simulated Number of Months of Exceedence of the Salinity Standard for the Old River at Tracy Road Bridge

Month	Existing Condition (2005)				Future Condition (2030)			
	Total All Years		Dry and Critical Years		Total All Years		Dry and Critical Years	
	Existing Condition (Number of Months)	CP3 Change (Number of Months (%))	Existing Condition (Number of Months)	CP3 Change (Number of Months (%))	No-Action Alternative (Number of Months)	CP3 Change (Number of Months (%))	No-Action Alternative (Number of Months)	CP3 Change (Number of Months (%))
Oct	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Nov	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Dec	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Jan	2	0.0 (0.0%)	1	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Feb	11	0.0 (0.0%)	10	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Mar	21	0.0 (0.0%)	19	0.0 (0.0%)	1	-1.0 (-100.0%)	1	-1.0 (-100.0%)
Apr	23	0.0 (0.0%)	21	0.0 (0.0%)	2	-2.0 (-100.0%)	2	-2.0 (-100.0%)
May	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Jun	16	1.0 (6.3%)	14	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Jul	10	0.0 (0.0%)	8	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Aug	2	1.0 (50.0%)	2	1.0 (50.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)
Sep	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)	0	0.0 (0.0%)

Source: Common Assumptions Common Modeling Package, version 8D, DSM2 Existing and Future simulations (Node ROLD059)

Note:
Simulation period: 1922-1994. Change as measured from either Existing Condition or No-Action Alternative. Dry and critical years as defined by the Sacramento Valley Index.

Key:
CP = Comprehensive Plan

Impact WQ-20 (CP3): X2 Position CP3 would not change average monthly X2 in either average years or in dry and critical years by more than 0.1 km under either the Existing Condition or Future Condition. While several months may be out of compliance under the bases of comparison, the change resulting from CP3 would not increase the amount out of compliance. This impact would be less than significant.

Impact WQ-20 (CP3) would be similar to Impact WQ-20 (CP1). Table 7-91 shows the simulated monthly average X2 position for CP3 compared to the Existing Condition and Future Condition baselines. CalSim-II calculates the X2 position on a 1-month delay; the values shown have been corrected to accurately reflect the X2 position for the specified month.

CP3 would not change average monthly X2 in either average years or in dry or critical years by more than 0.1 km under either the Existing Condition or Future Condition. While several months may be out of compliance under the bases of comparison, the change resulting from CP3 would not increase the amount out of compliance.

Table 7-91. Simulated Monthly Average X2 Position

Month	Existing Condition (2005)				Future Condition (2030)			
	Average All Years		Dry and Critical Years		Average All Years		Dry and Critical Years	
	Existing Condition (km)	CP3 Change (km (%))	Existing Condition (km)	CP3 Change (km (%))	No-Action Alternative (km)	CP3 Change (km (%))	No-Action Alternative (km)	CP3 Change (km (%))
Oct	85.2	0.0 (0.0%)	86.7	0.0 (0.0%)	85.6	0.0 (0.0%)	86.9	0.0 (0.0%)
Nov	82.7	0.0 (0.0%)	85.2	0.0 (0.0%)	83.1	0.0 (0.0%)	85.4	0.0 (-0.1%)
Dec	77.3	0.0 (0.0%)	83.0	-0.3 (-0.3%)	77.7	0.0 (0.0%)	83.3	-0.2 (-0.3%)
Jan	71.6	0.1 (0.1%)	80.4	0.1 (0.2%)	72.0	0.0 (0.0%)	80.7	-0.1 (-0.1%)
Feb	66.1	0.2 (0.3%)	75.1	0.4 (0.6%)	66.3	0.1 (0.1%)	75.3	0.0 (0.0%)
Mar	65.7	0.1 (0.2%)	74.0	0.2 (0.3%)	65.8	0.1 (0.1%)	74.1	0.1 (0.2%)
Apr	68.1	0.0 (0.0%)	75.5	0.0 (0.0%)	68.1	0.0 (0.0%)	75.6	0.0 (0.0%)
May	71.3	0.0 (0.0%)	78.9	0.0 (-0.1%)	71.3	0.0 (0.0%)	78.8	0.0 (0.0%)
Jun	75.2	0.0 (0.0%)	81.3	-0.1 (-0.1%)	75.2	0.0 (0.0%)	81.2	-0.2 (-0.3%)
Jul	79.2	0.0 (0.0%)	83.9	-0.1 (-0.1%)	78.8	0.0 (0.0%)	83.7	-0.1 (-0.1%)
Aug	84.1	-0.1 (-0.1%)	85.7	-0.2 (-0.3%)	84.0	0.0 (-0.1%)	85.5	-0.1 (-0.2%)
Sep	85.6	0.0 (0.0%)	88.8	-0.1 (-0.1%)	85.8	-0.1 (-0.1%)	88.5	-0.2 (-0.2%)

Source: Common Assumptions Common Modeling Package version 8D CalSim-II 2005 and 2030 simulations (Node X2_PRV)

Note:
Simulation period: 1922-1994. Change as measured from either Existing Condition or No-Action Alternative. Dry and critical years as defined by the Sacramento Valley Index.

Key:
CP = Comprehensive Plan
km = kilometer
X2 = geographic location of 2 parts per thousand near-bottom salinity isohaline in the Delta, measured in distance upstream from Golden Gate Bridge in Suisun Bay.

This impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

CP4 – 18.5-Foot Dam Raise, Anadromous Fish Focus with Water Supply Reliability

The primary function of CP4 is to address survival of anadromous fish, while still improving water supply reliability. It focuses on increasing the volume of cold water available to the TCD through reservoir reoperations, and on raising Shasta Dam 18.5 feet. As with CP3 and the common features, this raise would increase the full pool elevation by 20.5 feet and enlarge total reservoir storage space by 634 TAF. This additional storage space would expand Shasta Lake's cold-water supply available to the TCD by 378 TAF, a feature that would help improve cooler water temperatures in the upper Sacramento River. CP4 would differ from the No-Action Alternative primarily through a 634 TAF enlargement of Shasta Lake, with 256 TAF operated for water supply reliability and 378 TAF of the storage dedicated to anadromous fish survivability, through an increase in available cold water for release to the Sacramento River. In

addition, CP4 would include riparian, floodplain, and side channel habitat restoration activities at Reading Island.

Shasta Lake and Vicinity

Impact WQ-1 (CP4): Temporary Construction-Related Sediment Effects on Shasta Lake and Its Tributaries That Would Violate Water Quality Standards or Adversely Affect Beneficial Uses This impact would be similar to Impact WQ-1 (CP3). The nature of inundation and relocation impacts are consistent with those described for CP3 in Chapter 2, "Alternatives." This impact would be potentially significant. Mitigation for this impact is proposed in Section 7.3.5.

Impact WQ-2 (CP4): Temporary Construction-Related Temperature Effects on Shasta Lake and Its Tributaries That Would Violate Water Quality Standards or Adversely Affect Beneficial Uses This impact would be similar to Impact WQ-2 (CP3). The nature of inundation and relocation impacts are consistent with those described for CP3 in Chapter 2, "Alternatives." This impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact WQ-3 (CP4): Temporary Construction-Related Metal Effects on Shasta Lake and Its Tributaries That Would Violate Water Quality Standards or Adversely Affect Beneficial Uses This impact is similar to WQ-3 (CP1). There would be no construction activities that would disturb locations known to contain elevated metal concentrations in either sediments or the water column. Therefore, this impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact WQ-4 (CP4): Long-Term Sediment Effects That Would Violate Water Quality Standards or Adversely Affect Beneficial Uses in Shasta Lake or Its Tributaries This impact would be similar to Impact WQ-4 (CP3). The nature of inundation and relocation impacts are consistent with those described for CP3. This would be a potentially significant impact. Mitigation for this impact is proposed in Section 7.3.5.

Impact WQ-5 (CP4): Long-Term Temperature Effects That Would Violate Water Quality Standards or Adversely Affect Beneficial Uses in Shasta Lake or Its Tributaries Similar to CP1, this alternative would increase storage on a monthly basis, although it would vary by water year. Table 7-92 illustrates the monthly change in simulated storage for CP4 as a percent increase above the No-Action Alternative. On average, CP4 represents about a 17-percent increase in the end-of-month storage on an annual basis.

Under CP4, existing water temperature requirements would typically be met in most years; therefore, the additional increase in water storage shown in Table 7-92 would primarily be released for water supply purposes. Accordingly, minimal increases in releases from Shasta Dam would be expected in months when Delta exports are constrained, or when flow is not usable for water supply purposes.

Table 7-92. Simulated Average Increased End-of-Month Shasta Lake Storage – CP4

Month	Existing Condition (TAF)	CP4 (TAF)	CP4 % Increase
Oct	2,671	522	19.5%
Nov	2,690	526	19.6%
Dec	2,815	538	19.1%
Jan	3,067	543	17.7%
Feb	3,291	553	16.8%
Mar	3,624	553	15.3%
Apr	3,919	548	14.0%
May	3,950	549	13.9%
Jun	3,642	547	15.0%
Jul	3,187	540	16.9%
Aug	2,879	528	18.3%
Sep	2,782	523	18.8%

Source: Common Assumptions Common Modeling Package Version 8D CalSim-II 2005 and 2030 simulations (Node S4+S44)

Note:
Simulation period: 1922-2003

Key:
TAF = thousand acre-feet

Similar to CP1, the increase in storage provided by CP4 fluctuates greatly throughout a year. A key indicator of water temperature benefits of CP3 to the upper Sacramento River between Keswick Dam and Red Bluff is the amount of cold water available in Shasta Lake prior to the water temperature operation season, about May through October. Similar to CP1, the CWP volume in the lake accumulates during the winter and early spring and is not likely to increase after April. Therefore, the expected increase in spring storage for CP4 should also result in an incremental increase in the CWP volume.

The simulated end-of-April volume of water with a temperature lower than 52˚F for the No-Action Alternative and the change in CWP volume for CP4 is shown, by SVI, in Table 7-93.

Under CP4, existing water temperature requirements would typically be met in most years; therefore, the additional increase in water storage shown in Table 7-92 would primarily be released for water supply purposes. Accordingly, minimal increases in releases from Shasta Dam would be expected in months when Delta exports are constrained, or when flow is not usable for water supply purposes.

Table 7-93. Simulated Average Volume of Water Less than 52˚F in Shasta Lake at the End of April – CP4

SVI Year Type	Existing Condition (TAF)	CP4 (TAF)	CP4 % Increase
Average of All Years	1,577	348	22.1%
Wet	1,807	437	24.2%
Above Normal	1,721	324	18.8%
Below Normal	1,743	341	19.6%
Dry	1,451	310	21.4%
Critical	928	241	26.0%

Source: Common Assumptions Common Modeling Package Version 8D SRWQM 2005 and 2030 simulations

Note:
Simulation period: 1922-2003
Year types as defined by the Sacramento Valley Index

Key:
SVI = Sacramento Valley Index
TAF = thousand acre-feet

In addition to illustrating the average change in available CWP, Table 7-93 also shows the influence of climatic conditions on these values. The diversity between water year types, coupled with unique combinations of storage and rainfall would continue to influence the ability to manage storage in Shasta Lake to maximize carryover capacity. Although there is a meaningful increase in active storage and carryover storage of the CWP, this increase is considered to be a less than significant impact. Mitigation for this impact is not needed, and thus not proposed.

Impact WQ-6 (CP4): Long-Term Metals Effects That Would Violate Water Quality Standards or Adversely Affect Beneficial Uses in Shasta Lake or Its Tributaries This impact is similar to CP1. The nature of inundation and relocation impacts are consistent with those described for CP3. It would be a potentially significant impact. Mitigation for this impact is proposed in Section 7.3.5.

Upper Sacramento River (Shasta Dam to Red Bluff)

Impact WQ-7 (CP4): Temporary Construction-Related Sediment Effects on the Upper Sacramento River That Would Cause Violations of Water Quality Standards or Adversely Affect Beneficial Uses Construction would include ground-disturbing activities that could result in soil erosion and sediment effects on the upper Sacramento River. This impact would be potentially significant.

Ground-disturbing activities associated with construction could cause soil erosion and sedimentation of local drainages and eventually the Sacramento River. Construction activities could also discharge waste petroleum products or other construction-related substances that could enter these waterways/facilities in runoff. In addition, transportation, handling, and placement of materials used

for gravel augmentation as well as clearing, grubbing, and grading during construction could also adversely affect water quality and temporarily increase turbidity and sedimentation downstream from the gravel augmentation sites. In-water construction work at some gravel augmentation sites could also result in temporary increase in turbidity, downstream sedimentation, and accidental discharge of construction-related substances into the river channel.

In addition, riparian, floodplain, and side channel habitat restoration activities at Reading Island as part of CP4 would involve breaching the levee using an excavator, loader, and compaction equipment and excavation of approximately 15,650 cubic yards of earthen material for off-site disposal, and potential vegetation clearing along 0.8 mile of channel. Invasive aquatic vegetation would be removed as well. Although in-water construction is expected to take place during periods of low flow in the Sacramento River (October to November) to minimize effects on water quality, construction activities related to habitat restoration and vegetation clearing could adversely affect water quality and temporarily increase turbidity and sedimentation downstream, or result in the accidental discharge of construction-related substances into the river channel. In addition, excavated sediments could be contaminated with pesticides and metals. Development and implementation of a SWPPP as part of the environmental commitments described in Chapter 2, "Alternatives," would reduce potential impacts related to pesticides and metals. However, this impact would remain potentially significant. Mitigation for this impact is proposed in Section 7.3.5.

Impact WQ-8 (CP4): Temporary Construction-Related Temperature Effects on the Upper Sacramento River That Cause Violations of Water Quality Standards or Adversely Affect Beneficial Uses Construction activities are not anticipated to result in temperature effects on the upper Sacramento River because changes to water temperature in Shasta Lake and subsequent releases to the Sacramento River would be consistent with typical periodic fluctuations. This impact would be less than significant.

This impact would be similar to Impact WQ-8 (CP1). For the same reasons as described for Impact WQ-8 (CP1), this impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact WQ-9 (CP4): Temporary Construction-Related Metal Effects on the Upper Sacramento River That Cause Violations of Water Quality Standards or Adversely Affect Beneficial Uses Construction activities are not anticipated to result in water quality effects on the upper Sacramento River related to metals because construction would not disturb locations of known elevated metal concentrations. This impact would be less than significant.

This impact would be similar to Impact WQ-9 (CP1). For the same reasons as described for Impact WQ-9 (CP1), this impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact WQ-10 (CP4): Long-Term Sediment Effects That Cause Violations of Water Quality Standards or Adversely Affect Beneficial Uses in the Upper Sacramento River No long-term water quality impacts are anticipated in the upper Sacramento River in regard to sediment, because modeling results have indicated that CP4 would cause little change in average mean monthly flow, and could cause a decrease in peak flows that are associated with increased sediment transport. This impact would be less than significant.

This impact would be similar to Impact WQ-10 (CP1) because the extent of the effect of CP4 on sediment would be similar to that for CP1. For the same reasons as described for Impact WQ-10 (CP1), this impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact WQ-11 (CP4): Long-Term Temperature Effects That Cause Violations of Water Quality Standards or Adversely Affect Beneficial Uses in the Upper Sacramento River Analysis of temperature modeling results indicates that CP4 would improve compliance with the temperature requirements on the Sacramento River because of the increased depth of the cold-water pool in Shasta Lake and the associated enhanced ability to regulate water temperature releases to the upper Sacramento River. Therefore, the impact of CP4 on water quality measured as temperature would be beneficial.

CP4 would increase the ability of Shasta Dam to release cold water and regulate water temperature in the upper Sacramento River, primarily in dry and critically dry years. Raising Shasta Dam 18.5 feet would increase the cold-water pool and benefit seasonal water temperatures along the upper Sacramento River. This section focuses on compliance with water quality standards for temperature. For an analysis of temperature effects on fisheries and aquatic habitat, see Chapter 11, “Fisheries and Aquatic Ecosystems.”

Analysis of temperature modeling results indicates that CP4 would have a beneficial effect on temperature within the upper Sacramento River with a measurable decrease in average monthly water temperature during summer months under both existing and future conditions. For instance, at the Balls Ferry compliance station in September, average monthly water temperature would be reduced by 1.2^{o}F. During October at Balls Ferry, the average monthly temperature would decrease by 1.6^{o}F. For more information on modeling results and monthly water temperature, see Chapter 11, “Fisheries and Aquatic Ecosystems.”

Decreased temperatures would improve compliance with the temperature objectives for the upper Sacramento River in the 2004 BO. Analysis of modeling results indicates that CP4 would reduce temperature exceedences at Balls Ferry by 37 percent under existing conditions and 40 percent under future conditions. At the Bend Bridge compliance station, CP4 would reduce temperature exceedences by 13-percent under existing conditions and 15

percent under future conditions. Table 7-6 summarizes the temperature modeling results.

CP4 would have the greatest beneficial effect on water temperature of all alternatives evaluated. Based on this analysis, effects of CP4 on water quality measured as temperature would be beneficial. Mitigation for this impact is not needed, and thus not proposed.

Impact WQ-12 (CP4): Long-Term Metals Effects That Cause Violations of Water Quality Standards or Adversely Affect Beneficial Uses in the Upper Sacramento River Long-term operation of the project could result in water quality effects on the upper Sacramento River in regard to metals as a result of erosional processes to historic mining and smelting operation features. This impact would be potentially significant.

This impact is similar to Impact WQ-12 (CP1) because the extent of the effect of CP4 on metals would be similar to that for CP1. For the same reasons as described for Impact WQ-12 (CP1), this impact would be potentially significant. Mitigation for this impact is proposed in Section 7.3.5.

Lower Sacramento River and Delta and CVP/SWP Service Areas

Impact WQ-13 (CP4): Temporary Construction-Related Sediment Effects on the Extended Study Area That Would Cause Violations of Water Quality Standards or Adversely Affect Beneficial Uses Construction is not anticipated to affect water quality conditions in the extended study area. This impact would be less than significant.

This impact would be similar to Impact WQ-13 (CP1). For the same reasons as described for Impact WQ-13 (CP1), this impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact WQ-14 (CP4): Temporary Construction-Related Temperature Effects on the Extended Study Area That Cause Violations of Water Quality Standards or Adversely Affect Beneficial Uses This impact would be similar to Impact WQ-14 (CP1). For the same reasons as described for Impact WQ-14 (CP1), this impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact WQ-15 (CP4): Temporary Construction-Related Metal Effects on the Extended Study Area That Cause Violations of Water Quality Standards or Adversely Affect Beneficial Uses This impact would be similar to Impact WQ-15 (CP1). For the same reasons as described for Impact WQ-15 (CP1), this impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact WQ-16 (CP4): Long-Term Sediment Effects That Cause Violations of Water Quality Standards or Adversely Affect Beneficial Uses in the Extended Study Area Project implementation could affect water quality in the extended

study area, but effects would diminish with distance. This impact would be less than significant.

This impact would be similar to Impact WQ-16 (CP1). For the same reasons described for Impact WQ-16 (CP1), this impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact WQ-17 (CP4): Long-Term Temperature Effects That Cause Violations of Water Quality Standards or Adversely Affect Beneficial Uses in the Extended Study Area This impact would be similar to Impact WQ-17 (CP1). For the same reasons as described for Impact WQ-17 (CP1), this impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact WQ-18 (CP4): Long-Term Metals Effects That Cause Violations of Water Quality Standards or Adversely Affect Beneficial Uses in the Extended Study Area This impact would be similar to Impact WQ-18 (CP1). For the same reasons described for Impact WQ-18 (CP1), this impact would be potentially significant. Mitigation for this impact is proposed in Section 7.3.5.

Impact WQ-19a (CP4): Delta Salinity on the Sacramento River at Collinsville Operations for CP4 would result in both increases and decreases in salinity; however, none of the increases would be sufficient to change compliance for the Sacramento River at Collinsville. Similarly, on a percentage basis, all increases in salinity would be less than 10 percent; this would be within the range of natural variability. This impact would be less than significant.

This impact would be the same as Impact WQ-19a (CP1) and would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact WQ-19b (CP4): Delta Salinity on the Sacramento River at Jersey Point On an average monthly basis, for the basis of comparison, EC would meet the requirements in all months in an average year. Moreover, CP4 would not increase the EC at Jersey Point. This impact would be less than significant.

This impact would be the same as Impact WQ-19b (CP1) and would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact WQ-19c (CP4): Delta Salinity on the Sacramento River at Emmaton On an average monthly basis, for the basis of comparison, EC would meet the requirements in all months on an average annual basis; moreover, CP4 would not increase the EC at Emmaton during this period by more than 0.2 percent. This impact would be less than significant.

This impact would be the same as Impact WQ-19c (CP1) and would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact WQ-19d (CP4): Delta Salinity on the Old River at Rock Slough On an average annual basis, all months except October through January under both the

Existing Condition and Future Condition would be less than 150 mg/L. In dry and critical years, only October and November would exceed the standard under the Existing Condition, and October through February would exceed the standard in the Future Condition. In average annual years, CP4 would not increase chlorides by more than 1.2 percent, and even in that instance, the standard would be met. For dry and critical years, larger increases in chlorides would occur in November and December under the Existing Condition. However, the change in chloride concentration would not affect compliance with the standard; it would already be exceeded under the basis of comparison. This impact would be less than significant.

This impact would be the same as Impact WQ-19d (CP1) and would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact WQ-19e (CP4): Delta Salinity on the Delta-Mendota Canal at Jones Pumping Plant The water quality requirement on the Delta-Mendota Canal at Jones Pumping Plant has two components, a chloride requirement and an EC requirement. CP4 would not measurably change EC, and the increases in chloride concentration would be less than 1.0 percent. This impact would be less than significant.

This impact would be the same as Impact WQ-19e (CP1) and would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact WQ-19f (CP4): Delta Salinity on the West Canal at Clifton Court Forebay The 250 mg/L chloride concentration at the West Canal would not be exceeded on an average annual or dry and critical year basis. Furthermore, chloride concentrations would typically be lower under CP4 than under the basis of comparisons. CP4 would not measurably change EC, and the increases in chloride concentration would be less than 1.0 percent. This impact would be less than significant.

This impact would be the same as Impact WQ-19f (CP1) and would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact WQ-19g (CP4): Delta Salinity on the San Joaquin River near Vernalis On an average monthly basis, for the basis of comparison, EC would meet requirements in all months, in both average years and in dry and critical years. Moreover, CP4 would not measurably change the EC on the San Joaquin River at Vernalis. This impact would be less than significant.

This impact would be the same as Impact WQ-19g (CP1) and would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact WQ-19h (CP4): Delta Salinity on the San Joaquin River at Brandt Bridge Impact WQ-19h (CP4) would be the same as Impact WQ-19g (CP4). On an average monthly basis, for the basis of comparison, EC would meet requirements in all months, in both average years and in dry and critical years.

Moreover, CP4 would not measurably change EC on the San Joaquin River at Brandt Bridge. This impact would be less than significant.

This impact would be the same as Impact WQ-19h (CP1) and would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact WQ-19i (CP4): Delta Salinity on the Old River near the Middle River
Impact WQ-19i (CP4) would be similar to Impact WQ-19g (CP1). On an average monthly basis, for the basis of comparison, EC would meet requirements in all months, in both average years and in dry and critical years. Moreover, CP4 would not measurably change EC on the Old River near the Middle River. This impact would be less than significant.

This impact would be the same as Impact WQ-19i (CP1) and would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact WQ-19j (CP4): Delta Salinity on the Old River near Tracy Road Bridge
Impact WQ-19j (CP4) would be similar to Impact WQ-19j (CP1). On an average monthly basis, for the basis of comparison, EC would meet requirements in all months, in both average years and in dry and critical years. Moreover, CP4 would not measurably change EC on the Old River at Tracy Road Bridge. This impact would be less than significant.

This impact would be the same as Impact WQ-19j (CP1) and would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact WQ-20 (CP4): X2 Position CP4 would not change average monthly X2 in either average years or in dry and critical years by more than 0.1 km under either the Existing Condition or Future Condition. While several months may be out of compliance under the bases of comparison, the change resulting from CP4 would not increase the amount out of compliance. This impact would be less than significant.

This impact would be the same as Impact WQ-20 (CP1) and would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

CP5 – 18.5-Foot Dam Raise, Combination Plan
CP5 would address both the primary and secondary planning objectives. This alternative involves enlarging Shasta Dam 18.5 feet, which is consistent with the objectives of the 2000 CALFED ROD, and also includes the common features mentioned in CP1. CP5 also involves (1) implementing environmental restoration features along the lower reaches of major tributaries to Shasta Lake, (2) constructing shoreline fish habitat around Shasta Lake, and (3) constructing either additional or improved recreation features at various locations around Shasta Lake to increase the value of the recreational experience. CP5 would differ from the No-Action Alternative primarily through a 634-TAF enlargement of Shasta Lake with additional recreation facilities at Shasta Lake and environmental restoration to the lower ends of the Shasta Lake tributaries.

In addition, CP5, like CP4, would include riparian, floodplain, and side channel habitat restoration activities at Reading Island.

Shasta Lake and Vicinity

Impact WQ-1 (CP5): Temporary Construction-Related Sediment Effects on Shasta Lake and Its Tributaries That Would Violate Water Quality Standards or Adversely Affect Beneficial Uses This impact is similar to WQ-1 (CP3). However, CP5 includes several ecosystem restoration projects that would require temporary construction-related activities, as described in Chapter 2, "Alternatives."

Although the environmental protection measures and BMPs described in Chapter 2, "Alternatives," are intended to reduce the potential effects of introducing sediment into Shasta Lake and its tributaries, CP5 would affect water quality by increasing the levels of turbidity and suspended sediment in the receiving waters at levels that could be inconsistent with the Basin Plan. These increased levels of turbidity and suspended sediment could affect the beneficial uses of Shasta Lake and/or its tributaries. Therefore, this impact would be potentially significant. Mitigation for this impact is proposed in Section 7.3.5.

Impact WQ-2 (CP5): Temporary Construction-Related Temperature Effects on Shasta Lake and Its Tributaries That Would Violate Water Quality Standards or Adversely Affect Beneficial Uses This impact would be identical to Impact WQ-2 (CP3). The nature of inundation and relocation impacts are consistent with those described for CP3. This impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact WQ-3 (CP5): Temporary Construction-Related Metal Effects on Shasta Lake and Its Tributaries That Would Violate Water Quality Standards or Adversely Affect Beneficial Uses This impact is similar to WQ-3 (CP1). There would be no construction activities that would disturb locations known to contain elevated metal concentrations in either sediments or the water column. Therefore, this impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact WQ-4 (CP5): Long-Term Sediment Effects That Would Violate Water Quality Standards or Adversely Affect Beneficial Uses in Shasta Lake or Its Tributaries This impact is similar to WQ-4 (CP3). Although some ecosystem enhancement measures (i.e., road restoration) are expected to reduce the long-term sediment delivery to Shasta Lake and its tributaries, CP5 would nonetheless result in increased levels of suspended sediment and turbidity that could affect beneficial uses. The amount of sediment that could be delivered is not quantifiable because of the size of the lake and the number of variables that influence sediment transport and delivery. This would be a potentially significant impact. Mitigation for this impact is proposed in Section 7.3.5.

Impact WQ-5 (CP5): Long-Term Temperature Effects That Would Violate Water Quality Standards or Adversely Affect Beneficial Uses in Shasta Lake or Its Tributaries Similar to the discussion in CP3, this alternative would increase storage on a monthly basis although it would vary by water year. Table 7-65 illustrates the monthly change in simulated storage for CP5 as a percent increase above the No-Action Alternative. On average, CP5 represents about a 13 percent increase in the end-of-month storage on an annual basis.

Consistent with the discussion presented under CP3, existing water temperature requirements would typically be met in most years. The simulated end-of-April volume of water with a temperature lower than 52˚F for the No-Action Alternative and the change in CWP volume for CP5 is shown, by SVI, in Table 7-66.

In addition to illustrating the average change in available CWP, this table also shows the influence of climatic conditions on these values. The diversity between water year types, coupled with unique combinations of storage and rainfall would continue to influence the ability to manage storage in Shasta Lake to maximize carryover capacity. Although there is a meaningful increase in active storage and carryover storage of the CWP, this increase is considered to be a less than significant impact. Mitigation for this impact is not needed, and thus not proposed.

Impact WQ-6 (CP5): Long-Term Metals Effects That Would Violate Water Quality Standards or Adversely Affect Beneficial Uses in Shasta Lake or Its Tributaries This impact is similar to CP1. The nature of inundation and relocation impacts are consistent with those described for CP3. It would be a potentially significant impact. Mitigation for this impact is proposed in Section 7.3.5.

Upper Sacramento River (Shasta Dam to Red Bluff)

Impact WQ-7 (CP5): Temporary Construction-Related Sediment Effects on the Upper Sacramento River That Would Cause Violations of Water Quality Standards or Adversely Affect Beneficial Uses Construction would include ground-disturbing activities that could result in soil erosion and sediment effects on the upper Sacramento River. This impact would be potentially significant.

Ground-disturbing activities associated with construction could cause soil erosion and sedimentation of local drainages and eventually the Sacramento River. Construction activities could also discharge waste petroleum products or other construction-related substances that could enter these waterways/facilities in runoff. As described for Impact WQ-7 (CP4), gravel augmentation construction activities could also adversely affect water quality and temporarily increase turbidity and sedimentation downstream from the gravel augmentation sites.

In addition, riparian, floodplain, and side channel habitat restoration activities at Reading Island as part of CP5 would involve breaching the levee using an excavator, loader, and compaction equipment and excavation of approximately 15,650 cubic yards of earthen material for off-site disposal, and potential vegetation clearing along 0.8 mile of channel. Invasive aquatic vegetation would be removed as well. As described for Impact WQ-7 (CP4), construction activities related to habitat restoration and vegetation clearing could adversely affect water quality and temporarily increase turbidity and sedimentation downstream, or result in the accidental discharge of construction-related substances into the river channel. In addition, excavated sediments could be contaminated with pesticides and metals. Development and implementation of a SWPPP as part of the environmental commitments described in Chapter 2, "Alternatives," would reduce potential impacts related to pesticides and metals. However, this impact would be potentially significant. Mitigation for this impact is proposed in Section 7.3.5.

Impact WQ-8 (CP5): Temporary Construction-Related Temperature Effects on the Upper Sacramento River That Cause Violations of Water Quality Standards or Adversely Affect Beneficial Uses Construction activities are not anticipated to result in temperature effects on the upper Sacramento River because changes to water temperature in Shasta Lake and subsequent releases to the Sacramento River would be consistent with typical periodic fluctuations. This impact would be less than significant.

This impact would be similar to Impact WQ-8 (CP1). For the same reasons described for Impact WQ-8 (CP1), this impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact WQ-9 (CP5): Temporary Construction-Related Metal Effects on the Upper Sacramento River That Cause Violations of Water Quality Standards or Adversely Affect Beneficial Uses Construction activities are not anticipated to result in water quality effects on the upper Sacramento River related to metals because construction would not disturb locations of known elevated metal concentrations. This impact would be less than significant.

This impact would be similar to Impact WQ-9 (CP1). For the same reasons described for Impact WQ-9 (CP1), this impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact WQ-10 (CP5): Long-Term Sediment Effects That Cause Violations of Water Quality Standards or Adversely Affect Beneficial Uses in the Upper Sacramento River No long-term water quality impacts are anticipated in the upper Sacramento River in regard to sediment because modeling results have indicated that CP5 would cause little change in average mean monthly flow, and could cause a decrease in peak flows that are associated with increased sediment transport. This impact would be less than significant.

This impact would be similar to Impact WQ-10 (CP1) because the extent of the effect of CP5 on sediment would be similar to that for CP1. For the same reasons as described for Impact WQ-10 (CP1), this impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact WQ-11 (CP5): Long-Term Temperature Effects That Cause Violations of Water Quality Standards or Adversely Affect Beneficial Uses in the Upper Sacramento River Analysis of temperature modeling results indicates that CP5 would improve compliance with the temperature requirements on the Sacramento River because of the increased depth of the cold-water pool in Shasta Lake and the associated enhanced ability to regulate water temperature releases to the upper Sacramento River. Therefore, the impact of CP5 on water quality measured as temperature would be beneficial.

CP5 would increase the ability of Shasta Dam to release cold water and regulate water temperature in the upper Sacramento River, primarily in dry and critically dry years. Raising Shasta Dam 18.5 feet would increase the cold-water pool and benefit seasonal water temperatures along the upper Sacramento River. This section focuses on compliance with water quality standards for temperature. For an analysis of temperature effects on fisheries and aquatic habitat, see Chapter 11, "Fisheries and Aquatic Resources."

CP5 is the same as CP3 for both flow and temperature characteristics. Therefore, separate temperature modeling was not completed for CP5. See Impact WQ-11 (CP3) for a more complete discussion on temperature modeling analysis. For the same reasons as described for Impact WQ-11 (CP3), this impact would be beneficial. Mitigation for this impact is not needed, and thus not proposed.

Impact WQ-12 (CP5): Long-Term Metals Effects That Cause Violations of Water Quality Standards or Adversely Affect Beneficial Uses in the Upper Sacramento River Long-term operation of the project could result in water quality effects on the upper Sacramento River in regard to metals as a result of erosional processes to historic mining and smelting operation features. This impact would be potentially significant.

This impact would be similar to Impact WQ-12 (CP1) because the extent of the effect of CP5 on metals would be similar to that for CP1. For the same reasons as described for Impact WQ-12 (CP1), this impact would be potentially significant. Mitigation for this impact is proposed in Section 7.3.5.

Lower Sacramento River and Delta and CVP/SWP Service Areas

Impact WQ-13 (CP5): Temporary Construction-Related Sediment Effects on the Extended Study Area That Would Cause Violations of Water Quality Standards or Adversely Affect Beneficial Uses Construction is not anticipated to affect water quality conditions in the extended study area. This impact would be less than significant.

This impact is similar to Impact WQ-13 (CP1). For the same reasons as described for Impact WQ-13 (CP1), this impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact WQ-14 (CP5): Temporary Construction-Related Temperature Effects on the Extended Study Area That Cause Violations of Water Quality Standards or Adversely Affect Beneficial Uses This impact is similar to Impact WQ-14 (CP1). For the same reasons as described for Impact WQ-14 (CP1), this impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact WQ-15 (CP5): Temporary Construction-Related Metal Effects on the Extended Study Area That Cause Violations of Water Quality Standards or Adversely Affect Beneficial Uses This impact is similar to Impact WQ-15 (CP1). For the same reasons as described for Impact WQ-15 (CP1), this impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact WQ-16 (CP5): Long-Term Sediment Effects That Cause Violations of Water Quality Standards or Adversely Affect Beneficial Uses in the Extended Study Area Project implementation could affect water quality in the extended study area, but effects would diminish with distance. This impact would be less than significant.

This impact is similar to Impact WQ-16 (CP1). For the same reasons as described for CP1, this impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact WQ-17 (CP5): Long-Term Temperature Effects That Cause Violations of Water Quality Standards or Adversely Affect Beneficial Uses in the Extended Study Area This impact is similar to Impact WQ-17 (CP1). For the same reasons as described for CP1, this impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact WQ-18 (CP5): Long-Term Metals Effects That Cause Violations of Water Quality Standards or Adversely Affect Beneficial Uses in the Extended Study Area This impact is similar to Impact WQ-18 (CP1). For the same reasons as described for CP1, this impact would be potentially significant. Mitigation for this impact is proposed in Section 7.3.5.

Impact WQ-19a (CP5): Delta Salinity on the Sacramento River at Collinsville Operations for CP5 would result in both increases and decreases in salinity; however, none of the increases would be sufficient to change compliance for the Sacramento River at Collinsville. Similarly, on a percentage basis, all increases in salinity would be less than 10 percent; this would be within the range of natural variability. This impact would be less than significant.

This impact would be the same as Impact WQ-19a (CP3) and would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact WQ-19b (CP5): Delta Salinity on the Sacramento River at Jersey Point On an average monthly basis, for the basis of comparison, EC would meet the requirements in all months in an average year. Moreover, CP5 would not increase the EC at Jersey Point. This impact would be less than significant.

This impact would be the same as Impact WQ-19b (CP3) and would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact WQ-19c (CP5): Delta Salinity on the Sacramento River at Emmaton On an average monthly basis, for the basis of comparison, EC would meet the requirements in all months on an average annual basis; moreover, CP5 would not increase the EC at Emmaton during this period by more than 0.2 percent. This impact would be less than significant.

This impact would be the same as Impact WQ-19c (CP3) and would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact WQ-19d (CP5): Delta Salinity on the Old River at Rock Slough On an average annual basis, all months except October through January under both the Existing Condition and Future Condition would be less than 150 mg/L. In dry and critical years, only October and November would exceed the standard under the Existing Condition, and October through February would exceed the standard in the Future Condition. In average annual years, CP5 would not increase chlorides by more than 1.2 percent, and even in that instance, the standard would be met. For dry and critical years, larger increases in chlorides would occur in November and December under the Existing Condition. However, the change in chloride concentration would not affect compliance with the standard; it would already be exceeded under the basis of comparison. This impact would be less than significant.

This impact would be the same as Impact WQ-19d (CP3) and would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact WQ-19e (CP5): Delta Salinity on the Delta-Mendota Canal at Jones Pumping Plant The water quality requirement on the Delta-Mendota Canal at Jones Pumping Plant has two components, a chloride requirement and an EC requirement. CP1 would not measurably change EC, and the increases in chloride concentration would be less than 1.0 percent. This impact would be less than significant.

This impact would be the same as Impact WQ-19e (CP3) and would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact WQ-19f (CP5): Delta Salinity on the West Canal at Clifton Court Forebay The 250 mg/L chloride concentration at the West Canal would not be

exceeded on an average annual or dry and critical year basis. Furthermore, chloride concentrations would typically be lower under CP5 than under the basis of comparisons. CP5 would not measurably change EC, and the increases in chloride concentration would be less than 1.0 percent. This impact would be less than significant.

This impact would be the same as Impact WQ-19f (CP3) and would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact WQ-19g (CP5): Delta Salinity on the San Joaquin River near Vernalis On an average monthly basis, for the basis of comparison, EC would meet requirements in all months, in both average years and in dry and critical years. Moreover, CP5 would not measurably change the EC on the San Joaquin River at Vernalis. This impact would be less than significant.

This impact would be the same as Impact WQ-19g (CP3) and would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact WQ-19h (CP5): Delta Salinity on the San Joaquin River at Brandt Bridge Impact WQ-19h (CP5) would be the same as Impact WQ-19g (CP5). On an average monthly basis, for the basis of comparison, EC would meet requirements in all months, in both average years and in dry and critical years. Moreover, CP5 would not measurably change EC on the San Joaquin River at Brandt Bridge. This impact would be less than significant.

This impact would be the same as Impact WQ-19h (CP3) and would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact WQ-19i (CP5): Delta Salinity on the Old River near the Middle River Impact WQ-19i (CP1) would be similar to Impact WQ-19i (CP1). On an average monthly basis, for the basis of comparison, EC would meet requirements in all months, in both average years and in dry and critical years. Moreover, CP1 would not measurably change EC on the Old River near the Middle River. This impact would be less than significant.

This impact would be the same as Impact WQ-19i (CP3) and would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact WQ-19j (CP5): Delta Salinity on the Old River near Tracy Road Bridge Impact WQ-19j (CP5) would be similar to Impact WQ-19j (CP1). On an average monthly basis, for the basis of comparison, EC would meet requirements in all months, in both average years and in dry and critical years. Moreover, CP5 would not measurably change EC on the Old River at Tracy Road Bridge. This impact would be less than significant.

This impact would be the same as Impact WQ-19j (CP3) and would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact WQ-20 (CP5): X2 Position CP5 would not change average monthly X2 in either average years or in dry and critical years by more than 0.1 km under either the Existing Condition or Future Condition. While several months may be out of compliance under the bases of comparison, the change resulting from CP5 would not increase the amount out of compliance. This impact would be less than significant.

This impact would be the same as Impact WQ-20 (CP3) and would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

7.3.5 Mitigation Measures

Table 7-94 presents a summary of mitigation measures for water quality.

Table 7-94. Summary of Mitigation Measures for Water Quality

Impact		No-Action Alternative	CP1	CP2	CP3	CP4	CP5
Impact WQ-1: Temporary Construction-Related Sediment Effects on Shasta Lake and Its Tributaries That Would Cause Violations of Water Quality Standards or Adversely Affect Beneficial Uses	LOS before Mitigation	NI	PS	PS	PS	PS	PS
	Mitigation Measure	None required.	Mitigation Measure WQ-1: Prepare and Implement a Stormwater Pollution Prevention Plan That Minimizes the Potential Contamination of Surface Waters, and Comply with Applicable Federal Regulations Concerning Construction Activities.				
	LOS after Mitigation	NI	LTS	LTS	LTS	LTS	LTS
Impact WQ-2: Temporary Construction-Related Temperature Effects on Shasta Lake and Its Tributaries That Would Cause Violations of Water Quality Standards or Adversely Affect Beneficial Uses	LOS before Mitigation	NI	LTS	LTS	LTS	LTS	LTS
	Mitigation Measure	None required.	None needed; thus, none proposed.				
	LOS after Mitigation	NI	LTS	LTS	LTS	LTS	LTS
Impact WQ-3: Temporary Construction-Related Metal Effects on Shasta Lake and Its Tributaries That Would Cause Violations of Water Quality Standards or Adversely Affect Beneficial Uses	LOS before Mitigation	NI	LTS	LTS	LTS	LTS	LTS
	Mitigation Measure	None required.	None needed; thus, none proposed.				
	LOS after Mitigation	NI	LTS	LTS	LTS	LTS	LTS
Impact WQ-4: Long-Term Sediment Effects That Would Cause Violations of Water Quality Standards or Adversely Affect Beneficial Uses in Shasta Lake or Its Tributaries	LOS before Mitigation	NI	PS	PS	PS	PS	PS
	Mitigation Measure	None required.	Mitigation Measure WQ-4: Implement Mitigation Measure WQ-1 (CP1): Prepare and Implement a Stormwater Pollution Prevention Plan That Minimizes the Potential Contamination of Surface Waters, and Comply with Applicable Federal Regulations Concerning Construction Activities.				
	LOS after Mitigation	NI	LTS	LTS	LTS	LTS	LTS

Table 7-94. Summary of Mitigation Measures for Water Quality (contd.)

Impact		No-Action Alternative	CP1	CP2	CP3	CP4	CP5
Impact WQ-5: Long-Term Temperature Effects That Would Cause Violations of Water Quality Standards or Adversely Affect Beneficial Uses in Shasta Lake or Its Tributaries	LOS before Mitigation	NI	LTS	LTS	LTS	LTS	LTS
	Mitigation Measure	None required.	None needed; thus, none proposed.				
	LOS after Mitigation	NI	LTS	LTS	LTS	LTS	LTS
Impact WQ-6: Long-Term Metals Effects That Would Cause Violations of Water Quality Standards or Adversely Affect Beneficial Uses in Shasta Lake or Its Tributaries	LOS before Mitigation	NI	PS	PS	PS	PS	PS
	Mitigation Measure	None required.	Mitigation Measure WQ-6: Prepare and Implement a Site-Specific Remediation Plan for Historic Mine Features Subject to Inundation in the Vicinity of the Bully Hill and Rising Star Mines.				
	LOS after Mitigation	NI	LTS	LTS	LTS	LTS	LTS
Impact WQ-7: Temporary Construction-Related Sediment Effects on the Upper Sacramento River That Would Cause Violations of Water Quality Standards or Adversely Affect Beneficial Uses	LOS before Mitigation	NI	PS	PS	PS	PS	PS
	Mitigation Measure	None required.	Mitigation Measure WQ-7 (CP1–CP3): Implement Mitigation Measure WQ-1 (CP1): Prepare and Implement a Stormwater Pollution Prevention Plan That Minimizes the Potential Contamination of Surface Waters, and Comply with Applicable Federal Regulations Concerning Construction Activities.			Mitigation Measure WQ-7 (CP4, CP5): Implement Mitigation Measure WQ-1 (CP1): Prepare and Implement a Stormwater Pollution Prevention Plan That Minimizes the Potential Contamination of Surface Waters, and Comply with Applicable Federal Regulations Concerning Construction Activities and Gravel Augmentation BMPs.	
	LOS after Mitigation	NI	LTS	LTS	LTS	LTS	LTS

Table 7-94. Summary of Mitigation Measures for Water Quality (contd.)

Impact		No-Action Alternative	CP1	CP2	CP3	CP4	CP5
Impact WQ-8: Temporary Construction-Related Temperature Effects on the Upper Sacramento River That Would Cause Violations of Water Quality Standards or Adversely Affect Beneficial Uses	LOS before Mitigation	NI	LTS	LTS	LTS	LTS	LTS
	Mitigation Measure	None required.	None needed; thus, none proposed.				
	LOS after Mitigation	NI	LTS	LTS	LTS	LTS	LTS
Impact WQ-9: Temporary Construction-Related Metal Effects on the Upper Sacramento River That Would Cause Violations of Water Quality Standards or Adversely Affect Beneficial Uses	LOS before Mitigation	NI	LTS	LTS	LTS	LTS	LTS
	Mitigation Measure	None required	None needed; thus, none proposed				
	LOS after Mitigation	NI	LTS	LTS	LTS	LTS	LTS
Impact WQ-10: Long-Term Sediment Effects That Would Cause Violations of Water Quality Standards or Adversely Affect Beneficial Uses in the Upper Sacramento River	LOS before Mitigation	NI	LTS	LTS	LTS	LTS	LTS
	Mitigation Measure	None required	None needed; thus, none proposed				
	LOS after Mitigation	NI	LTS	LTS	LTS	LTS	LTS
Impact WQ-11: Long-Term Temperature Effects That Would Cause Violations of Water Quality Standards or Adversely Affect Beneficial Uses in the Upper Sacramento River	LOS before Mitigation	NI	B	B	B	B	B
	Mitigation Measure	None required	None needed; thus, none proposed				
	LOS after Mitigation	NI	B	B	B	B	B

Table 7-94. Summary of Mitigation Measures for Water Quality (contd.)

Impact		No-Action Alternative	CP1	CP2	CP3	CP4	CP5
Impact WQ-12: Long-Term Metals Effects That Cause Violations of Water Quality Standards or Adversely Affect Beneficial Uses in the Upper Sacramento River	LOS before Mitigation	NI	PS	PS	PS	PS	PS
	Mitigation Measure	None required	Mitigation Measure WQ-12: Implement Mitigation Measure WQ-6 (CP1): Prepare and Implement a Site-Specific Remediation Plan for Historic Mine Features Subject to Inundation in the Vicinity of the Bully Hill and Rising Star Mines				
	LOS after Mitigation	NI	LTS	LTS	LTS	LTS	LTS
Impact WQ-13: Temporary Construction-Related Sediment Effects on the Extended Study Area That Would Cause Violations of Water Quality Standards or Adversely Affect Beneficial Uses	LOS before Mitigation	NI	LTS	LTS	LTS	LTS	LTS
	Mitigation Measure	None required	None needed; thus, none proposed				
	LOS after Mitigation	NI	LTS	LTS	LTS	LTS	LTS
Impact WQ-14: Temporary Construction-Related Temperature Effects on the Extended Study Area That Cause Violations of Water Quality Standards or Adversely Affect Beneficial Uses	LOS before Mitigation	NI	LTS	LTS	LTS	LTS	LTS
	Mitigation Measure	None required	None needed; thus, none proposed				
	LOS after Mitigation	NI	LTS	LTS	LTS	LTS	LTS
Impact WQ-15: Temporary Construction-Related Metal Effects on the Extended Study Area That Would Cause Violations of Water Quality Standards or Adversely Affect Beneficial Uses	LOS before Mitigation	NI	LTS	LTS	LTS	LTS	LTS
	Mitigation Measure	None required	None needed; thus, none proposed				
	LOS after Mitigation	NI	LTS	LTS	LTS	LTS	LTS

Table 7-94. Summary of Mitigation Measures for Water Quality (contd.)

Impact		No-Action Alternative	CP1	CP2	CP3	CP4	CP5
Impact WQ-16: Long-Term Sediment Effects That Cause Violations of Water Quality Standards or Adversely Affect Beneficial Uses in the Extended Study Area	LOS before Mitigation	NI	LTS	LTS	LTS	LTS	LTS
	Mitigation Measure	None required	None needed; thus, none proposed				
	LOS after Mitigation	NI	LTS	LTS	LTS	LTS	LTS
Impact WQ-17: Long-Term Temperature Effects That Cause Violations of Water Quality Standards or Adversely Affect Beneficial Uses in the Extended Study Area	LOS before Mitigation	NI	LTS	LTS	LTS	LTS	LTS
	Mitigation Measure	None required	None needed; thus, none proposed				
	LOS after Mitigation	NI	LTS	LTS	LTS	LTS	LTS
Impact WQ-18: Long-Term Metals Effects That Would Cause Violations of Water Quality Standards or Adversely Affect Beneficial Uses in the Extended Study Area	LOS before Mitigation	NI	PS	PS	PS	PS	PS
	Mitigation Measure	Non required	Mitigation Measure WQ-18: Implement Mitigation Measure WQ-6 (CP1): Prepare and Implement a Site-Specific Remediation Plan for Historic Mine Features Subject to Inundation in the Vicinity of the Bully Hill and Rising Star Mines				
	LOS after Mitigation	NI	LTS	LTS	LTS	LTS	LTS
Impact WQ-19a: Delta Salinity on the Sacramento River at Collinsville	LOS before Mitigation	NI	LTS	LTS	LTS	LTS	LTS
	Mitigation Measure	None required	None needed; thus, none proposed				
	LOS after Mitigation	NI	LTS	LTS	LTS	LTS	LTS

Table 7-94. Summary of Mitigation Measures for Water Quality (contd.)

Impact		No-Action Alternative	CP1	CP2	CP3	CP4	CP5
Impact WQ-19b: Delta Salinity on the San Joaquin River at Jersey Point	LOS before Mitigation	NI	LTS	LTS	LTS	LTS	LTS
	Mitigation Measure	None required	None needed; thus, none proposed				
	LOS after Mitigation	NI	LTS	LTS	LTS	LTS	LTS
Impact WQ-19c: Delta Salinity on the Sacramento River at Emmaton	LOS before Mitigation	NI	LTS	LTS	LTS	LTS	LTS
	Mitigation Measure	None required	None needed; thus, none proposed				
	LOS after Mitigation	NI	LTS	LTS	LTS	LTS	LTS
Impact WQ-19d: Delta Salinity on the Old River at Rock Slough	LOS before Mitigation	NI	LTS	LTS	LTS	LTS	LTS
	Mitigation Measure	None required	None needed; thus, none proposed				
	LOS after Mitigation	NI	LTS	LTS	LTS	LTS	LTS
Impact WQ-19e: Delta Water Quality on the Delta-Mendota Canal at Jones Pumping Plant	LOS before Mitigation	NI	LTS	LTS	LTS	LTS	LTS
	Mitigation Measure	None required	None needed; thus, none proposed				
	LOS after Mitigation	NI	LTS	LTS	LTS	LTS	LTS

Table 7-94. Summary of Mitigation Measures for Water Quality (contd.)

Impact		No-Action Alternative	CP1	CP2	CP3	CP4	CP5
Impact WQ-19f: Delta Water Quality on the West Canal at the Mouth of the Clifton Court Forebay	LOS before Mitigation	LTS	LTS	LTS	LTS	LTS	LTS
	Mitigation Measure	None required	None needed; thus, none proposed				
	LOS after Mitigation	LTS	LTS	LTS	LTS	LTS	LTS
Impact WQ-19g: Delta Salinity on the San Joaquin River at Vernalis	LOS before Mitigation	NI	LTS	LTS	LTS	LTS	LTS
	Mitigation Measure	None required	None needed; thus, none proposed				
	LOS after Mitigation	NI	LTS	LTS	LTS	LTS	LTS
Impact WQ-19h: Delta Salinity on the San Joaquin River at Brandt Bridge	LOS before Mitigation	NI	LTS	LTS	LTS	LTS	LTS
	Mitigation Measure	None required.	None needed; thus, none proposed				
	LOS after Mitigation	NI	LTS	LTS	LTS	LTS	LTS
Impact WQ-19i: Delta Salinity on the Old River near the Middle River	LOS before Mitigation	NI	LTS	LTS	LTS	LTS	LTS
	Mitigation Measure	None required.	None needed; thus, none proposed				
	LOS after Mitigation	NI	LTS	LTS	LTS	LTS	LTS

Table 7-94. Summary of Mitigation Measures for Water Quality (contd.)

Impact		No-Action Alternative	CP1	CP2	CP3	CP4	CP5
Impact WQ-19j: Delta Salinity on the Old River at Tracy Road Bridge	LOS before Mitigation	NI	LTS	LTS	LTS	LTS	LTS
	Mitigation Measure	None required.	None needed; thus, none proposed				
	LOS after Mitigation	NI	LTS	LTS	LTS	LTS	LTS
Impact WQ-20: X2 Position	LOS before Mitigation	NI	LTS	LTS	LTS	LTS	LTS
	Mitigation Measure	None required.	None needed; thus, none proposed				
	LOS after Mitigation	NI	LTS	LTS	LTS	LTS	LTS

Key:
B = Beneficial
LTS = less than significant
NI = no impact
PS = potentially significant

No-Action Alternative

No mitigation measures are needed for this alternative.

CP1 – 6.5-Foot Dam Raise, Anadromous Fish Survival and Water Supply Reliability

No mitigation measures are needed for Impacts WQ-2 (CP1), WQ-3 (CP1), WQ-5 (CP1), WQ-8 (CP1) through WQ-11 (CP1), WQ-13 (CP1) through WQ-17 (CP1), WQ-19a (CP1) through WQ-19j (CP1), and WQ-20 (CP1). Mitigation is provided below for the remaining impacts of CP1 on water quality.

Mitigation Measure WQ-1 (CP1): Prepare and Implement a Stormwater Pollution Prevention Program that Minimizes the Potential Contamination of Surface Waters, and Comply with Applicable Federal Regulations Concerning Construction Activities This project is subject to construction-related stormwater permit requirements of the CWA NPDES program. Reclamation will obtain any required permits through the CVRWQCB before any ground-disturbing construction activity. Reclamation will prepare and implement a SWPPP that identifies BMPs to prevent or minimize the introduction of contaminants into surface waters. BMPs for the project could include but are not limited to silt fencing, straw bale barriers, fiber rolls, storm drain inlet protection, hydraulic mulch, and stabilized construction entrance.

The SWPPP will include development of site-specific structural and operational BMPs to prevent and control impacts on runoff quality, measures to be implemented before each storm event, inspection and maintenance of BMPs, and monitoring of runoff quality by visual and/or analytical means.

Implementation of this mitigation measure would reduce Impact WQ-1 (CP1) to a less than significant level.

Mitigation Measure WQ-4 (CP1): Implement Mitigation Measure WQ-1 (CP1) to Reduce Long-Term Effects on Shasta Lake and Its Tributaries Related to Sediment Reclamation will implement Mitigation Measure WQ-1 (CP1) as described above to reduce long-term effects related to sediment. Implementation of this mitigation measure would reduce Impact WQ-4 (CP1) to a less than significant level.

Mitigation Measure WQ-6 (CP1): Prepare and Implement a Site-Specific Remediation Plan for Historic Mine Features Subject to Inundation in the Vicinity of the Bully Hill and Rising Star Mines Reclamation will prepare and implement a plan to remove or otherwise remediate two sites related to historic mining activities that have the potential to introduce metals into Shasta Lake, a Section 303(d)-listed water body. This plan will include requirements to coordinate with Federal, State, and local agencies and landowners to ensure that measures taken will reduce the potential for a discharge of metals into Shasta

Lake. Reclamation will obtain any required permits, approvals, and authorizations before any ground-disturbing remediation activity occurs.

Implementation of this mitigation measure would reduce Impact WQ-6 (CP1) to a less than significant level.

Mitigation Measure WQ-7 (CP1): Implement Mitigation Measure WQ-1 (CP1) to Reduce Temporary Construction-Related Effects on the Upper Sacramento River Related to Sediment Reclamation will implement Mitigation Measure WQ-1 (CP1) as described above to reduce temporary construction-related effects related to sediment. Implementation of this mitigation measure would reduce Impact WQ-7 (CP1) to a less than significant level.

Mitigation Measure WQ-12 (CP1): Implement Mitigation Measure WQ-6 (CP1) to Reduce Long-Term Metals Effects on the Upper Sacramento River Reclamation will implement Mitigation Measure WQ-6 (CP1) as described above to reduce long-term metals effects. Implementation of this mitigation measure would reduce Impact WQ-12 (CP1) to a less than significant level.

Mitigation Measure WQ-18 (CP1): Implement Mitigation Measure WQ-6 (CP1) to Reduce Long-Term Metals Effects on the Extended Study Area Reclamation will implement Mitigation Measure WQ-6 (CP1) as described above to reduce long-term metals effects. Implementation of this mitigation measure would reduce Impact WQ-18 (CP1) to a less than significant level.

CP2 – 12.5-Foot Dam Raise, Anadromous Fish Survival and Water Supply Reliability

No mitigation measures are needed for Impacts WQ-2 (CP2), WQ-3 (CP2), WQ-5 (CP2), WQ-8 (CP2) through WQ-11 (CP2), WQ-13 (CP2) through WQ-17 (CP2), WQ-19a (CP2) through WQ-19j (CP2), and WQ-20 (CP2). Mitigation is provided below for the remaining impacts of CP2 on water quality.

Mitigation Measure WQ-1 (CP2): Prepare and Implement a Stormwater Pollution Prevention Plan that Minimizes the Potential Contamination of Surface Waters, and Comply with Applicable Federal Regulations Concerning Construction Activities This mitigation measure is identical to Mitigation Measure WQ-1 (CP1). Implementation of this mitigation measure would reduce Impact WQ-1 (CP2) to a less than significant level.

Mitigation Measure WQ-4 (CP2): Implement Mitigation Measure WQ-1 (CP1) to Reduce Long-Term Effects on Shasta Lake and Its Tributaries Related to Sediment Reclamation will implement Mitigation Measure WQ-1 (CP1) as described above to reduce long-term effects related to sediment.

Implementation of this mitigation measure would reduce Impact WQ-4 (CP2) to a less than significant level.

Mitigation Measure WQ-6 (CP2): Prepare and Implement a Site-Specific Remediation Plan for Historic Mine Features Subject to Inundation in the Vicinity of the Bully Hill and Rising Star Mines This mitigation measure is identical to Mitigation Measure WQ-6 (CP1). Implementation of this mitigation measure would reduce Impact WQ-6 (CP2) to a less than significant level.

Mitigation Measure WQ-7 (CP2): Implement Mitigation Measure WQ-1 (CP1) to Reduce Temporary Construction-Related Effects on the Upper Sacramento River Related to Sediment Reclamation will implement Mitigation Measure WQ-1 (CP1) as described above to reduce temporary construction-related effects related to sediment. Implementation of this mitigation measure would reduce Impact WQ-7 (CP2) to a less than significant level.

Mitigation Measure WQ-12 (CP2): Implement Mitigation Measure WQ-6 (CP1) to Reduce Long-Term Metals Effects on the Upper Sacramento River Reclamation will implement Mitigation Measure WQ-6 (CP1) as described above to reduce long-term metals effects. Implementation of this mitigation measure would reduce Impact WQ-12 (CP2) to a less than significant level.

Mitigation Measure WQ-18 (CP2): Implement Mitigation Measure WQ-6 (CP1) to Reduce Long-Term Metals Effects on the Extended Study Area Reclamation will implement Mitigation Measure WQ-6 (CP1) as described above to reduce long-term metals effects. Implementation of this mitigation measure would reduce Impact WQ-18 (CP2) to a less than significant level.

CP3 – 18.5-Foot Dam Raise, Anadromous Fish Survival and Water Supply

No mitigation measures are needed for Impacts WQ-2 (CP3), WQ-3 (CP3), WQ-5 (CP3), WQ-8 (CP3) through WQ-11 (CP3), WQ-13 (CP3) through WQ-17 (CP3), WQ-19a (CP3) through WQ-19j (CP3), and WQ-20 (CP3). Mitigation is provided below for the remaining impacts of CP3 on water quality.

Mitigation Measure WQ-1 (CP3): Prepare and Implement a Stormwater Pollution Prevention Plan that Minimizes the Potential Contamination of Surface Waters, and Comply with Applicable Federal Regulations Concerning Construction Activities This mitigation measure is identical to Mitigation Measure WQ-1 (CP1). Implementation of this mitigation measure would reduce Impact WQ-1 (CP3) to a less than significant level.

Mitigation Measure WQ-4 (CP3): Implement Mitigation Measure WQ-1 (CP1) to Reduce Long-Term Effects on Shasta Lake and Its Tributaries Related to Sediment Reclamation will implement Mitigation Measure WQ-1

(CP1) as described above to reduce long-term effects related to sediment. Implementation of this mitigation measure would reduce Impact WQ-4 (CP3) to a less than significant level.

Mitigation Measure WQ-6 (CP3): Prepare and Implement a Site-Specific Remediation Plan for Historic Mine Features Subject to Inundation in the Vicinity of the Bully Hill and Rising Star Mines This mitigation measure is identical to Mitigation Measure WQ-6 (CP1). Implementation of this mitigation measure would reduce Impact WQ-6 (CP3) to a less than significant level.

Mitigation Measure WQ-7 (CP3): Implement Mitigation Measure WQ-1 (CP1) to Reduce Temporary Construction-Related Effects on the Upper Sacramento River Related to Sediment Reclamation will implement Mitigation Measure WQ-1 (CP1) as described above to reduce temporary construction-related effects related to sediment. Implementation of this mitigation measure would reduce Impact WQ-7 (CP3) to a less than significant level.

Mitigation Measure WQ-12 (CP3): Implement Mitigation Measure WQ-6 (CP1) to Reduce Long-Term Metals Effects on the Upper Sacramento River Reclamation will implement Mitigation Measure WQ-6 (CP1) as described above to reduce long-term metals effects. Implementation of this mitigation measure would reduce Impact WQ-12 (CP3) to a less than significant level.

Mitigation Measure WQ-18 (CP3): Implement Mitigation Measure WQ-6 (CP1) to Reduce Long-Term Metals Effects on the Extended Study Area
Reclamation will implement Mitigation Measure WQ-6 (CP1) as described above to reduce long-term metals effects. Implementation of this mitigation measure would reduce Impact WQ-18 (CP3) to a less than significant level.

CP4 – 18.5-Foot Dam Raise, Anadromous Fish Focus with Water Supply Reliability

No mitigation measures are needed for Impacts WQ-2 (CP4), WQ-3 (CP4), WQ-5 (CP4), WQ-8 (CP4) through WQ-11 (CP4), WQ-13 (CP4) through WQ-17 (CP4), WQ-19a (CP4) through WQ-19j (CP4), and WQ-20 (CP4). Mitigation is provided below for the remaining impacts of CP4 on water quality.

Mitigation Measure WQ-1 (CP4): Prepare and Implement a Stormwater Pollution Prevention Plan that Minimizes the Potential Contamination of Surface Waters, and Comply with Applicable Federal Regulations Concerning Construction Activities This mitigation measure is identical to Mitigation Measure WQ-1 (CP1). Implementation of this mitigation measure would reduce Impact WQ-1 (CP4) to a less than significant level.

Mitigation Measure WQ-4 (CP4): Implement Mitigation Measure WQ-1 (CP1) to Reduce Long-Term Effects on Shasta Lake and Its Tributaries Related to Sediment Reclamation will implement Mitigation Measure WQ-1 (CP1) as described above to reduce long-term effects related to sediment. Implementation of this mitigation measure would reduce Impact WQ-4 (CP4) to a less than significant level.

Mitigation Measure WQ-6 (CP4): Prepare and Implement a Site-Specific Remediation Plan for Historic Mine Features Subject to Inundation in the Vicinity of the Bully Hill and Rising Star Mines This mitigation measure is identical to Mitigation Measure WQ-6 (CP1). Implementation of this mitigation measure would reduce Impact WQ-6 (CP4) to a less than significant level.

Mitigation Measure WQ-7 (CP4): Implement Mitigation Measure WQ-1 (CP1) and Gravel Augmentation BMPs to Reduce Temporary Construction-Related Effects on the Upper Sacramento River Related to Sediment Reclamation will implement (a) Mitigation Measure WQ-1 (CP1) as described above; and (b) specific BMPs for the gravel augmentation program. Gravel augmentation BMPs will include, but will not be limited to:

- **Construction Work Windows** – All gravel augmentation construction activities will be conducted outside of the flood season (e.g., June 15 to September 15).

- **Source and Handle Gravel So As to Minimize Potential Water Quality Impacts** – Gravel will be sorted and transported in a manner that minimizes potential water quality impacts (e.g., management of fine sediments). Gravel will be washed at least once and have a cleanliness value of 85 or higher based on Caltrans Test No. 227. Gravel will also be completely free of oils, clay, debris, and organic material.

- **Minimize Potential Impacts Associated with Equipment Contaminants** – For in-river work, all equipment will be steam cleaned every day to remove hazardous materials before the equipment enters the water.

- **Implement Feasible Spill Prevention and Hazardous Materials Management** – The accidental release of chemicals, fuels, lubricants, and non-storm drainage water into channels will be prevented to the extent feasible. Spill prevention kits will always be in close proximity when using hazardous materials (e.g., crew trucks and other logical locations). Feasible measures will be implemented to ensure that hazardous materials are properly handled and the quality of aquatic resources is protected by all reasonable means. No fueling will be done within the ordinary high-water mark or immediate floodplain, unless equipment stationed in these locations is not readily relocated (i.e.,

pumps, generators). For stationary equipment that must be fueled on site, containments will be provided in such a manner that any accidental spill of fuel will not be able to enter the water or contaminate sediments that may come in contact with water. Any equipment that is readily moved out of the channel will not be fueled in the channel or immediate floodplain. All fueling done at the construction site will provide containment to the degree that any spill shall be unable to enter the channel or damage wetland or riparian vegetation. No equipment servicing will be done within the ordinary high-water mark or immediate floodplain, unless equipment stationed in these locations cannot be readily relocated (i.e., pumps, generators). Additional BMPs designed to avoid spills from construction equipment and subsequent contamination of waterways will also be implemented.

- **Minimize Potential Impacts Associated with Access and Staging** – Existing access roads will be used. Equipment staging areas will be located outside of the ordinary high-water mark and away from sensitive resources.

- **Remove Temporary Fills as Appropriate** – Temporary fill, such as for access, side channel diversions, and/or side channel cofferdams, will be completely removed upon the completion of construction.

Implementation of this mitigation measure would reduce Impact WQ-1 (CP4) to a less than significant level.

Mitigation Measure WQ-12 (CP4): Implement Mitigation Measure WQ-6 (CP1) to Reduce Long-Term Metals Effects on the Upper Sacramento River Reclamation will implement Mitigation Measure WQ-6 (CP1) as described above to reduce long-term metals effects. Implementation of this mitigation measure would reduce Impact WQ-12 (CP4) to a less than significant level.

Mitigation Measure WQ-18 (CP4): Implement Mitigation Measure WQ-6 (CP1) to Reduce Long-Term Metals Effects on the Extended Study Area Reclamation will implement Mitigation Measure WQ-6 (CP1) as described above to reduce long-term metals effects. Implementation of this mitigation measure would reduce Impact WQ-18 (CP4) to a less than significant level.

CP5 – 18.5-Foot Dam Raise, Combination Plan

No mitigation measures are needed for Impacts WQ-2 (CP5), WQ-3 (CP5), WQ-5 (CP5), WQ-8 (CP5) through WQ-11 (CP5), WQ-13 (CP5) through WQ-17 (CP5), WQ-19a (CP5) through WQ-19j (CP5), and WQ-20 (CP5). Mitigation is provided below for the remaining impacts of CP5 on water quality.

Mitigation Measure WQ-1 (CP5): Prepare and Implement a Stormwater Pollution Prevention Plan That Minimizes the Potential Contamination of Surface Waters, and Comply with Applicable Federal Regulations Concerning Construction Activities This mitigation measure is identical to Mitigation Measure WQ-1 (CP1). Implementation of this mitigation measure would reduce Impact WQ-1 (CP5) to a less than significant level.

Mitigation Measure WQ-4 (CP5): Implement Mitigation Measure WQ-1 (CP1) to Reduce Long-Term Effects on Shasta Lake and Its Tributaries Related to Sediment Reclamation will implement Mitigation Measure WQ-1 (CP1) as described above to reduce long-term effects related to sediment. Implementation of this mitigation measure would reduce Impact WQ-4 (CP5) to a less than significant level.

Mitigation Measure WQ-6 (CP5): Prepare and Implement a Site-Specific Remediation Plan for Historic Mine Features Subject to Inundation in the Vicinity of the Bully Hill and Rising Star Mines This mitigation measure is identical to Mitigation Measure WQ-6 (CP1). Implementation of this mitigation measure would reduce Impact WQ-6 (CP5) to a less than significant level.

Mitigation Measure WQ-7 (CP5): Implement Mitigation Measure WQ-1 (CP1) and Gravel Augmentation BMPs to Reduce Temporary Construction-Related Effects on the Upper Sacramento River Related to Sediment This mitigation measure is identical to Mitigation Measure WQ-7 (CP4). Implementation of this mitigation measure would reduce Impact WQ-7 (CP5) to a less than significant level.

Mitigation Measure WQ-12 (CP5): Implement Mitigation Measure WQ-6 (CP1) to Reduce Long-Term Metals Effects on the Upper Sacramento River Reclamation will implement Mitigation Measure WQ-6 (CP1) as described above to reduce long-term metals effects. Implementation of this mitigation measure would reduce Impact WQ-12 (CP5) to a less than significant level.

Mitigation Measure WQ-18 (CP5): Implement Mitigation Measure WQ-6 (CP1) to Reduce Long-Term Metals Effects on the Extended Study Area Reclamation will implement Mitigation Measure WQ-6 (CP1) as described above to reduce long-term metals effects. Implementation of this mitigation measure would reduce Impact WQ-18 (CP5) to a less than significant level.

7.3.6 Cumulative Effects

Chapter 3, “Considerations for Describing the Affected Environment and Environmental Consequences” discusses the overall methodology for cumulative impacts of the project alternatives, including the relationship to the CALFED programmatic cumulative impacts analysis, qualitative and quantitative assessment, past and future actions in the study area, and significance criteria.

This section analyzes the overall cumulative impacts of the project alternatives with other past, present, and reasonably foreseeable future projects that would produce related impacts.

The projects listed in the quantitative analysis section of Chapter 3, "Considerations for Describing the Affected Environment and Environmental Consequences" are included in the 2030 level of development alternatives above. Accordingly, quantitative effects of the projects combined with the SLWRI alternatives are described in the Section 7.3, "Environmental Consequences and Mitigation Measures." The discussion below focuses on the qualitative effect of the SLWRI alternatives and the other past, present, and reasonably foreseeable future projects.

Given the substantial degradation in water quality in the study areas when considering past, present, and reasonably foreseeable projects, and as identified in the existing conditions presented in this chapter, it is concluded that there is a significant cumulative impact on water quality overall under both existing and future conditions. These cumulative impacts are occurring without the proposed action. Several factors could substantially affect water quality in both the primary and extended study areas as an outcome of reasonably foreseeable future actions, but the potential effects are highly uncertain and may result in either a beneficial or adverse impact on water quality in the study areas.

The effect of climate change on operations at Shasta Lake could potentially result in changes to water quality. As described in the Climate Change Projection Appendix, climate change could result in higher inflows to Shasta Lake in the winter and early spring due to a shift from precipitation falling as snow to rain. This change could result in both higher Shasta Lake releases in the winter and spring to manage the increased potential for flood events, and an increase in water temperature for Shasta Lake inflows. A corresponding decrease in Shasta Lake releases in the summer and fall and a decrease in operable cold-water volume could result in warmer flows downstream.

CP1 – 6.5-Foot Dam Raise, Anadromous Fish Survival and Water Supply Reliability

CP1 would not result in adverse changes to sediment, metals, and temperature, and therefore would not make a cumulatively considerable incremental contribution to an overall significant cumulative impact on water quality.

Without mitigation, CP1 could cause potentially significant effects on water quality in the primary study area. These effects could be caused temporarily or for the short term by construction-related activities that cause sediment, petroleum, or other substances to enter waterways in runoff. Mitigation measures would eliminate these effects or reduce them to a less than significant level.

CP1 would also affect water quality by increasing the volume of water in the reservoir and by altering downstream river flows. The effects on water quality resulting from these hydrologic alterations would be long term and much greater than the temporary and short-term effects related to construction.

Hydrologic modeling output predicts that hydrologically, CP1 would result in a small change in reservoir storage and minimal change in river flows relative to the No-Action Alternative. A small increase in the volume of water stored in the reservoir under CP1 could result in additional inputs of metals from shoreline erosion of historical mining deposits and would result in a slight dilution of inputs of sediment and metals relative to existing and future No-Action conditions. The potential for additional inputs of metals would be substantially reduced or eliminated by Mitigation Measure WQ-6 (CP1). Changes in Sacramento River flows can be best characterized as a small decrease in monthly average winter and early spring flows in some years as measured below Keswick Dam, RBDD, Wilkins Slough, and Freeport, and a slight increase in summer flows in most years. This redistribution of flows would have little effect on water quality as measured by metals, sediment, salinity, and temperature.

The small reduction in winter flows caused by CP1 would slightly reduce potential sediment loading and discharge rates, and would also slightly reduce transport of heavy metals. Therefore, the water quality impact of CP1 related to metals and sediment would not be adverse.

Monthly mean water temperatures at all modeling locations (below Shasta Dam, below Keswick Dam, above Bend Bridge, and above Red Bluff) within the upper Sacramento River under CP1 would be essentially equivalent or slightly decreased (i.e., beneficial). Therefore, the effects of CP1 on water quality measured as water temperature would be beneficial, not adverse.

Implementing Mitigation Measure WQ-1 (CP1) would eliminate adverse effects from CP1, and the incremental contribution of CP1 to cumulative effects on water quality would no longer be cumulatively considerable. In summary, effects of CP1 on water quality measured as water temperature, metals, and sediment would be less than significant, and CP1 would not cause an incremental cumulatively considerable contribution to an overall significant cumulative impact on water quality in the primary study area.

In the extended study area, CP1 could also influence water quality in the Delta by altering the quality, volume, or timing of Sacramento River flows. However, because changes in Sacramento River flows relative to the No-Action Alternative would be minimal and effects would diminish with distance from Shasta Dam, the effects would be very minor. (Water quality effects are attenuated by multiple factors, including flow from tributaries, stormwater runoff, and municipal and agricultural discharges.) Furthermore, the Central Valley’s reservoirs and diversions are managed as a single integrated system,

and the guidelines for this system, which are described in the CVP OCAP, have been designed to maintain standards for Delta inflow and water quality. Therefore, water quality impacts of CP1 at the Delta would not make a cumulatively considerable incremental contribution to the overall significant cumulative impact on Delta water quality.

As stated previously, effects of climate change on operations of Shasta Lake could include increased inflows and releases at certain times of the year, and decreased releases with potentially increased water temperatures at other times. The additional storage associated with CP1 could potentially reduce these effects, allowing Shasta Lake to capture some of the increased runoff in the winter and early spring for both cold-water storage and release in summer and fall. This would benefit both Sacramento River water temperatures and Delta water quality. Potential impacts associated with Sacramento River water temperatures and Delta water quality would be less than significant under CP1. Therefore, even with the addition of anticipated effects of climate change, CP1 would not have a significant cumulative effect, and could be potentially beneficial.

CP2 – 12.5-Foot Dam Raise, Anadromous Fish Survival and Water Supply Reliability

The cumulative effects of CP2 would be similar to those of CP1, except that the greater increase in reservoir storage and river flow alteration under CP2 would result in greater beneficial effects on water temperature in the upper Sacramento River. Effects on sediments and metals in the Upper Sacramento River, and on Delta water quality would be effectively the same as CP1. Therefore, water quality impacts of CP2 would not make a cumulatively considerable incremental contribution to the overall significant cumulative water quality impact in the primary study area or extended study area, including the Delta.

As stated previously, effects of climate change on operations of Shasta Lake could include increased inflows and releases at certain times of the year, and decreased releases with potentially increased water temperatures at other times. The additional storage associated with CP2 could potentially reduce these effects, allowing Shasta Lake to capture some of the increased runoff in the winter and early spring for both cold-water storage and release in summer and fall. This would benefit both Sacramento River water temperatures and Delta water quality. Potential impacts associated with Sacramento River water temperatures and Delta water quality would be less than significant under CP2. Therefore, even with the addition of anticipated effects of climate change, CP2 would not have a significant cumulative effect, and could be potentially beneficial.

CP3 – 18.5-Foot Dam Raise, Anadromous Fish Survival and Water Supply

The cumulative effects of CP3 would be similar to those of CP1 and CP2, except that the greater increase in reservoir storage and river flow alteration under CP3 would result in greater beneficial effects on water temperature in the

upper Sacramento River. Effects on sediments and metals in the Upper Sacramento River, and on Delta water quality would be effectively the same as CP1. Therefore, water quality impacts of CP3 would not make a cumulatively considerable incremental contribution to the overall significant cumulative water quality impact in the primary study area or extended study area, including the Delta.

As stated previously, effects of climate change on operations of Shasta Lake could include increased inflows and releases at certain times of the year, and decreased releases with potentially increased water temperatures at other times. The additional storage associated with CP3 could potentially reduce these effects, allowing Shasta Lake to capture some of the increased runoff in the winter and early spring for both cold-water storage and release in summer and fall. This would benefit both Sacramento River water temperatures and Delta water quality. Potential impacts associated with Sacramento River water temperatures and Delta water quality would be less than significant under CP3. Therefore, even with the addition of anticipated effects of climate change, CP3 would not have a significant cumulative effect, and could be potentially beneficial.

CP4 – 18.5-Foot Dam Raise, Anadromous Fish Focus with Water Supply Reliability

With the exception of water quality measured as water temperature, the cumulative effects of CP4 would be the same as those of CP1. Effects of CP4 on water quality measured as water temperature would be beneficial and greater than those of other alternatives.

Therefore, water quality impacts of CP4 would not make a cumulatively considerable incremental contribution to the overall significant cumulative water quality impact in the primary study area or extended study area, including the Delta.

As stated previously, effects of climate change on operations of Shasta Lake could include increased inflows and releases at certain times of the year, and decreased releases with potentially increased water temperatures at other times. The additional storage associated with CP4 could potentially reduce these effects, allowing Shasta Lake to capture some of the increased runoff in the winter and early spring for both cold-water storage and release in summer and fall. This would benefit both Sacramento River water temperatures and Delta water quality. Potential impacts associated with Sacramento River water temperatures and Delta water quality would be less than significant under CP4. Therefore, even with the addition of anticipated effects of climate change, CP4 would not have a significant cumulative effect, and could be potentially beneficial.

CP5 – 18.5-Foot Dam Raise, Combination Plan

With the exception of water quality measured as water temperature, the cumulative effects of CP5 would be the same as those of CP1. Effects of CP5 on water quality measured as water temperature would be beneficial and effectively the same as CP3. Therefore, water quality impacts of CP5 would not make a cumulatively considerable incremental contribution to the overall significant cumulative water quality impact in the primary study area or extended study area, including the Delta.

As stated previously, effects of climate change on operations of Shasta Lake could include increased inflows and releases at certain times of the year, and decreased releases with potentially increased water temperatures at other times. The additional storage associated with CP5 could potentially reduce these effects, allowing Shasta Lake to capture some of the increased runoff in the winter and early spring for both cold-water storage and release in summer and fall. This would benefit both Sacramento River water temperatures and Delta water quality. Potential impacts associated with Sacramento River water temperatures and Delta water quality would be less than significant under CP5. Therefore, even with the addition of anticipated effects of climate change, CP5 would not have a significant cumulative effect, and could be potentially beneficial.

Chapter 8
Noise and Vibration

8.1 Affected Environment

This section describes the affected environment related to noise and vibration for the dam and reservoir modifications proposed under the Shasta Lake Water Resources Investigation.

8.1.1 Acoustic Fundamentals

Noise is generally defined as sound that is loud, disagreeable, or unexpected. Sound, as described in more detail below, is an audible vibration of an elastic medium.

Sound Properties

A sound wave is introduced into a medium (e.g., air) by a vibrating object. The vibrating object (e.g., vocal cords, the string and sound board of a guitar, or the diaphragm of a radio speaker) is the source of the disturbance that sets the medium to vibrate and then propagates through the medium. Regardless of the type of source creating the sound wave, the particles of the medium through which the sound moves are vibrating in a back-and-forth motion at a given frequency, tone, or pitch. The frequency of a wave refers to how often the particles vibrate when a wave passes through the medium. Wave frequency is measured as the number of complete back-and-forth vibrations of a particle per unit of time. If a particle of air undergoes 1,000 longitudinal vibrations in 2 seconds, then the frequency of the wave would be 500 vibrations per second. A commonly used unit for frequency is Hertz (Hz).

Each particle vibrates as a result of the motion of its nearest neighbor. For example, the first particle of the medium begins vibrating at 500 Hz and sets the second particle of the medium into motion at the same frequency (500 Hz). The second particle begins vibrating at 500 Hz and thus sets the third particle into motion at 500 Hz. The process continues throughout the medium; hence each particle vibrates at the same frequency, which is the frequency of the original source. Subsequently, a guitar string vibrating at 500 Hz will set the air particles in the room vibrating at the same frequency (500 Hz), which carries a sound signal to the ear of a listener that is detected as a 500-Hz sound wave.

The back-and-forth vibration motion of the particles of the medium would not be the only observable phenomenon occurring at a given frequency. Because a sound wave is a pressure wave, a detector could be used to detect oscillations in pressure from high to low and back to high pressure. As the compression (high-

pressure points) and rarefaction (low-pressure points) disturbances move through the medium, they would reach the detector at a given frequency. For example, a compression would reach the detector 500 times per second if the frequency of the wave were 500 Hz. Similarly, a rarefaction would reach the detector 500 times per second if the frequency of the wave were 500 Hz. Thus, the frequency of a sound wave refers not only to the number of back-and-forth vibrations of the particles per unit of time but also to the number of compression or rarefaction disturbances that pass a given point per unit of time. A detector could be used to detect the frequency of these pressure oscillations over a given period of time. The period of the sound wave can be found by measuring the time between successive compressions or the time between successive rarefactions. The frequency is simply the reciprocal of the period; thus an inverse relationship exists so that as frequency increases, the period decreases, and vice versa.

A wave is a disturbance through some medium (e.g., air, water, space) that typically transfers energy. Waves travel and transfer energy from one point to another, often with little or no permanent displacement of the particles of the medium. For example, in an ocean wave, the seawater appears to be move along the path of the wave. However, the water particles themselves are nearly stationary—it is the energy transferred through those particles (the wave) causing displacement that makes it appear that the water itself is moving.

In the case of sound (and noise), the “wave” is a vibration or disturbance moving through air particles and, at a certain range of frequencies, is audible to the human ear. The amount of energy carried by a wave is related to the amplitude (loudness) of the wave. A high-energy wave is characterized by high amplitude; a low-energy wave is characterized by low amplitude. The amplitude of a wave refers to the maximum amount of displacement of a particle from its rest position. The energy transported by a wave is directly proportional to the square of the amplitude of the wave. This means that a doubling of the amplitude of a wave indicates a quadrupling of the energy transported by the wave.

Sound and the Human Ear

Because of the ability of the human ear to detect a wide range of sound-pressure fluctuations, sound-pressure levels are expressed in logarithmic units called decibels (dB). The sound-pressure level in decibels is calculated by taking the log of the ratio between the actual sound pressure and the reference sound pressure squared. The reference sound pressure is considered the absolute hearing threshold (Caltrans 1998). Use of this logarithmic scale reveals that the total sound from two individual sources of 65 A-weighted decibels (dBA) each (see explanation of the A-weighting scale below) is 68 dBA, not 130 dBA; that is, doubling the source strength increases the sound pressure by 3 dBA.

The human ear is sensitive to frequencies from 20 Hz to 20,000 Hz (the audible range) and can detect the vibration amplitudes that are comparable in size to a

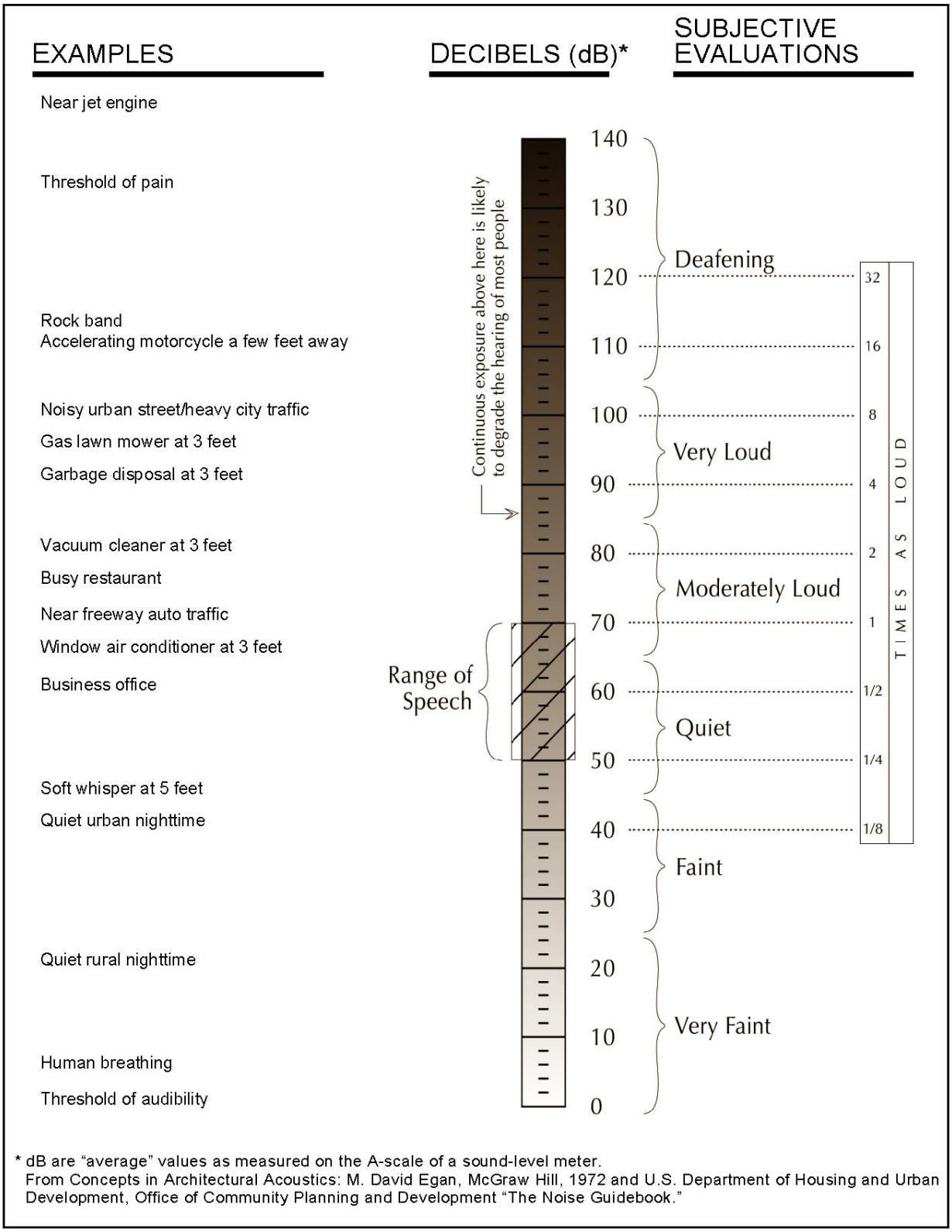
hydrogen atom (EPA 1974). When damaged by noise, the ear is typically affected at the 4,000-Hz frequency first; therefore, this can be considered the most noise-sensitive frequency. The averaged frequencies of 500 Hz, 1,000 Hz, and 2,000 Hz have traditionally been employed in hearing conservation criteria because of their importance to the hearing of speech sounds (ASA 1997).

The human ear is not equally sensitive to all sound frequencies, depending on the amplitude of the sound; therefore, a specific frequency-dependent rating scale was devised to relate noise to human sensitivity. This called the weighting scale or function. The A-weighting scale is the most commonly used and is noted as A-weighted dB, dB(A), or dBA. The dBA scale discriminates against frequencies in a manner approximating the sensitivity of the human ear when a source is at 50 dB. The basis for compensation is a comparison of the "loudness" of tones played one at a time with a reference tone producing 50 dB. This dBA scale has been chosen by most authorities for the purpose of regulating environmental noise. Typical indoor and outdoor noise levels are presented on Figure 8-1.

With respect to how humans perceive increases in noise levels, for pure tones or some broadband tones, a 1-dBA increase is imperceptible, a 3-dBA increase is barely perceptible, a 6-dBA increase is clearly perceptible, and a 10-dBA increase is subjectively perceived as approximately twice as loud (Egan 1988). For this reason, an increase of 3 dBA or more is generally considered a degradation of the existing noise environment for this type of source. For more complex sources, that is, where the tones differ substantially between sources, such as for the sound of a heavy truck versus a new car or a kitchen blender, the ear perceives differences much more quickly.

Sound Propagation

As sound (noise) propagates from the source to the receptor, the attenuation, or manner of noise reduction in relation to distance, depends on surface characteristics, atmospheric conditions, and the presence of physical barriers. The inverse-square law describes the attenuation when sound travels from a point source such as an air-conditioning unit to the receptor. Sound travels uniformly outward from a point source in a spherical pattern with an attenuation rate of 6 dBA per doubling of distance (dBA/DD). However, from a line source, such as a long line of traffic on a freeway, sound travels uniformly outward in a cylindrical pattern with an attenuation rate of 3 dBA/DD. The surface characteristics between the source and the receptor may result in additional sound absorption and/or reflection. Atmospheric conditions such as wind speed, temperature, and humidity may affect noise levels. Furthermore, the presence of a barrier between the source and the receptor may also attenuate noise levels. The actual amount of attenuation depends on the size of the barrier and the frequency of the noise. A noise barrier may be any natural or human-made feature such as a hill, building, wall, or berm (Caltrans 1998).



Source: Data compiled by AECOM in 2011

Figure 8-1. Typical Noise Levels

Noise Descriptors

The selection of a proper noise descriptor for a specific source depends on the spatial and temporal distribution, duration, and fluctuation of the noise. The noise descriptors most often encountered when dealing with traffic, community, and environmental noise are defined below (Caltrans 1998; Lipscomb and Taylor 1978):

- **L_{max} (maximum noise level)** – The maximum noise level during a specific period of time. The L_{max} may also be referred to as the "highest (noise) level."

- **L_{min} (minimum noise level)** – The minimum noise level during a specific period of time.

- **L_x (statistical descriptor)** – The noise level exceeded X percent of a specific period of time.

- **L_{eq} (equivalent noise level)** – The energy mean (average) noise level. The instantaneous noise levels during a specific period of time in dBA are converted to relative energy values. From the sum of the relative energy values, an average energy value is calculated, which is then converted back to dBA to determine the L_{eq}.

- **L_{dn} (day-night noise level)** – The 24-hour L_{eq} with a 10-dBA "penalty" for the noise-sensitive hours between 10 p.m. and 7 a.m. The L_{dn} attempts to account for the fact that noise during this specific period of time is a potential source of disturbance with respect to normal sleeping hours.

- **CNEL (community noise equivalent level)** – A noise level similar to the L_{dn} described above, but with an additional 5-dBA "penalty" for the noise-sensitive hours between 7 p.m. and 10 p.m., which are typically reserved for relaxation, conversation, reading, and television. If the same 24-hour noise data are used, the CNEL is typically approximately 0.5 dBA higher than the L_{dn}.

- **SEL (single-event (impulsive) noise level)** – A receiver's cumulative noise exposure from a single impulsive-noise event, which is defined as an acoustical event of short duration and which involves a change in sound pressure above some reference value.

Negative Effects of Noise on Humans

Negative effects of noise exposure include physical damage to the human auditory system, speech interference, sleep interference, activity interference, and disease. Exposure to noise may result in physical damage to the auditory system, which may lead to gradual or traumatic hearing loss. Gradual hearing loss is caused by sustained exposure to moderately high noise levels over a

period of time; traumatic hearing loss is caused by sudden exposure to extremely high noise levels over a short period. However, gradual and traumatic hearing loss both may result in permanent hearing damage. In addition, noise may interfere with or interrupt sleep, relaxation, recreation, and communication. Although most interference may be classified as annoying, the inability to hear a warning signal may be considered dangerous. Noise may also be a contributor to diseases associated with stress, such as hypertension, anxiety, and heart disease. The degree to which noise contributes to such diseases depends on the frequency, bandwidth, and level of the noise, and the exposure time (Caltrans 1998).

Vibration Fundamentals

Vibration is sound radiated through the ground. The rumbling sound caused by the vibration of room surfaces is called groundborne noise. Sources of groundborne vibrations include natural phenomena (e.g., earthquakes, volcanic eruptions, sea waves, and landslides) and human-made causes (e.g., explosions, machinery, traffic, trains, and construction equipment). Vibration sources may be continuous, such as factory machinery, or transient, such as explosions. As is the case with airborne sound, groundborne vibrations may be described by amplitude and frequency.

Vibration amplitudes are usually expressed in peak particle velocity (PPV) or root mean squared (RMS), as in RMS vibration velocity. The PPV and RMS velocity are normally described in inches per second (in/sec). PPV is defined as the maximum instantaneous positive or negative peak of a vibration signal. PPV is often used in monitoring of blasting vibration because it is related to the stresses that are experienced by buildings (FTA 2006; Caltrans 2002a).

Although PPV is appropriate for evaluating the potential for building damage, it is not always suitable for evaluating human response. It takes some time for the human body to respond to vibration signals. In a sense, the human body responds to average vibration amplitude. The RMS of a signal is the average of the squared amplitude of the signal, typically calculated over a 1-second period. As with airborne sound, the RMS velocity is often expressed in decibel notation, expressed as vibration decibels (VdB), which serves to compress the range of numbers required to describe vibration (FTA 2006).

The background vibration-velocity level in residential areas is usually approximately 50 VdB. Groundborne vibration is normally perceptible to humans at approximately 65 VdB. For most people, a vibration-velocity level of 75 VdB is the approximate dividing line between barely perceptible and distinctly perceptible levels (FTA 2006).

Typical outdoor sources of perceptible groundborne vibration are construction equipment, steel-wheeled trains, and traffic on rough roads. If a roadway is smooth, the groundborne vibration is rarely perceptible. The range of interest is from approximately 50 VdB, which is the typical background vibration-velocity

level, to 100 VdB, which is the general threshold where minor damage can occur in fragile buildings. Construction activities can generate groundborne vibrations, which can pose a risk to nearby structures. Constant or transient vibrations can weaken structures, crack facades, and disturb occupants (FTA 2006).

Construction vibrations can be either transient, random, or continuous. Transient construction vibrations are generated by blasting, impact pile driving, and wrecking balls. Continuous vibrations result from vibratory pile drivers, large pumps, and compressors. Random vibration can result from jackhammers, pavement breakers, and heavy construction equipment. Table 8-1 describes the general human response to different levels of groundborne vibration-velocity levels.

Table 8-1. Human Response to Different Levels of Groundborne Noise and Vibration

Vibration-Velocity Level	Human Reaction
65 VdB	Approximate threshold of perception.
75 VdB	Approximate dividing line between barely perceptible and distinctly perceptible. Many people find that transportation-related vibration at this level is unacceptable.
85 VdB	Vibration acceptable only if there are an infrequent number of events per day.

Source: FTA 2006

Key:
VdB = vibration decibels

8.1.2 Existing Noise Sources and Levels

Shasta Lake and Vicinity and Upper Sacramento River (Shasta Dam to Red Bluff)

Existing sources of noise and vibration in the primary study area associated with roadway traffic and aircraft noise are outlined below. Noise is also generated by watercraft on Shasta Lake and stationary noise sources such as mechanical equipment at the existing dam facility. Additional sites that would be affected by the project are existing bridges, roads, and structures that would be inundated with implementation of the proposed dam rise and would need to be modified, demolished, or reconstructed. Sensitive receptors in these areas consist of residences, transient lodging, and recreational facilities.

Roadway Traffic Interstate 5 (I-5) and State Routes 36, 44, 151, 273, and 299 contribute the majority of roadway noise in the greater Shasta area. The Federal Highway Administration's Highway Traffic Noise Prediction Model was used to predict existing traffic noise levels for these routes. Table 8-2 shows existing average daily traffic volumes for Shasta County's major roadways, modeled

vehicle distribution characteristics, and the modeled distance from the roadway centerline to the various noise-level contours for each affected roadway segment in the study area under existing conditions. The traffic noise levels shown in the table assume no shielding or reflection from structures or topography. Actual noise levels would vary from day to day.

Railway Traffic Shasta County is served by the Union Pacific Railroad single-track main line, which travels north/south through the primary study area, paralleling I-5. (The McCloud Railway Company, a single-track short line, runs from McCloud to Burney, but because its activity is limited, noise measurements were not conducted for this line.) Noise measurements were conducted at two sites near Redding and Cottonwood for the *Shasta County General Plan* Noise Element. Table 8-3 presents noise levels associated with railroad noise in the Shasta Lake area.

Aircraft The three existing airports in the primary study area are described below.

Redding Municipal Airport In 2003, there were approximately 81,000 total aircraft operations at Redding Municipal Airport. As shown in the background report for the *Shasta County General Plan* Noise Element, the 65-dB CNEL contour is confined primarily to the airport property. The 60-dB CNEL contour extends outside of the property, but does not encroach on existing residential uses. According to the *Redding Municipal Airport Master Plan*, aviation growth at the airport will affect the surrounding area. The total number of aircraft operations is estimated to increase to 162,400 by 2015.

Shingletown Airport In 2003, there were zero aircraft operations at Shingletown Airport. Because of trees in the runway protection zone and deterioration of the tarmac, the operating permit was suspended indefinitely by the State in 2002. No future operations are planned for this facility at this time.

Fall River Mills Airport In 2001, there were approximately 6,000 total aircraft operations at Fall River Mills Airport. Based on the *Environmental Assessment for the Fall River Mills Airport Layout Plan* (April 2003), the existing 65-dB CNEL contour is contained within the existing airport boundary. Aviation growth at Fall River Mills Airport can also affect the area surrounding the airport. The number of aircraft operations is expected to increase to 15,000 by 2021. The future (2021) 65-dB CNEL contour is confined to Public Facility and Agriculture lands. The 60-dB CNEL contour also encompasses Urban Residential lands.

Table 8-2. Summary of Modeled Existing Traffic Noise Levels (Year 2006)

Roadway Segment	Modeling Assumptions					Distance (feet) from Roadway Edge to CNEL/L_{dn} (dBA)[1]				CNEL/L_{dn} (dBA) from Roadway Edge
	Average Daily Traffic Volume	Speed (mph)	Grade (%)	Traffic Distribution Percentages (%)		70 CNEL	65 CNEL	60 CNEL	55 CNEL	50 Feet
				Auto/Medium Truck/Heavy Truck	Day/ Evening/ Night					
SR 36, north of Red Bluff	12,000	45	0	79/9/12	79/11/10	64	138	298	641	72
SR 44, junction with I-5	51,000	65	0	81/9/10	79/11/10	235	507	1,093	2354	80
SR 151, Shasta Lake	5,500	45	0	81/9/10	79/11/10	36	77	165	356	68
SR 273, Redding	23,800	35	0	81/9/10	79/11/10	74	160	345	742	73
SR 299, Redding	19,900	35	0	81/9/10	79/11/10	66	142	306	659	72
I-5, Bridgebay	27,500	70	0	81/9/10	79/11/10	171	368	792	1,706	78
I-5, Shasta Lake	37,000	70	0	81/9/10	79/11/10	208	448	965	2,080	79
I-5, Redding	67,000	70	0	81/9/10	79/11/10	309	666	1,434	3,090	82
I-5, Anderson	50,000	70	0	81/9/10	79/11/10	254	548	1,180	2,542	81
I-5, Cottonwood	46,500	70	0	81/9/10	79/11/10	242	522	1,124	2,422	80
I-5, Red Bluff	40,500	70	0	79/9/12	79/11/10	231	498	1,073	2,313	80

Source: Average daily traffic volumes from CalTrans (2006). Modeling performed by EDAW (now AECOM) in 2007

Key:
CalTrans = California Department of Transportation
CNEL = community noise equivalent level
dBA = A-weighted decibels
I-5 = Interstate 5
L_{dn} = day-night noise level
mph = miles per hour
SR = State Route

Table 8-3. Approximate Distance to Union Pacific Railroad Noise Contours

L_{dn}, Based on Distance from Railroad Tracks				Distance to L_{dn} Contour (feet)			
At 50 Feet		At 100 Feet		60 dB		65 dB	
Existing	Future	Existing	Future	Existing	Future	Existing	Future
South of Bonnyview Road				South of Bonnyview Road			
69.5 dB	70.8 dB	65.0 dB	66.3 dB	215	262	100	122
Cottonwood				Cottonwood			
76.0 dB	77.3 dB	71.5 dB	72.8 dB	580	711	269	330

Source: Shasta County 2004

Key:
dB = decibel
L_{dn} = day-night noise level

Benton Airpark In 2009, there were approximately 35,000 total aircraft operations at Benton Airpark. Based on the *Benton Airpark Master Plan* (March 2005), the existing 65-dB CNEL contour is contained within the existing airport boundary. Aviation growth at Benton Airpark can also affect the area surrounding the airport. The number of aircraft operations is expected to increase to 38,000 by 2021. The future (2021) 65-dB CNEL contour is confined to airport property and vacant land.

Other Aircraft Activities In addition to the aircraft facilities listed above, helipads from medical facilities in Redding are also in use. Usage of these helipads would be reserved for emergencies and would be intermittent in comparison to usage by full-time facilities such as the Benton Airpark. In the fire season, aircraft operated by the California Department of Forestry and Fire Protection use Shasta Lake as a source of water for fighting wildfires. Fire helicopters and tankers use the lake as needed during emergencies. Because firefighting is intermittent, no consistent noise levels would result from firefighting operations.

Fixed Noise Sources Industrial, light industrial, commercial, and public service facilities that could produce objectionable noise levels at nearby noise-sensitive uses are dispersed throughout the primary study area. Among these fixed noise sources are lumber mills, auto maintenance shops, car washes, loading docks, recycling centers, electricity generating stations, landfills, and athletic fields.

Lower Sacramento River and Delta and CVP/SWP Service Areas

Noise sources within the extended study area would be similar to the general descriptions provided for the primary study area.

8.1.3 Existing Noise-Sensitive Land Uses

Shasta Lake and Vicinity and Upper Sacramento River (Shasta Dam to Red Bluff)

Noise-sensitive land uses (sensitive receptors) are uses where exposure to noise would result in adverse effects and uses where quiet is essential. Residential dwellings are of primary concern. Other noise-sensitive land uses are schools, hospitals, convalescent facilities, parks, hotels, places of worship, and libraries. No sensitive land uses are immediately adjacent to (within 0.5 mile of) the dam. Sensitive land uses in the proximity of the dam raise site would be the vacant on site residence at the fish hatchery approximately one-half mile downstream. The nearest occupied residence is the horse camp located approximately 7,000 feet downstream; residents on Lake Boulevard are located approximately 4,500 feet east. Other sensitive receptors would include any residences within one-half mile of other construction work being done as a result of the dam raise. Bridge construction would occur at Charlie Creek, Doney Creek, McCloud River, Pit River, and other Union Pacific Railroad bridges. Major road construction would occur on Lakeshore Drive, in the Turntable Bay Area, on Gillman Road, in Jones Valley and the Silverthorne Area, and on Salt Creek Road. The nearest school to construction activities would be the Smithson School in Lakehead (approximately 500 feet); the nearest place of worship would be Canyon Community Church also in Lakehead (approximately 800 feet).

Lower Sacramento River and Delta and CVP/SWP Service Areas

Noise receptors within the extended study area would be similar to those generally described above for the primary study area.

8.2 Regulatory Framework

8.2.1 Federal

No Federal plans, policies, regulations, or laws related to noise are applicable to the project. The environmental review of Federal projects generally defers to State, county, or other local guidelines.

To address the human response to groundborne vibration, the Federal Transit Administration (FTA) of the U.S. Department of Transportation has set forth guidelines for maximum-acceptable vibration criteria for different types of land uses. These criteria include 65 VdB for land uses where low ambient vibration is essential for interior operations (e.g., hospitals, high-tech manufacturing, and laboratory facilities), 80 VdB for residential uses and buildings where people normally sleep, and 83 VdB for institutional land uses with primarily daytime operations (e.g., schools, churches, clinics, and offices) (FTA 2006).

Standards have also been established to address the potential for groundborne vibration to cause structural damage to buildings. These standards were developed by the Committee of Hearing, Bio Acoustics, and Bio Mechanics at

the request of the U.S. Environmental Protection Agency (FTA 2006). For fragile structures, Committee of Hearing, Bio Acoustics, and Bio Mechanics recommends a maximum limit of 0.25 in/sec PPV (FTA 2006).

8.2.2 State

Governor's Office of Planning and Research

The Governor's Office of Planning and Research published the *State of California General Plan Guidelines* (OPR 2003), which provides guidance for the acceptability of projects within specific L_{dn} contours. Table 8-4 summarizes acceptable and unacceptable community noise exposure limits for various land use categories.

Generally, residential uses (e.g., mobile homes) are considered to be acceptable in areas where exterior noise levels do not exceed 60 dBA L_{dn}. Residential uses are normally unacceptable in areas exceeding 70 dBA L_{dn} and conditionally acceptable within 55–70 dBA L_{dn}. Schools are normally acceptable in areas up to 70 dBA L_{dn} and normally unacceptable in areas exceeding 70 dBA L_{dn}. Commercial uses are normally acceptable in areas up to 70 dBA CNEL. Between 67.5 and 77.5 dBA L_{dn}, commercial uses are conditionally acceptable, depending on the noise insulation features and the noise reduction requirements. With respect to water recreation uses, exterior noise levels that do not exceed 75 dBA CNEL/L_{dn} are considered normally acceptable, levels between 70 and 80 dBA CNEL/L_{dn} are normally unacceptable, and levels that exceed 80 dBA CNEL/L_{dn} are clearly unacceptable. The guidelines also present adjustment factors that may be used to arrive at noise-acceptability standards that reflect the noise-control goals of the community, the particular community's sensitivity to noise, and the community's assessment of the relative importance of noise issues.

California Department of Transportation

For the protection of fragile, historic, and residential structures, the California Department of Transportation (Caltrans) recommends a threshold of 0.2 in/sec PPV for normal residential buildings and 0.08 in/sec PPV for old or historically significant structures (Caltrans 2002a). These standards are more stringent than the Federal standard established by Committee of Hearing, Bio Acoustics, and Bio Mechanics, presented above.

Table 8-4. State Noise-Compatibility Guidelines by Land-Use Category

Land-Use Category	Community Noise Exposure (CNEL/L_{dn}, dBA)			
	Normally Acceptable [a]	Conditionally Acceptable [b]	Normally Unacceptable [c]	Clearly Unacceptable [d]
Residential – Low-Density Single-Family, Duplexes, Mobile Homes	< 60	55–70	70–75	75+
Residential – Multifamily	< 65	60–70	70–75	75+
Transient Lodging – Motels, Hotels	< 65	60–70	70–80	80+
Schools, Libraries, Churches, Hospitals, Nursing Homes	< 70	60–70	70–80	80+
Auditoriums, Concert Halls, Amphitheaters		< 70	65+	
Sports Arenas, Outdoor Spectator Sports		< 75	70+	
Playgrounds, Neighborhood Parks	< 70		68–75	72.5+
Golf Courses, Riding Stables, Water Recreation, Cemeteries	< 75		70–80	80+
Office Buildings, Businesses, Commercial and Professional	< 70	68–78	75+	
Industrial, Manufacturing, Utilities, Agriculture	< 75	70–80	75+	

Source: OPR 2003

Notes:

[a] Specified land use is satisfactory, based on the assumption that any buildings involved are of normal conventional construction, without any special noise-insulation requirements.

[b] New construction or development should be undertaken only after a detailed analysis of the noise-reduction requirements is made and needed noise-insulation features are included in the design. Conventional construction, but with closed windows and fresh-air supply systems or air conditioning, will normally suffice.

[c] New construction or development should generally be discouraged. If new construction or development does proceed, a detailed analysis of the noise-reduction requirements must be made and needed noise-insulation features included in the design. Outdoor areas must be shielded.

[d] New construction or development should generally not be undertaken.

Key:

CNEL = community noise equivalent level

dBA = A-weighted decibels

L_{dn} = day-night noise level

8.2.3 Regional and Local

Shasta County

Shasta County General Plan Noise Element The Noise Element of the *Shasta County General Plan* includes goals, standards, and policies designed to ensure that county residents are not subjected to noise beyond acceptable levels (Shasta County 2004). Policies that may be applicable to the project include the following:

- **Policy N-b** – Noise likely to be created by a proposed non-transportation land use shall be mitigated so as not to exceed the noise level standards of Table 8-5 as measured immediately within the property line of adjacent lands designated as noise-sensitive.

- **Policy N-c** – Where proposed non-residential land uses are likely to produce noise levels exceeding the performance standards of Table 8-5 upon existing or planned noise-sensitive uses, an acoustical analysis shall be required as part of the environmental review process so that appropriate noise mitigation may be included in the project design. The requirements for the content of an acoustical analysis are given by Table 8-5.

- **Policy N-d** – The feasibility of proposed projects with respect to existing and future transportation noise levels shall be evaluated by comparison to Tables 8-5 and 8-6.

- **Policy N-f** – Noise created by new transportation sources shall be mitigated to satisfy the levels specified in Table 8-5 at outdoor activity areas and/or interior spaces of existing noise-sensitive land uses. Transportation noise shall be compared with existing and projected noise levels.

- **Policy N-g** – Existing noise-sensitive uses may be exposed to increased noise levels due to future roadway improvement projects as a result of increased traffic capacity and volumes and increases in travel speeds. In these instances, it may not be practical to reduce increased traffic noise levels consistent with those contained in Table 8-5. Therefore, as an alternative, the following criteria may be used as a test of significance for increases in the ambient outdoor activity areas of the noise level of noise-sensitive uses created as a result of a new roadway improvement project:

Table 8-5. Noise Level Performance Standards for New Projects Affected by or Including Nontransportation Sources

Noise Level Descriptor	Daytime (7 a.m. to 10 p.m.)	Nighttime (10 p.m. to 7 a.m.)
Hourly L_{eq}, dB	55	50
The noise levels specified above shall be lowered by 5 dB for simple tone noises, noises consisting primarily of speech or music, or for recurring impulsive noises. These noise level standards do not apply to residential units established in conjunction with industrial or commercial uses (e.g., caretaker dwellings). The County can impose noise level standards which are more restrictive than those specified above based upon determination of existing low ambient noise levels. In rural areas where large lots exist, the exterior noise level standard shall be applied at a point 100 feet away from the residence. Industrial, light industrial, commercial, and public service facilities which have the potential for producing objectionable noise levels at nearby noise-sensitive uses are dispersed throughout the County. Fixed-noise sources which are typically of concern include, but are not limited to, the following:		
HVAC Systems Cooling Towers/Evaporative Condensers Pump Stations Lift Stations Emergency Generators Boilers Steam Valves Steam Turbines Generators Fans Air Compressors	Heavy Equipment Conveyor Systems Transformers Pile Drivers Grinders Drill Rigs Gas or Diesel Motors Welders Cutting Equipment Outdoor Speakers Blowers	

Source: Shasta County 2004

Notes:

The types of uses which may typically produce the noise sources described above include, but are not limited to: industrial facilities including lumber mills, trucking operations, tire shops, auto maintenance shops, metal fabricating shops, shopping centers, drive-up windows, car washes, loading docks, public works projects, batch plants, bottling and canning plants, recycling centers, electric generating stations, race tracks, landfills, sand and gravel operations, and athletic fields.

For the purposes of the Noise Element, transportation noise sources are defined as traffic on public roadways, railroad line operations, and aircraft in flight. Control of noise from these sources is preempted by Federal and State regulations. Other noise sources are presumed to be subject to local regulations, such as a noise control ordinance. Non-transportation noise sources may include industrial operations, outdoor recreation facilities, heating, ventilation, and air conditioning units, loading docks, etc.

Key:

County = Shasta County

dB = decibels

HVAC = heating, ventilation, and air conditioning

L_{eq} = equivalent noise level

Table 8-6. Requirements for an Acoustical Analysis

An acoustical analysis prepared pursuant to the Noise Element shall:	
A.	Be the financial responsibility of the applicant.
B.	Be prepared by a qualified person experienced in the fields of environmental noise assessment and architectural acoustics.
C.	Include representative noise level measurements with sufficient sampling periods and locations to adequately describe local conditions and the predominant noise sources.
D.	Estimate existing and projected cumulative (20 years) noise levels in terms of L_{dn} or CNEL and/or the standards of Table [8-5], and compare those levels to the adopted policies of the Noise Element.
E.	Recommend appropriate mitigation to achieve compliance with the adopted policies and standards of the Noise Element, giving preference to proper site planning and design over mitigation measures which require the construction of noise barriers or structural modifications to buildings which contain noise-sensitive land uses.
F.	Estimate noise exposure after the prescribed mitigation measures have been implemented.
G.	Describe a post-project assessment program which could be used to evaluate the effectiveness of the proposed mitigation measures.

Source: Shasta County 2004

Key:
CNEL = community noise equivalent level
L_{dn} = day-night noise level

  - Where existing traffic noise levels are less than 60 dB Ldn, a +5 dB Ldn increase will be considered significant,

  - Where existing traffic noise levels range between 60 and 65 dB Ldn, a +3 dB Ldn increase will be considered significant, and

  - Where existing traffic noise levels are greater than 65 dB Ldn, a + 1.5 dB Ldn increase will be considered significant.

- **Policy N-i** – Where noise mitigation measures are required to achieve the standards of Tables 8-5 and 8-6, the emphasis of such measures shall be placed upon site planning and project design. The use of noise barriers shall be considered a means of achieving compliance with the noise standards only after all other practical design-related noise mitigation measures have been integrated into the project.

- **Policy N-j** – Encourage railroad officials to install noise-mitigation features on trains, equipment, and at fixed-based facilities whenever possible, and instruct railroad engineers to limit their use of air horns to reduce rail-related noise impacts on cities, towns, and rural community centers.

- **Policy N-k** – All County airports lacking adopted noise level contours consistent with the General Plan forecast year of 2025 should update their respective Master Plans or Comprehensive Land Use Plans to reflect aircraft operation noise levels for existing and future operations.

- **Policy N-l** – The use of site planning and building materials/design as primary methods of noise attenuation is encouraged.

- **Policy N-m** – The County should adopt noise control guidelines to assist staff and project applicants in determining the appropriate methods for reducing transportation and non-transportation generated noise.

- **Policy N-n** – The State Noise Insulation Standards (California Code of Regulations, Title 24) and Chapter 35 of the Uniform Building Code shall be enforced.

- **Policy N-o** – As the County updates the GIS mapping data base, the traffic, airport, and railroad noise contour information contained within the Background Report for the Noise Element shall be included as a part of the mapping data base. Noise contours for transportation and fixed noise sources should be periodically updated and any subsequent revisions of the data shall be incorporated into the General Plan and adopted for noise control planning purposes, as appropriate (see Tables 8-7 and 8-8).

Table 8-7. Maximum Allowable Noise Exposure Transportation Noise Sources

Land Use	Outdoor Activity Areas[a] L_{dn}/CNEL, dB	Interior Spaces	
		L_{dn}/CNEL, dB	L_{eq}, dB[b]
Residential	60 [c]	45	–
Transient Lodging	60 [d]	45	–
Hospitals, Nursing Homes	60 [c]	45	–
Theaters, Auditoriums, Music Halls	–	–	35
Churches, Meeting Halls	60 [c]	–	40
Office Buildings	–	–	45
Schools, Libraries, Museums	–	–	45
Playgrounds, Neighborhood Parks	70	–	–

Source: Shasta County 2004

Notes:

[a] Where the location of outdoor activity areas is unknown, the exterior noise level standard shall be applied to the property line of the receiving land use. Where it is not practical to mitigate exterior noise levels at patio or balconies of apartment complexes, a common area such as a pool or recreation area may be designated as the outdoor activity area.

[b] As determined for a typical worst-case hour during periods of use.

[c] Where it is not possible to reduce noise in outdoor activity areas to 60 dB Ldn/CNEL or less using a practical application of the best-available noise reduction measures, exterior noise levels of up to 65 dB Ldn/CNEL may be allowed provided that available exterior noise level reduction measures have been implemented and interior noise levels are in compliance with this table.

[d] In the case of hotel/motel facilities or other transient lodging, outdoor activity areas such as pool areas may not be included in the project design. In these cases, only the interior noise level criterion will apply.

Key:

CNEL = community noise equivalent level

dB = decibels

L_{dn} = day-night noise level

Table 8-8. Transportation Noise–Related Land Use Compatibility Guidelines for Development in Shasta County

Land Use Category		Community Noise Exposure (L_{dn} or CNEL, dB)						
		55	60	65	70	75	80	
Residential, Theaters, Music and Meeting Halls, Churches, and Auditoriums	G.A.	X	X					
	C.A.			X	X			
	G.U.					X	X	X
Transient Lodging— Motels, Hotels, and RV Parks	G.A.	X	X					
	C.A.			X	X	X		
	G.U.						X	X
Schools, Libraries, Museums, Nursing Homes, and Child Care	G.A.	X	X					
	C.A.			X	X	X		
	G.U.						X	X
Playgrounds, Neighborhood Parks, and Amphitheaters	G.A.	X	X	X	X			
	C.A.					X		
	G.U.						X	X
Office Buildings, Business, Commercial, and Professional	G.A.	X	X	X				
	C.A.				X	X		
	G.U.						X	X
Industrial, Manufacturing, Agriculture, and Utilities	G.A.	X	X	X	X			
	C.A.					X	X	X
	G.U.							
Golf Courses, Outdoor Spectator Sports, and Riding Stables	G.A.	X	X	X	X			
	C.A.					X	X	
	G.U.							X

Source: Shasta County 2004

Notes:

G.A. = Generally Acceptable. Specified land use is satisfactory. No noise mitigation measures are required.

C.A. = Conditionally Acceptable. Use should be permitted only after careful study and inclusion of protective measures as needed to satisfy the policies of the Noise Element.

G.U. = Generally Unacceptable. Development is usually not feasible in accordance with the goals of the Noise Element.

Key:

CNEL = community noise equivalent level

dB = decibels

L_{dn} = day-night noise level

Shasta County Code The Shasta County Code has one provision related to noise:

> 13.04.170: Unnecessary Noise Prohibited. No person shall operate any aircraft in flight or on the ground in such a manner as to cause unnecessary noise as determined by applicable Federal or State or local laws and regulations. (Prior code Section 2112.)

Tehama County

Tehama County General Plan The Noise Element of the *Tehama County General Plan* provides a basis for comprehensive local policies to control and abate environmental noise and to protect the citizens of the county from excessive noise exposure (Tehama County 2009). The fundamental goals of the Noise Element are as follows:

- **Goal N-1** – Provide sufficient information concerning the community noise environment so that noise may be effectively considered in the land use planning process.
  - **Policy N-1.1** – The County shall require an acoustical analysis for new projects anticipated to generate excessive noise located adjacent, or near, to noise-sensitive land uses. The acoustical analysis shall be prepared in accordance with Table 8-9, Requirements for Acoustical Analysis Prepared in Tehama County.

Table 8-9. Requirements for an Acoustical Analysis Prepared In Tehama County

An acoustical analysis prepared pursuant to the Noise Element shall:
(1) Be the responsibility of the applicant.
(2) Be prepared by qualified persons experienced in the fields of environmental noise assessment and architectural acoustics.
(3) Include representative noise level measurements with sufficient sampling periods and locations to adequately describe local conditions.
(4) Estimate existing and projected cumulative noise levels in terms of the standards of Tables 9-6 and 9-7 of this General Plan and compare those levels to the adopted policies of the Noise Element.
(5) Recommend appropriate mitigation to achieve compliance with the adopted policies and standards of the Noise Element. Where the noise source in question consists of intermittent single events, the report must address the effects of maximum noise levels in sleeping rooms evaluating possible sleep disturbance.
(6) Estimate interior and exterior noise exposure after the prescribed mitigation measures have been implemented.
(7) Describe the post-project assessment program that could be used to evaluate the effectiveness of the proposed mitigation measures.

Source: Tehama County 2009

- **Goal N-2** – Develop strategies for abating excessive noise exposure through cost-effective mitigation measures in combination with appropriate zoning to avoid incompatible land uses.
  - **Policy N-2.4** – The County shall restrict construction activities to the hours as determined in the Countywide Noise Control Ordinance, if such an Ordinance is adopted.
    - **Implementation Measure N-2.4a** – Restrict construction activities to the hours as determined by the County's Noise Control Ordinance unless an exemption is received from the County to cover special circumstances. Special circumstances

may include emergency operations, short-duration construction, etc.

- **Implementation Measure N-2.4b** – Require all internal combustion engines that are used in conjunction with construction activities be muffled according to the equipment manufacturer's requirements.

- **Goal N-3** – Protect those existing regions of the planning area whose noise environments are deemed acceptable, and also those locations throughout the community deemed "noise sensitive."

- **Goal N-4** – Protect existing noise-producing commercial and industrial uses in Tehama County from encroachment by noise-sensitive land uses.

  – **Policy N-4.1** – The County shall require review for discretionary industrial, commercial, or other noise-generating land uses for compatibility with adjacent and nearby noise-sensitive land uses.

  – **Policy N-4.2** – The interior and exterior noise level standards for noise-sensitive areas of new uses affected by non-transportation noise sources within Tehama County are depicted in Table 8-10.

Lower Sacramento River and Delta

General plan noise elements and noise ordinances from all counties in the lower Sacramento River and Delta and communities in Tehama, Butte, Glenn, Colusa, Sutter, Yolo, Sacramento, Solano, and Contra Costa counties would be applicable to affected areas within their jurisdictions. The general plans and codes in these jurisdictions would be similar to the Shasta and Tehama county regulations outlined above. Construction, land use, and acceptable levels for various land uses would be defined and outlined.

CVP/SWP Service Areas

All community and county plans and ordinances in the CVP and SWP service areas would be applicable to affected areas within their jurisdictions. The general plans and codes in these jurisdictions would be similar to the Shasta and Tehama county regulations outlined above. Construction, land use, and acceptable levels for various land uses would be defined and outlined.

Table 8-10. Noise Standards for New Uses Affected By Nontransportation Noise in Tehama County

New Land Use	Outdoor Activity Area—L_{eq}, dB		Interior—L_{eq}, dB	
	Daytime	Nighttime	Day and Night	Notes
All Residential	50	45	35	1,2,7
Transient Lodging	55	–	40	3
Hospitals and Nursing Homes	50	45	35	4
Theaters and Auditoriums	–	–	35	
Churches, Meeting Halls, Schools, Libraries, etc.	55	–	40	
Office Buildings	55	–	45	5,6
Commercial Buildings	55	–	45	5,6
Playgrounds, Parks, etc.	65	–	–	6
Industry	65	65	50	5

Source: Tehama County 2009

Notes:

[1] Outdoor activity areas for single-family residential uses are defined as back yards. For large parcels or residences with no clearly defined outdoor activity area, the standard shall be applicable within a 100-foot radius of the residence.

[2] For multi-family residential uses, the exterior noise level standard shall be applied at the common outdoor recreation area, such as at pools, play areas or tennis courts. Where such areas are not provided, the standards shall be applied at individual patios and balconies of the development.

[3] Outdoor activity areas of transient lodging facilities include swimming pool and picnic areas, and are not commonly used during nighttime hours.

[4] Hospitals are often noise generating uses. The exterior noise level standards for hospitals are applicable only at clearly identified areas designated for outdoor relaxation by either hospital staff or patients.

[5] Only the exterior spaces of these uses designated for employee or customer relaxation have any degree of sensitivity to noise.

[6] The outdoor activity areas of office, commercial and park uses are not typically utilized during nighttime hours.

[7] It may not be possible to achieve compliance with this standard at residential uses located immediately adjacent to loading dock areas of commercial uses while trucks are unloading. The daytime and nighttime noise level standards applicable to loading docks shall be 55 and 50 dB Leq, respectively.

General: The Table 9-7 standards shall be reduced by 5 dB for sounds consisting primarily of speech or music, and for recurring impulsive sounds. If the existing ambient noise level exceeds the standards of Table 9-7, then the noise level standards shall be increased at 5 dB increments to encompass the ambient.

Key:
dB = decibels
L_{eq} = equivalent noise level

8.3 Environmental Consequences and Mitigation Measures

8.3.1 Methods and Assumptions

Land use types and major noise sources in the project vicinity were identified based on existing documentation (e.g., the Shasta County Zoning Code) and site reconnaissance data. To assess potential short-term construction noise impacts,

sensitive receptors and their relative exposure (considering topographic barriers and distance) were identified. Noise levels of specific construction equipment were determined and resultant noise levels at those receptors were calculated.

Potential long-term (operational) traffic, area-source, and stationary-source noise impacts were qualitatively assessed based on the number of vehicle trips and other potential operational noise sources introduced to the project area.

Groundborne vibration impacts were qualitatively assessed based on existing documentation (e.g., vibration levels produced by specific construction equipment) and the distance of sensitive receptors from the given source.

Predicted noise levels were compared with applicable standards for determination of significance. Mitigation measures were developed for significant and potentially significant noise impacts.

8.3.2 Criteria for Determining Significance of Effects

An environmental document prepared to comply with NEPA must consider the context and intensity of the environmental effects that would be caused by, or result from, the proposed action. Under NEPA, the significance of an effect is used solely to determine whether an environmental impact statement must be prepared. An environmental document prepared to comply with CEQA must identify the potentially significant environmental effects of a proposed project. A "[s]ignificant effect on the environment" means a substantial, or potentially substantial, adverse change in any of the physical conditions within the area affected by the project" (State CEQA Guidelines, Section 15382). CEQA also requires that the environmental document propose feasible measures to avoid or substantially reduce significant environmental effects (State CEQA Guidelines, Section 15126.4(a)).

The following significance criteria were developed based on guidance provided by the State CEQA Guidelines, other Federal, State, and local guidance, and consider the context and intensity of the environmental effects as required under NEPA. Impacts of an alternative on noise would be significant if project implementation would do any of the following:

- Expose persons to or generate noise levels in excess of standards established in the local general plan or noise ordinance, or applicable standards of other agencies.
- Expose persons to or generate excessive groundborne vibration or groundborne noise levels.
- Permanently increase ambient noise levels in the project vicinity substantially above levels existing without the project.

- Temporarily or periodically increase ambient noise levels in the project vicinity substantially above levels existing without the project.

- Expose people residing or working in the project area to excessive aircraft-generated noise levels.

8.3.3 Topics Eliminated from Further Consideration

None of the project alternatives would expose people residing or working in the project area to excessive aircraft-generated noise levels because of the distance of existing airports to the project area. There would also be no change in railway traffic as a result of any of the alternatives. Therefore, potential effects on the primary and extended study areas related to these issues are not discussed further in this PDEIS.

This analysis assumes that the operation of any of the project alternatives would not generate any new significant long-term noise sources because operation and maintenance of Shasta Dam and current or relocated recreational facilities would be relatively unchanged compared to existing conditions. Relocated recreational facilities would presumably generate the same levels and types of noise, but in a slightly different location than currently exists. After completion of the dam raise, bridge and levee construction, and relocation of recreational facilities, the number of personnel serving at all sites during construction would be reduced to approximately the number currently serving to operate and maintain the facilities. Therefore, no further analysis is needed and no mitigation would be needed.

No effects on the current ambient noise environment would occur in the lower Sacramento River and Delta and the CVP and SWP service areas; no construction activities would occur in these geographic regions, and there would be no long-term noise sources from dam operation, modified flows in the Sacramento River and other tributaries, or water storage and conveyance throughout the CVP and SWP service areas. Therefore, potential effects related to project noise in those geographic regions are not discussed further in this PDEIS.

8.3.4 Direct and Indirect Effects

No-Action Alternative

Shasta Lake and Vicinity and Upper Sacramento River (Shasta Dam to Red Bluff)

Impact Noise-1 (No-Action): Exposure of Sensitive Receptors in the Primary Study Area to Project-Generated Construction Noise No construction activities would occur and current operations would continue. Recreational use, population, and traffic would all increase but these increases and the effect on the noise environment would not be substantial. This impact would be less than significant.

No construction activities would occur and the dam would continue to function as it currently functions. Because no construction activities would occur under this alternative, implementing the No-Action Alternative could not contribute toward a temporary change in the ambient noise environment. Generally, ambient noise levels would likely increase under the No-Action Alternative because greater recreational use, population growth, and traffic would occur; however, these increases would not be substantial. As a result, this impact would be less than significant. Mitigation is not required for the No-Action Alternative.

Impact Noise-2 (No-Action): Exposure of Sensitive Receptors in the Primary Study Area to Project-Generated Vibration During Construction No construction activities would occur and current operations would continue. Recreational use, population, and traffic would all increase, but these increases and the effect on the noise environment would not be substantial. This impact would be less than significant.

This impact is similar to Impact Noise-1 (No-Action) for the primary study area. For the same reasons as described under Impact Noise-1 (No-Action), this impact would be less than significant. Mitigation is not required for the No-Action Alternative.

Impact Noise-3 (CP1): Exposure of Sensitive Receptors in the Primary Study Area to Project-Generated Mobile-Source Noise During Operations No construction activities would occur and current operations would continue. Recreational use, population, and traffic would all increase, but these increases and the effect on the noise environment would not be substantial. This impact would be less than significant.

This impact is similar to Impact Noise-1 (No-Action) for the primary study area. For the same reasons as described under Impact Noise-1 (No-Action), this impact would be less than significant. Mitigation is not required for the No-Action Alternative.

Lower Sacramento River and Delta and CVP/SWP Service Areas No effects related to noise and vibration are expected to occur in the lower Sacramento River and Delta and the CVP/SWP service areas; therefore, potential effects in those geographic regions are not discussed further in this PDEIS.

CP1 – 6.5-Foot Dam Raise, Anadromous Fish Survival and Water Supply Reliability

Shasta Lake and Vicinity and Upper Sacramento River (Shasta Dam to Red Bluff)

Impact Noise-1 (CP1): Exposure of Sensitive Receptors in the Primary Study Area to Project-Generated Construction Noise Temporary construction noise would not exceed applicable noise-level standards at nearby noise-sensitive

receptors. Construction activities at Shasta Dam would consist of site preparation (e.g., excavation, grading, and clearing), the dam raise, blasting, tree removal, material handling, demolition, and site restoration and cleanup. Increases in truck traffic from construction would not cause a perceptible increase in current traffic noise levels or a noticeable difference in ambient noise levels. This temporary impact would be significant.

Construction activities at the Shasta Dam site under CP1 would include site preparation (e.g., excavation, grading, and clearing), the proposed dam raise, blasting, tree removal, material handling, site restoration and clean-up, and other miscellaneous activities. Temporary noise effects of the operation of heavy-duty construction equipment at the dam, blasting activities, operation of heavy-duty construction equipment at other project sites, and off-site construction traffic are addressed separately below.

Operation of Heavy-Duty Construction Equipment at the Dam The construction activities mentioned above would require the use of scrapers, excavators, bulldozers, compactors, loaders, trucks, crushers, pumps, pavers, concrete mixers, cranes, generators, and other miscellaneous pieces of equipment based on similar projects. According to the U.S. Environmental Protection Agency, noise levels generated by individual pieces of these types of equipment can range from 76 to 94 dBA at 50 feet without feasible noise control (Table 8-11). Simultaneous operation of the heavy-duty construction equipment could result in combined intermittent noise levels of approximately 94 dBA at 50 feet from the project site. Based on these noise levels and a typical noise-attenuation rate of 6.0 dBA/DD, exterior noise levels at noise-sensitive receptors located within 4,000 feet of construction activity could exceed 55 dBA L_{eq} (the Shasta County standard for daytime hours) without noise control. However, there is a 450-foot elevation increase spanning 4,500 feet of intervening topography between the nearest receptors (residences on Lake Boulevard) and Shasta Dam. Accounting for the intervening topography attenuation, the vegetation, and the distance between the dam and receptors, an attenuation rate of approximately -100 dBA can be applied (-40 dBA for distance, -10 dBA for trees and vegetation, and -50 dBA for topographic elevation change). Thus, noise levels at the nearest sensitive receptor would be less than 50 dBA L_{dn}.

Additional residential receptors are approximately 7,000 feet down the Sacramento River from Shasta Dam. The construction-related noise level at this location would be approximately 45 dBA (95 dBA at 50 feet from construction site minus 45 dBA attenuation for distance, and minus 5 dBA attenuation from vegetation and topography). Thus, project construction noise generated by on-site construction equipment at Shasta Dam under CP1 would not expose sensitive receptors to or generate noise levels in excess of applicable standards (55 dBA daytime, 50 dBA nighttime), or to a substantial temporary increase in noise levels above existing conditions. This temporary impact would be less than significant.

Blasting Activities at the Dam Construction of the Shasta Dam height increase would require blasting during excavation of rock for the concrete tie-in to adjacent rock. Specific blast design parameters such as explosive type and amount (charge weight), drill pattern, and time scheme are not known at this time. However, it is anticipated that few blasts would occur each day. Blasting operations would result in airborne noise caused by the energy released in the explosion, which creates an air overpressure (airblast) in the form of a propagating wave. Still, as currently planned, single-event noise levels could exceed 110 dBA (FTA 2006). Based on the above attenuation rates, construction noise from project-related blasting activities could result in noise levels of 60 dBA at sensitive receptors downstream along the Sacramento River (7,000 feet away). As a result, the temporary impact of single-event increases in noise levels would be significant.

Operation of Heavy-Duty Construction Equipment at Other Project Sites Multiple construction activities would occur at the other project-related sites (Pit River Bridge, the lakeshore area, and other areas where bridges and roads would require relocation; recreation facilities that would require removal and reconstruction; and inundation areas that would require clearing). Among the anticipated construction activities are site preparation (e.g., excavation, grading, demolition, and clearing), paving, pile driving, laying of railroad tracks, bridge relocation, removal of trees and vegetation, material handling, and site restoration and cleanup.

Based on similar projects, the on-site construction equipment required for the activities would likely include but not be limited to an excavator, bulldozer, front-end loader, grader, compactor, cranes, pile drivers, trucks, and other large pieces of equipment as necessary. According to the U.S. Environmental Protection Agency, noise levels from individual pieces of these types of equipment, when operated without feasible noise control, can range from 79 to 96 dBA at 50 feet (Table 8-11). Simultaneous operation of the three noisiest pieces of heavy-duty construction equipment, including pile driving, could result in combined intermittent noise levels of approximately 97 dBA at 50 feet from the project site. Based on these noise levels and a typical noise-attenuation rate of 6.0 dBA/DD, exterior noise levels at noise-sensitive receptors located within 75 feet of construction activity (i.e., sensitive receptors along Lakeshore Drive) could exceed 94 dBA L_{eq} without noise control. Such noise levels would exceed Shasta County standards (55 dBA daytime, 50 dBA nighttime).

Table 8-11. Typical Construction Equipment Noise Levels

Type of Equipment	Noise Level at 50 feet (dBA)
Scraper	89
Excavator	89
Bulldozer	85
Compactor	82
Loader	85
Truck	88
Crusher	94
Pump	76
Paver	89
Concrete Pump	82
Concrete Mixer	85
Derrick Crane	88
Pile Driving (sonic)	96
Generator	81

Source: FTA 2006

Key:
dBA = A-weighted decibels

Helicopters would be used for vegetation removal during the spring and fall, when helicopters are not in use for firefighting. Helicopter noise levels range from 80 to 90 dBA at 250 feet (Caltrans 2002b). Noise levels from helicopters would be similar to those of other construction equipment described above.

Construction in areas away from the dam site would occur primarily during the daytime; however, the exact hours of construction are not specified at this time, nor has Shasta County adopted a noise ordinance that exempts construction noise from the provisions of the standard. If construction activities were to occur during the more noise-sensitive hours (evening, nighttime, and early morning), or if equipment were not properly equipped with noise-control devices, construction noise could exceed applicable noise-level standards (i.e., Shasta County's nighttime standard of 50 dBA L_{eq}) at existing noise-sensitive receptors located within 7,000 feet. In addition, any project-related construction noise generated during these more noise-sensitive hours may annoy and/or disrupt the sleep of occupants of the nearby existing noise-sensitive land uses, and temporarily but substantially increase ambient noise levels in the project vicinity. As a result, this impact would be significant.

Off-Site Construction Traffic Project construction would require approximately 350 on-site employees at any given time. Assuming two total trips per day per employee and 81 round trips per day for the transport of equipment and materials, project construction would result in a maximum of

approximately 862 one-way daily trips at the dam site. Typically, traffic volumes must double before the associated increase in noise levels is noticeable (3 dBA CNEL/L_{dn}) along roadways. Given that the average daily traffic volumes are 5,500 for State Route 151, 37,000 for I-5, and 2,000 for the Lakeshore Community, traffic would not double. Therefore, adding these daily trips on the local roadway system to existing volumes would be a minor change. Consequently, project construction under CP1 would not noticeably change the traffic-noise contours of area roadways. This impact would be less than significant.

Summary Implementing CP1 would result in less than significant noise impacts related to operation of heavy-duty construction equipment at Shasta Dam and off-site construction traffic. However, the impact of this alternative related to blasting activities at Shasta Dam and operation of heavy-duty construction equipment at other project sites would be significant. Mitigation for this impact is proposed in Section 8.3.5.

Impact Noise-2 (CP1): Exposure of Sensitive Receptors in the Primary Study Area to Project-Generated Vibration During Construction Temporary construction-related activities would not expose persons to or generate excessive groundborne vibration or groundborne noise. As a result, this temporary impact would be less than significant.

According to FTA, vibration levels associated with the use of trucks, dozers, and other heavy-duty construction equipment such as the equipment types used at project construction sites are 0.076 to 0.089 in/sec PPV and 86–87 VdB at 25 feet, and vibration levels from pile driving can reach 0.73 in/sec PPV (Table 8-10). Vibration levels generated during project construction under CP1 could exceed Caltrans's recommended standard with respect to the prevention of structural damage (0.2 in/sec PPV for buildings) and FTA's maximum-acceptable constant vibration standard of 80 VdB with respect to human annoyance for residential uses within 65 feet of the impact zone. Because there are no sensitive receptors within these distances from any of the construction sites (the nearest residences would be along Lakeshore Drive and approximately 75 feet from road and bridge construction activities taking place in the area), implementing CP1 would not generate excessive groundborne vibration or groundborne noise levels, nor would it expose persons or buildings to such groundborne vibration or noise. As a result, this temporary impact would be less than significant.

Blasting at the Shasta Dam site would result in ground vibration from the creation of seismic waves that radiate along the earth's surface. As discussed previously, no noise-sensitive receptors are located near the dam site. Receptors would need to be within 250 feet of the blasts to be affected (greater than 80 VdB) by groundborne vibration. No sensitive receptors are within this range of the dam. Therefore, this temporary impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact Noise-3 (CP1): Exposure of Sensitive Receptors in the Primary Study Area to Project-Generated Mobile-Source Noise During Operations Traffic associated with project operations would not expose persons to or generate noise in excess of applicable mobile-source noise standards, nor would such traffic noise create a substantial increase in ambient noise levels in the project vicinity. As a result, this impact would be less than significant.

Relocating Lakeshore Drive would move traffic noise closer to sensitive receptors in the Lakeshore Community. Based on roads of this size and service, it is estimated that the maximum average daily traffic in this area would be approximately 2,000 vehicles per day. Modeling by the Federal Highway Administration for a 2,000-average daily traffic two-lane roadway places the 60-dBA L_{dn} contour (Shasta County's transportation standard) at 70 feet from the roadway centerline. With the additional noise emanating from the adjacent railroad line (Shasta County 2004) and the nearest receptors farther than 75 feet from the new roadway centerline, the ambient noise level would not increase by more than 3 dBA or exceed 60 dBA (Shasta County 2004). Thus, project-generated long-term traffic noise would not result in an exceedence of the Shasta County standards. This impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Lower Sacramento River and Delta and CVP/SWP Service Areas
Implementing CP1 would not generate any new long-term noise outside of the primary study area. Furthermore, no construction work would occur in the extended study area; as a result, no project noise would be temporarily added to the current noise environment. No effects related to noise and vibration are expected to occur in the lower Sacramento River and Delta and the CVP/SWP service areas; therefore, potential effects of CP1 in those geographic regions are not discussed further in this PDEIS.

CP2 – 12.5-Foot Dam Raise, Anadromous Fish Survival and Water Supply Reliability

The direct and indirect impacts of CP2 related to noise and vibration would be essentially the same as those described for CP1 because construction activities, and equipment and workforce needs, would be similar under both alternatives. Also, the long-term impact of CP2 on traffic levels associated with relocating Lakeshore Drive would be expected to be similar to the corresponding impact of CP1. Thus, as described below, the impacts described for CP1 would generally also apply to CP2.

Shasta Lake and Vicinity and Upper Sacramento River (Shasta Dam to Red Bluff)
Impact Noise-1 (CP2): Exposure of Sensitive Receptors in the Primary Study Area to Project-Generated Construction Noise Temporary construction noise would not exceed applicable noise-level standards at nearby noise-sensitive receptors. Construction activities at Shasta Dam would consist of site preparation (e.g., excavation, grading, and clearing), the dam raise, blasting, tree

removal, material handling, demolition, and site restoration and cleanup. Increases in truck traffic from construction would not cause a perceptible increase in current traffic noise levels or a noticeable difference in ambient noise levels. This temporary impact would be significant.

This impact would be the same as Impact Noise-1 (CP1) and would be significant. Mitigation for this impact is proposed in Section 8.3.5.

Impact Noise-2 (CP2): Exposure of Sensitive Receptors in the Primary Study Area to Project-Generated Vibration During Construction Temporary construction-related activities would not expose persons to or generate excessive groundborne vibration or groundborne noise. As a result, this impact would be less than significant.

This impact would be the same as Impact Noise-2 (CP1) and would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact Noise-3 (CP2): Exposure of Sensitive Receptors in the Primary Study Area to Project-Generated Mobile-Source Noise During Operations Traffic associated with project operations would not expose persons to or generate noise in excess of applicable mobile-source noise standards, nor would such traffic create a substantial increase in ambient noise levels in the project vicinity. As a result, this impact would be less than significant.

This impact would be the same as Impact Noise-3 (CP1) and would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Lower Sacramento River and Delta and CVP/SWP Service Areas Similar to CP1, implementing CP2 would not generate any new long-term noise outside of the primary study area. Furthermore, no construction work would occur in the extended study area; as a result, no project noise would be temporarily added to the current noise environment. No effects related to noise and vibration are expected to occur in the lower Sacramento River and Delta and the CVP/SWP service areas; therefore, potential effects of CP2 in those geographic regions are not discussed further in this PDEIS.

CP3 – 18.5-Foot Dam Raise, Anadromous Fish Survival and Water Supply

The direct and indirect impacts of CP3 related to noise and vibration would be essentially the same as those described for CP1 and CP2 because construction activities, and equipment and workforce needs, would be similar under these alternatives. Also, the long-term impact of CP3 on traffic levels associated with relocating Lakeshore Drive would be expected to be similar to the corresponding impact of CP1 and CP2. Thus, as described below, the impacts described for CP1 and CP2 would generally also apply to CP3.

Shasta Lake and Vicinity and Upper Sacramento River (Shasta Dam to Red Bluff)

Impact Noise-1 (CP3): Exposure of Sensitive Receptors in the Primary Study Area to Project-Generated Construction Noise Temporary construction noise would not exceed applicable noise-level standards at nearby noise-sensitive receptors. Construction activities at Shasta Dam would consist of site preparation (e.g., excavation, grading, and clearing), the dam raise, blasting, tree removal, material handling, demolition, and site restoration and cleanup. Increases in truck traffic from construction would not cause a perceptible increase in current traffic noise levels or a noticeable difference in ambient noise levels. This temporary impact would be significant.

This impact would be the same as Impact Noise-1 (CP1) and would be significant.

Impact Noise-2 (CP3): Exposure of Sensitive Receptors in the Primary Study Area to Project-Generated Vibration During Construction Temporary construction-related activities would not expose persons to or generate excessive groundborne vibration or groundborne noise. As a result, this impact would be less than significant.

This impact would be the same as Impact Noise-2 (CP1) and would be less than significant. Mitigation for this impact is proposed in Section 8.3.5.

Impact Noise-3 (CP3): Exposure of Sensitive Receptors in the Primary Study Area to Project-Generated Mobile-Source Noise During Operations Traffic associated with project operations would not expose persons to or generate noise in excess of applicable mobile-source noise standards, nor would such traffic create a substantial increase in ambient noise levels in the project vicinity. As a result, this impact would be less than significant.

This impact would be the same as Impact Noise-3 (CP1) and would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Lower Sacramento River and Delta and CVP/SWP Service Areas Similar to CP1 and CP2, implementing CP3 would not generate any new long-term noise outside of the primary study area. Furthermore, no construction work would occur in the extended study area; as a result, no project noise would be temporarily added to the current noise environment. No effects related to noise and vibration are expected to occur in the lower Sacramento River and Delta and the CVP/SWP service areas; therefore, potential effects of CP3 in those geographic regions are not discussed further in this PDEIS.

CP4 – 18.5-Foot Dam Raise, Anadromous Fish Focus With Water Supply Reliability

The direct and indirect impacts of CP4 related to noise and vibration would be essentially the same as those described for CP1 through CP3 because

construction activities, and equipment and workforce needs, would be similar under these alternatives. Also, the long-term impact of CP4 on traffic levels associated with relocating Lakeshore Drive would be expected to be similar to the corresponding impact of CP1 and CP2. Thus, as described below, the impacts described for CP1 and CP2 would generally also apply to CP4.

Shasta Lake and Vicinity and Upper Sacramento River (Shasta Dam to Red Bluff)

Impact Noise-1 (CP4): Exposure of Sensitive Receptors in the Primary Study Area to Project-Generated Construction Noise Temporary construction noise levels would not exceed applicable noise-level standards at nearby noise-sensitive receptors. Construction activities at Shasta Dam would consist of site preparation (e.g., excavation, grading, and clearing), the dam raise, blasting, tree removal, material handling, demolition, and site restoration and cleanup. Increases in truck traffic from construction would not cause a perceptible increase in current traffic noise levels or a noticeable difference in ambient noise levels. Gravel augmentation under CP4 would increase the total number of construction-related truck trips, but not enough to result in a violation of traffic noise standards or a substantial increase in traffic noise. This temporary impact would be significant.

This impact would be similar to Impact Noise-1 (CP1), but slightly greater because of the addition of gravel augmentation along the upper Sacramento River that is proposed under CP4. The proposed gravel augmentation would result in approximately 800 truck trips per year. Assuming 44 work days, approximately 18 truck trips per day would be added to the local roadway network. In addition, the Reading Island restoration project component would also be included under CP4. Reading Island restoration construction would include an excavator, loader, and compaction equipment. Noise levels would be similar to those described under CP1 and CP2 (see Table 8-11). Approximately 350 haul trips would be needed to remove material from the site, resulting in approximately eight trips per day over a 2-month period. As discussed above under Impact Noise-1 (CP1), to generate a substantial increase in traffic noise, the traffic volume must double. Because adding 26 truck trips would not double roadway traffic volumes, no violation of traffic noise standards or substantial increase in traffic noise would occur. For the same reasons as described for Impact Noise-1 (CP1), this impact would be significant. Mitigation for this impact is proposed in Section 8.3.5.

Impact Noise-2 (CP4): Exposure of Sensitive Receptors in the Primary Study Area to Project-Generated Vibration During Construction Temporary construction-related activities would not expose persons to or generate excessive groundborne vibration or groundborne noise. As a result, this impact would be less than significant.

This impact would be the same as Impact Noise-2 (CP1) and would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact Noise-3 (CP4): Exposure of Sensitive Receptors in the Primary Study Area to Project-Generated Mobile-Source Noise During Operations Traffic associated with project operations would not expose persons to or generate noise in excess of applicable mobile-source noise standards, nor would such traffic create a substantial increase in ambient noise levels in the project vicinity. As a result, this impact would be less than significant.

This impact would be the same as Impact Noise-3 (CP1) and would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Lower Sacramento River and Delta and CVP/SWP Service Areas Similar to CP1, implementing CP4 would not generate any new long-term noise sources outside of the primary study area. Furthermore, no construction work would occur in the extended study area; as a result, no project noise would be temporarily added to the current noise environment. No effects related to noise and vibration are expected to occur in the lower Sacramento River and Delta and the CVP/SWP service areas; therefore, potential effects of CP4 in those geographic regions are not discussed further in this PDEIS.

CP5 – 18.5-Foot Dam Raise, Combination Plan

The direct and indirect impacts of CP5 related to noise and vibration would be essentially the same as those described for CP1 through CP4 because construction activities, and equipment and workforce needs, would be similar under these alternatives. Also, the long-term impact of CP5 on traffic levels associated with relocating Lakeshore Drive would be expected to be similar to the corresponding impact under CP1 and CP2. Thus, as described below, the impacts described for CP1 and CP2 would generally also apply to CP5.

Shasta Lake and Vicinity and Upper Sacramento River (Shasta Dam to Red Bluff)

Impact Noise-1 (CP5): Exposure of Sensitive Receptors in the Primary Study Area to Project-Generated Construction Noise Temporary construction noise levels would not exceed applicable noise-level standards at nearby noise-sensitive receptors. Construction activities at Shasta Dam would consist of site preparation (e.g., excavation, grading, and clearing), the dam raise, blasting, tree removal, material handling, demolition, and site restoration and cleanup. Increases in truck traffic from construction would not cause a perceptible increase in current traffic noise levels or a noticeable difference in ambient noise levels. Gravel augmentation under CP5 would increase the total number of construction-related truck trips, but not enough to result in a violation of traffic noise standards or a substantial increase in traffic noise. This temporary impact would be significant.

Like CP4, CP5 would involve gravel augmentation along the upper Sacramento River and restoration at Reading Island, neither of which would occur under CP1, CP2, or CP3. Reading Island restoration construction would include an excavator, loader, and compaction equipment. Noise levels would be similar to

those described under CP1 and CP2 (see Table 8-11). Approximately 350 haul trips would be needed to remove material from the site, resulting in approximately eight trips per day over a 2-month period. As discussed above under Impact Noise-1(CP1), to generate a substantial increase in traffic noise, a doubling of traffic volume would be required. Because adding 26 truck trips would not double roadway traffic volumes, no violation of traffic noise standards or substantial increase in traffic noise would occur. Noise levels from construction equipment, however, would still likely exceed noise standards. Therefore, temporary, construction-related impacts would be significant.

Thus, this impact would be the same as Impact Noise-1 (CP4) and would be significant. Mitigation for this impact is proposed in Section 8.3.5.

Impact Noise-2 (CP5): Exposure of Sensitive Receptors in the Primary Study Area to Project-Generated Vibration During Construction Temporary construction-related activities would not expose persons to or generate excessive groundborne vibration or groundborne noise. The additional habitat development included in CP5 would occur in uninhabited areas of Shasta-Trinity National Forest, would not affect sensitive receptors, and would be temporary. As a result, this impact would be less than significant.

This impact would be the same as Impact Noise-2 (CP1). CP5 would also involve development of additional habitat; however, habitat development would occur in an uninhabited area managed by the U.S. Bureau of Land Management, would not be expected to affect any sensitive receptors, and would be temporary. Therefore, this impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact Noise-3 (CP5): Exposure of Sensitive Receptors in the Primary Study Area to Project-Generated Mobile-Source Noise During Operations Traffic associated with project operations would not expose persons to or generate noise in excess of applicable mobile-source noise standards, nor would such traffic create a substantial increase in ambient noise levels in the project vicinity. The additional habitat development included in CP5 would occur in uninhabited areas of Shasta-Trinity National Forest, would not create new operational traffic, and would not affect sensitive receptors. This impact would be less than significant.

This impact would be the same as Impact Noise-3 (CP1). CP5 would also involve development of additional habitat; however, habitat development would occur in an uninhabited area managed by the U.S. Bureau of Land Management, would not create any new operational traffic, and is not expected to affect any sensitive receptors. Therefore, this impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Lower Sacramento River and Delta and CVP/SWP Service Areas Similar to CP1 and CP2, implementing CP5 would not generate any new long-term

noise outside of the primary study area. Furthermore, no construction work would occur in the extended study area; as a result, no project noise would be temporarily added to the current noise environment. No effects related to noise and vibration are expected to occur in the lower Sacramento River and Delta and the CVP/SWP service areas; therefore, potential effects of CP5 in those geographic regions are not discussed further in this **P**DEIS.

8.3.5 Mitigation Measures

Table 8-12 presents a summary of mitigation measures for noise and vibration.

Table 8-12. Summary of Mitigation Measures for Noise and Vibration

Impact		No-Action Alternative	CP1	CP2	CP3	CP4	CP5
Impact Noise-1: Exposure of Sensitive Receptors in the Primary Study Area to Project-Generated Construction Noise	LOS before Mitigation	LTS	S	S	S	S	S
	Mitigation Measure	None required.	Mitigation Measure Noise-1: Implement Measures to Prevent Exposure of Sensitive Receptors to Temporary Construction Noise at Project Construction Sites.				
	LOS after Mitigation	LTS	LTS	LTS	LTS	LTS	LTS
Impact Noise-2: Exposure of Sensitive Receptors in the Primary Study Area to Project-Generated Vibration During Construction	LOS before Mitigation	LTS	LTS	LTS	LTS	LTS	LTS
	Mitigation Measure	None required.	None needed; thus, none proposed				
	LOS after Mitigation	LTS	LTS	LTS	LTS	LTS	LTS
Impact Noise-3: Exposure of Sensitive Receptors in the Primary Study Area to Project-Generated Mobile-Source Noise During Operations	LOS before Mitigation	LTS	LTS	LTS	LTS	LTS	LTS
	Mitigation Measure	None required.	None needed; thus, none proposed.				
	LOS after Mitigation	LTS	LTS	LTS	LTS	LTS	LTS

Key:
LOS = level of significance
LTS = less than significant
S = significant

No-Action Alternative

No mitigation measures are needed for this alternative.

CP1 – 6.5-Foot Dam Raise, Anadromous Fish Survival and Water Supply Reliability

No mitigation is needed for Impacts Noise-2 (CP1) and Noise-3 (CP1). Mitigation is provided below for the remaining noise impact of CP1.

Mitigation Measure Noise-1 (CP1): Implement Measures to Prevent Exposure of Sensitive Receptors to Temporary Construction Noise at Project Construction Sites Reclamation and its primary construction contractors will implement the measures listed below during construction:

- Construction activities at non-dam sites will be limited to the less noise-sensitive daytime hours (7 a.m. to 10 p.m., Monday through Friday).
- All construction equipment and staging areas will be located at the farthest distance possible from nearby noise-sensitive land uses.
- All construction equipment will be properly maintained and equipped with noise-reduction intake and exhaust mufflers and engine shrouds, in accordance with manufacturers' recommendations. Equipment engine shrouds will be closed during equipment operation.
- All motorized construction equipment will be shut down when not in use to prevent idling.
- A temporary barrier will be placed as close to the noise source or receptor as possible and will break the line of sight between the source and receptor.
- A disturbance coordinator will be designated and the person's telephone number conspicuously posted around the project sites and supplied to nearby residences. The disturbance coordinator will receive all public complaints and be responsible for determining the cause of the complaint and implementing any feasible measures to alleviate the problem.

Implementation of this mitigation measure would reduce temporary project-generated construction source noise levels and limit them to the less sensitive daytime hours, thus preventing exposure of sensitive receptors to temporary construction noise at dam and non-dam sites. As a result, Impact Noise-1 (CP1) would be reduced to a less than significant level.

CP2 – 12.5-Foot Dam Raise, Anadromous Fish Survival and Water Supply Reliability

No mitigation is needed for Impacts Noise-2 (CP2) and Noise-3 (CP2). Mitigation is provided below for the remaining noise impact of CP2.

Mitigation Measure Noise-1 (CP2): Implement Measures to Prevent Exposure of Sensitive Receptors to Temporary Construction Noise at Project Construction Sites This mitigation measure is identical to Mitigation Measure Noise-1 (CP1). Implementation of this mitigation measure would reduce Impact Noise-1 (CP2) to a less than significant level.

CP3 – 18.5-Foot Dam Raise, Anadromous Fish Survival and Water Supply

No mitigation is needed for Impacts Noise-2 (CP3) and Noise-3 (CP3). Mitigation is provided below for the remaining noise impact of CP3.

Mitigation Measure Noise-1 (CP3): Implement Measures to Prevent Exposure of Sensitive Receptors to Temporary Construction Noise at Project Construction Sites This mitigation measure is identical to Mitigation Measure Noise-1 (CP1). Implementation of this mitigation measure would reduce Impact Noise-1 (CP3) to a less than significant level.

CP4 – 18.5-Foot Dam Raise, Anadromous Fish Focus With Water Supply Reliability

No mitigation is needed for Impacts Noise-2 (CP4) and Noise-3 (CP4). Mitigation is provided below for the remaining noise impact of CP4.

Mitigation Measure Noise-1 (CP4): Implement Measures to Prevent Exposure of Sensitive Receptors to Temporary Construction Noise at Project Construction Sites This mitigation measure is identical to Mitigation Measure Noise-1 (CP1). Implementation of this mitigation measure would reduce Impact Noise-1 (CP4) to a less than significant level.

CP5 – 18.5-Foot Dam Raise, Combination Plan

No mitigation is needed for Impacts Noise-2 (CP5) and Noise-3 (CP5). Mitigation is provided below for the remaining noise impact of CP5.

Mitigation Measure Noise-1 (CP5): Implement Measures to Prevent Exposure of Sensitive Receptors to Temporary Construction Noise at Project Construction Sites This mitigation measure is identical to Mitigation Measure Noise-1 (CP1). Implementation of this mitigation measure would reduce Impact Noise-1 (CP5) to a less than significant level.

8.3.6 Cumulative Effects

Past and present projects from areas within Shasta and Tehama counties affect noise conditions in the primary study area through the use of heavy construction equipment and the increase in traffic resulting from construction activities. Other stationary sources (e.g., railroads, traffic on existing highways) also contribute to ambient noise in the primary study area. In many cases, other related projects could create substantially more noise than the project, and would result in a cumulatively significant noise impact.

Shasta Lake and Vicinity and Upper Sacramento River (Shasta Dam to Red Bluff)

Projects that could influence ambient noise levels in areas where the SLWRI could contribute noise include the *Shasta-Trinity National Forest Land and Resource Management Plan, Iron Mountain Mine Restoration Plan, and Mendocino National Forest Land and Resource Management Plan; development of the Turntable Bay Master Development Plan*; and construction of the Antlers Bridge replacement. If the listed projects were to occur

concurrently with any of the project alternatives under the SLWRI (CP1–CP5), combined noise generation during construction would be unlikely to be substantial because noise is generally a local phenomenon and is minimal beyond 0.5 mile. Noise from the SLWRI would not combine with other noise sources, such as construction from the projects listed above. After project construction is completed, the ambient noise environment relative to Shasta Dam would return to existing conditions. Therefore, none of the project alternatives would make a cumulatively considerable incremental contribution to cumulative noise effects.

Lower Sacramento and Delta and CVP/SWP Service Areas

Raising Shasta Dam would not result in any short-term or long-term effects on the ambient noise environment in the extended study area under any of the project alternatives. Therefore, there would be no cumulatively considerable incremental contribution to cumulative noise effects under any of the project alternatives.

Chapter 9
Hazards and Hazardous Materials and Waste

9.1 Affected Environment

This chapter describes the affected environment related to hazards and hazardous materials for the dam and reservoir modifications proposed under SLWRI.

Because of the potential influence of the proposed modification of Shasta Dam and water deliveries over a rather large geographic area, the SLWRI includes both a primary study area and an extended study area. The primary study area has been further divided into Shasta Lake and vicinity and upper Sacramento River (Shasta Dam to Red Bluff). The extended study area has been further divided into the lower Sacramento River and Delta and CVP/SWP service areas.

This section describes hazards and hazardous materials, defined as hazardous waste and hazardous substances, in the primary and extended study areas. The discussion of hazards focuses primarily on wildland fire and its related effects on the human environment and natural resources, and water safety hazards, particularly those related to Shasta Lake. Other relevant hazards, such as flooding, dam failure, and issues related to hydropower generation, public services (e.g., fire protection, law enforcement, emergency services), roadways and bridges, and recreation, are addressed in separate chapters. The effects of proposed fuels treatments, such as pile burning, on air quality are addressed in Chapter 5, “Air Quality.”

The hazards and hazardous waste setting for the primary study area consists of the portion of Shasta County above Shasta Dam and the upper Sacramento River from the dam downstream to the Red Bluff Diversion Dam, including the lands within the boundary of the Shasta Unit of the Whiskeytown-Shasta-Trinity National Recreation Area (NRA). This area encompasses parts of the Pit River, Squaw Creek, McCloud River, and Sacramento River watersheds. The hazards and hazardous waste setting for the upper Sacramento River portion of the primary study area consists of lands draining to the Sacramento River between Shasta Dam and Red Bluff.

The hazards and hazardous waste setting for the extended study area includes the Sacramento River basin downstream from the Red Bluff Diversion Dam to the Delta, the Delta itself, the San Joaquin River basin to the Delta, portions of the American River basin, and the CVP/SWP service areas.

9.1.1 Hazards

Shasta Lake and Vicinity

Water Safety Hazards The surface waters of Shasta Lake and, to a lesser extent, Keswick Reservoir and other surface waters in the vicinity pose hazards to persons engaging in boating and other water-based activities (see Chapter 18, "Recreation," for a detailed discussion of water safety hazards related to recreational activities). Water safety hazards are related to equipment operations, flow velocity, morphology, instream or submerged material, accessibility, and water temperature. Working in and adjacent to water bodies also poses risks to workers.

Fluctuations in the reservoir's pool level affect the pattern of submerged obstacles, which poses a risk to boaters, water skiers, operators of personal watercraft, and workers. Reservoir drawdowns can leave rocks, shoals, and islands submerged below the water surface, where watercraft or skiers can strike them. Conversely, increases in the reservoir's pool level conceal obstacles beneath the water surface that may be visible one day and submerged the next. Most of these hazards are not marked; however, the USFS public information program warns water-based recreationists via signage and various media to use caution when operating watercraft on the lake.

Although the USFS manages Shasta Lake and adjacent Federal lands comprising the NRA's Shasta Unit, law enforcement and emergency services are provided through a partnership between the Shasta-Trinity National Forest (STNF) and the Shasta County Sheriff's Office (SCSO) (see Chapter 22, "Public Services," for a detailed discussion of fire, law enforcement, and emergency services in Shasta Lake and vicinity). SCSO provides safety patrols and emergency response on Shasta Lake and its associated recreational areas and manages a Boating Safety Unit at the Bridge Bay Resort. SCSO staff consists of four full-time personnel and 22 seasonal deputies. An organized citizen volunteer patrol also assists with boater safety on Shasta Lake.

Fire Hazards Wildland fires pose a hazard to rural development, infrastructure, and natural resources. Climate, topography, vegetation characteristics, and ignition sources in a given area influence the degree of fire hazard. The California Department of Forestry and Fire Protection (CDF) and STNF have delineated most of the primary study area as being at very high risk for wildland fire; some areas, such as Lakehead, are at extreme risk for fire (Figure 9-1) (CDF 2005, CDF 2008, USFS 1995, WSRCD 2010).

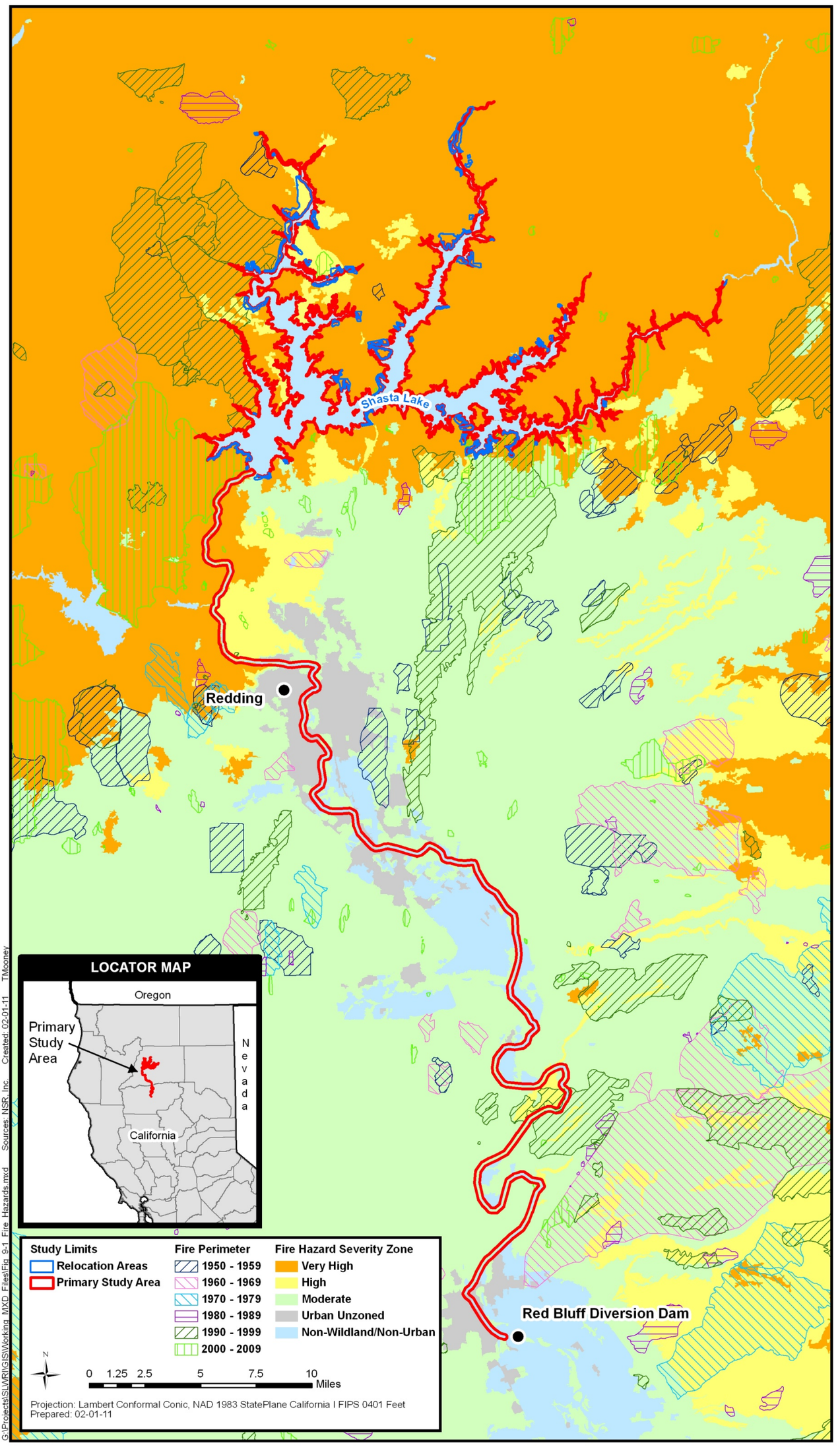


Figure 9-1. Fire Hazard Severity and Historic Fires

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Historic fire data show that high-intensity, stand-replacing fires commonly occur at the lower elevations surrounding Shasta Lake. Major transportation corridors cross the NRA and the area receives high recreational use, resulting in numerous human-caused fires each year (USFS 1996). During the 5-year period from 2000 through 2004, the Shasta and Trinity units of the NRA experienced 1,545 vegetation fires affecting 40,352 acres (CDF 2005). Roadside fires, abandoned campfires, and fireworks are common causes of these fires. Lightning from summer thunderstorms also causes a significant number of wildfires in and adjacent to the NRA. Large fires (more than 300 acres) that have occurred in the primary study area since 1950 are shown in Figure 9-1.

Rural and urban development has increasingly influenced the wildland fire hazard potential. Development in grasslands, oak woodlands, and forests (generally referred to as the wildland-urban interface (WUI)) and population growth have increased the risk to humans of wildland fire hazards. CDF and other fire protection agencies expect this trend to continue.

Fire suppression has had a significant effect on the volume and types of fuels across the Shasta Lake region. Extreme fire weather conditions are perpetuated by high summer temperatures and dry lightning storms; particularly along the Sacramento and McCloud arms of Shasta Lake, frequent strong zonal north winds occur during the late summer and fall months. In the past 30 years, the Lakehead area, which is along the Sacramento Arm, has experienced several major fires, including the 1999 High Complex Fire, which was eventually contained at 39,000 acres, and numerous smaller fires that were suppressed in their initial stages (WSRCD 2010).

The concentration of human activity along the McCloud Arm of Shasta Lake prompted the STNF to prepare a fire analysis as part of the McCloud Arm Watershed Analysis (USFS 1998). The fire analysis concludes that, at the time it was prepared (1998), more than 17,500 acres of forest surrounding the McCloud Arm was considered at high risk for a catastrophic fire. The fire hazard severity potential in the McCloud Arm has been designated as very high by CDF (CDF 2008).

The Jones Valley/Silverthorn area adjacent to the Pit Arm of Shasta Lake is another interface area with recognized fire hazards. In the last 12 years, two large fires have greatly affected residential and commercial developments in this area. The Bear Fire in 2004 burned 10,484 acres and destroyed 80 homes in the Jones Valley community, and the 1999 Jones Fire burned 26,020 acres and consumed 900 structures.

CDF has devised a fire hazard severity scale that considers fuel load (vegetation is the major source of fuel), climate, and topography (fire hazards increase with slope) to evaluate the level of wildfire hazard in areas where the State is primarily responsible for fire suppression (these are known as State Responsibility Areas). CDF designates three levels of fire hazard severity zones

– moderate, high, and very high – to indicate the severity of fire hazard in a particular geographical area. Based on a review of CDF's statewide map of fire hazard severity zones, the primary study area includes lands designated as high and very high (Figure 9-1) (CDF 2007).

Fuels management actions are conducted with some frequency on Federal lands in the Shasta Lake and vicinity portion of the study area. Since 2009, USFS has completed, or is currently proposing, several fuels management projects along the various arms of Shasta Lake, including the Bear Hazardous Fuels Project (Pit Arm), the Green-Horse Habitat Restoration and Maintenance Project (between the Pit and McCloud arms), the Interstate-5 Corridor Fuels Reduction Project (upper Sacramento Arm), and the Packers Bay Invasive Plant Species Removal Project (Sacramento Arm) (USFS 2009, 2011).

Upper Sacramento River (Shasta Dam to Red Bluff)

Water Safety Hazards Water safety hazards in the upper Sacramento River are similar to those in Shasta Lake and vicinity. Surface waters (i.e., Keswick Reservoir and the Sacramento River) pose hazards to persons engaging in boating and other water-based activities on these water bodies. Water hazards are posed by equipment operations, flow velocity, morphology, instream or submerged material, accessibility, and water temperature. Working in and adjacent to water bodies also poses risks to workers.

Fire Hazards Wildland and nonwildland fires present hazard risks to rural and urban development in the upper Sacramento River area. Based on a review of CDF's statewide map of fire hazard severity zones, the upper Sacramento River area includes lands designated as high and very high risk (Figure 9-1) (CDF 2007).

Human activities such as smoking, debris burning, and equipment operation cause 90 percent of the wildland fires in Shasta County, and lightning causes the remaining 10 percent. Wildland fires present a major safety hazard to rural development located in forest, brush, and grass-covered areas. Between 1992 and 2003, an average of 333 wildland fires per year occurred in Shasta County; the majority of these fires were in upland areas, where fire hazards are extreme because of an abundance of highly flammable vegetation and long, dry summers (Shasta County 2004). Large fires (more than 300 acres) that have occurred in the primary study area since 1950, including the upper Sacramento River near Shasta Dam, are shown in Figure 9-1.

Much of Tehama County, outside of the valley floor, is classified as wildland and contains substantial forest fire risks and hazards (PMC 2009). Outside of urbanized areas, fire hazard is considered to be moderate (CDF 2007). Encroachment by development into previously uninhabited areas has expanded the WUI, compounding the challenges of wildland fire management. In the portion of the project area that is in Tehama County, no large fires (greater than 300 acres) have occurred in the last 60 years (Figure 9-1) (CDF 2009), because

vegetation adjacent to the Sacramento River is not conducive to carrying wildland fire.

Lower Sacramento River and Delta and CVP/SWP Service Areas

Water safety hazards are similar to those described for the primary study area. Fire hazard in the extended study area varies, with risk increasing proportionally with the degree of WUI. As noted previously, CDF maintains a map-based program that identifies fire hazard severity zones throughout the state. The program differentiates between State Responsibility Areas and Local Responsibility Areas. Most of the extended study area is mapped as local (or Federal) responsibility areas with moderate or unzoned fire hazard severity classifications (CDF 2008).

9.1.2 Hazardous Materials and Waste

For purposes of this section, the term "hazardous materials" refers to both hazardous substances and hazardous wastes. A hazardous material is defined in the Code of Federal Regulations (CFR) as "a substance or material that … is capable of posing an unreasonable risk to health, safety, and property when transported in commerce" (49 CFR 171.8). California Health and Safety Code Section 25501 defines a hazardous material as follows:

> *Hazardous material" means any material that, because of its quantity, concentration, or physical or chemical characteristics, poses a significant present or potential hazard to human health and safety or to the environment if released into the workplace or the environment. "Hazardous materials" include, but are not limited to, hazardous substances, hazardous waste, and any material which a handler or the administering agency has a reasonable basis for believing that it would be injurious to the health and safety of persons or harmful to the environment if released into the workplace or the environment.*

Hazardous wastes are defined in California Health and Safety Code Section 25141(b) as wastes that

> *…because of their quantity, concentration, or physical, chemical, or infectious characteristics, [may either] cause, or significantly contribute to an increase in mortality or an increase in serious illness [or] pose a substantial present or potential hazard to human health or the environment when improperly treated, stored, transported, disposed of, or otherwise managed.*

Potential sources of hazardous material and waste may exist in the urbanized, rural, industrial, and agricultural portions of the study areas. Hazardous materials may be present in a variety of common contexts, including the following:

- Construction and demolition debris
- Drums
- Landfills or solid waste disposal sites
- Pits, ponds, or lagoons
- Wastewater and wastewater treatment plants
- Fill, dirt, depressions, and mounds
- Herbicides, pesticides, and fungicides
- Contaminated aggregate (mercury, dioxin)
- Explosives
- Fish hatcheries (e.g., Livingston Stone, Coleman)
- Underground storage tanks
- Stormwater runoff structures
- Transformers that may contain polychlorinated biphenyls (PCB)
- Utility poles
- Abandoned mines

Shasta Lake and Vicinity

Facilities used to store, generate, and transport hazardous materials and hazardous waste are present upstream from Shasta Dam. In addition, several inactive or abandoned mines contribute hazardous materials to Shasta Lake or its tributaries. The following discussion describes these features and facilities.

Reclamation operates the Shasta Dam facility and controls the use and movement of hazardous materials and associated hazardous waste in and out of the Shasta Dam administrative compound. Operation and maintenance of the dam and the water project facility require the use of many of the hazardous materials listed in the previous section. In addition, utility poles, transformers, and associated power transmission facilities typically contain hazardous materials.

A number of recreational facilities are located on or adjacent to Shasta Lake. These facilities include marinas, campgrounds, day use facilities, and residences for recreational use. Although several of these are privately owned, most are operated under special use permits issued by USFS. Operation and maintenance of recreational facilities involve the use of a number of substances that are considered hazardous under Federal or State statutes. Additionally, facilities that service and/or repair watercraft (e.g., marinas) generate wastes that are considered hazardous (e.g., oil, grease, solvents).

Currently, there are three underground fuel storage tanks permitted by the State Water Resources Control Board in the primary study area, all of which are in the Shasta Lake and vicinity portion of the primary study area: Holiday Harbor, Sugarloaf Marina, and Digger Bay Marina (SWRCB 2011). Also in the Shasta Lake and vicinity portion are four underground fuel storage tanks that are no longer in use due to regulatory actions resulting from documented occurrences of fuel leaks (SWRCB 2011).

The project would include the decommissioning/abandonment and/or relocation of a number of features and facilities on or adjacent to Shasta Lake. Underground and aboveground fuel storage tanks – including tanks in use and tanks no longer used – would be permanently removed from areas that would be inundated by the project. Above- and belowground fuel pipelines within the inundation area would be relocated/removed. Relocated fuel storage tanks would be designed and constructed in accordance with Title 23 of the California Code of Regulations (Division 3, Chapter 15, Underground Tank Regulations); the Uniform Fire Code; California Air Resources Board; Shasta County Development Standards, Section 6.7; and Shasta County Environmental Health Division requirements. Additionally, the age of some buildings suggests that substances such as asbestos or lead paint may be included in demolition debris.

A records search of the Federal Superfund National Priorities List (NPL) identified no sites in the Shasta Lake and vicinity portion of the study area. In its scoping comments, the Central Valley Regional Water Quality Control Board identified three sites that are currently subject to some degree of remediation. These sites are associated with the Bully Hill/Rising Star Mine and the Digger Bay and Sugarloaf marinas. All three sites may be influenced by fluctuating water levels in Shasta Lake. An additional site near the Bully Hill Mine complex contains depositional features with elevated metal concentrations that are exposed to surficial and wave erosion processes. Central Valley Regional Water Quality Control Board has also identified an abandoned mine complex west of Shasta Dam (Golinsky Mine) as a source of heavy metals and acid mine discharge that enters Shasta Lake via Dry Creek.

Interstate 5 (I-5) and Union Pacific Railroad transportation corridors are near to Shasta Lake and its tributaries. The potential exists for the accidental spill of chemicals and hazardous materials transported through these travel corridors. Transport through mountainous terrain and over water bodies, equipment failure, and improper storage and handling of hazardous materials contribute to the risk of accidental chemical spills.

The Cantara Spill is a prime example of the hazards associated with the transport of hazardous materials through the region. On July 14, 1991, a Southern Pacific train derailed upstream from Dunsmuir, sending several cars into the Sacramento River, including a tank car containing the herbicide/pesticide metam sodium (a potent chemical used principally to sterilize soil for agricultural purposes). A rupture in one of the tank cars resulted

in the catastrophic spill of approximately 19,000 gallons of the soil fumigant into the river. When mixed with water, metam sodium breaks down into several highly toxic compounds. Although the toxins formed by the mixing of metam sodium with water dissipated in a matter of hours or weeks, the immediate effects of the spill were staggering. In the upper Sacramento River, every living aquatic creature downstream from the spill died over the 20-mile stretch of river between the spill and Shasta Lake (Cantara Trustee Council 2007). On July 17, 1991, the plume, estimated to have traveled at just under 1 mile per hour, entered Shasta Lake, where the chemical was reduced to undetectable levels approximately 2 weeks later. As a result of the Cantara Spill, more than $14 million in settlement funds – administered by the Cantara Trust Council – have been available for ecosystem restoration.

Historic mining activities in the Shasta Lake and vicinity portion of the primary study area have left mine tailings piles scattered throughout the uplands surrounding the lake. These tailings piles often contain high concentrations of various metals, including iron, copper, zinc, and mercury. The discharge of these dissolved metals into waterways can have an adverse effect on water quality, aquatic ecosystems, and human health. The historic Bully Hill Mine, located along the Squaw Arm, is the only mine site that would be inundated by the project. The effects on water quality that could result from the inundation of mine tailings are discussed in detail in Chapter 7, “Water Quality.”

Upper Sacramento River (Shasta Dam to Red Bluff)

A number of business and industrial land uses in the upper Sacramento River area use and transport hazardous materials as part of their operations. Existing land uses that may have a hazardous material component include mining operations, heavy and light industrial uses, propane/petroleum fueling and/or storage facilities, and commercial and retail operations. Businesses that require storage of hazardous materials must submit a Hazardous Material Business Plan (HMBP) to the County Environmental Health Department. I-5, Union Pacific Railroad lines, and several major surface routes are used for the transportation of hazardous materials throughout the region.

Hazardous waste sites associated with agricultural activities include storage facilities and agricultural ponds or pits contaminated with fertilizers, pesticides, herbicides, or insecticides. Petroleum products and other materials may also be present in the soil and groundwater near leaking underground tanks used to store these materials. However, there are no permitted underground fuel storage tanks – Including tanks currently in use or tanks that have been subject to regulatory actions – within the project boundaries for the upper Sacramento River portion of the primary study area (SWRCB 2011).

Metals such as cadmium, copper, mercury, and zinc are present in inactive and abandoned mines in the upper Sacramento River area. Landfills and commercial activities, such as dry cleaning, could also be sources of contamination in this

region. The project would not result in the inundation of any of these potentially hazardous locations.

A records search of the U.S. Environmental Protection Agency's (EPA) NPL identified one site in the upper Sacramento River area: Iron Mountain Mine. The mine is a privately owned site southwest of Shasta Dam and 9 miles northwest of Redding. The entire mine area, which encompasses about 2,000 acres, is drained by Boulder Creek and Slickrock Creek, tributaries to Spring Creek. Spring Creek enters Keswick Reservoir several miles downstream from Shasta Dam.

From the 1860s through 1963, the 4,400-acre Iron Mountain Mine was periodically mined for iron, silver, gold, copper, zinc, and pyrite. Although mining operations were discontinued in 1963, underground mine workings, waste rock dumps, piles of mine tailings, and an open mine pit remain at the site. Historic mining activity at Iron Mountain Mine has fractured the rock units, exposing minerals to surface water, rainwater, and oxygen. Acidic mine drainage typically contains high concentrations of copper, cadmium, zinc, and other heavy metals. Much of the acidic mine drainage ultimately is channeled into Spring Creek Reservoir via adjacent creeks and constructed diversion facilities. The low pH level and the heavy metal contamination from the mine have virtually extirpated aquatic life in sections of Slickrock Creek, Boulder Creek, and Spring Creek. (Project effects on potentially contaminated historic mine waste are discussed in Chapter 7, "Water Quality".)

Reclamation periodically releases water from Spring Creek Reservoir into Keswick Reservoir. Planned releases are timed to coincide with the presence of diluting releases of water from Shasta Dam. On occasion, uncontrolled spills and excessive waste releases have occurred when Spring Creek Reservoir reaches capacity. Without sufficient dilution, these events have resulted in the release of harmful quantities of heavy metals into the Sacramento River downstream from Keswick Dam. Acid mine drainage and associated heavy-metal contamination from the Spring Creek drainage and other abandoned mine sites are among the principal water quality issues in the upper Sacramento River portion of the primary study area. In recent years, Reclamation has implemented a dredging program to restore active storage space in Keswick Reservoir, which has been reduced by the influx of sediment from the Spring Creek watershed.

In 2009, EPA began the removal of approximately 200,000 cubic yards of contaminated sediment from the Spring Creek Arm of Keswick Reservoir for disposal in an engineered disposal cell. The project was near completion at the end of 2010. EPA plans to use a hydraulic dredge to fully remove contaminated sediments located in two areas that have high erosion potential and to partially remove sediments located in a deep-water area of the Spring Creek Arm (EPA 2008).

The Livingston Stone National Fish Hatchery facility, located at the foot of Shasta Dam, is used to propagate adult winter-run Chinook salmon collected from the mainstem Sacramento River. Water from Shasta Dam is used to supply the hatchery and waste is discharged to the Sacramento River downstream from the dam. The facility's discharge is regulated under the Central Valley Water Board General Order R5-2010-0018 (National Pollutant Discharge Elimination System No. GAG135001) Waste Discharge Requirements for Cold-Water Concentrated Aquatic Animal Production Facility Discharges to Surface Waters (California RWQCB 2010).

Lower Sacramento River and Delta and CVP/SWP Study Areas

Many of the land uses in the extended study area are similar to those in the primary study area. Thus, contamination is possible from agricultural, urban, industrial, commercial, landfill, and military land uses in the region. Because the extended study area covers many counties and regions, a records search of the NPL and the California Department of Toxic Substances Control list was not conducted. Although many sites in the extended study area undoubtedly are on these lists, it is not expected that these sites would be affected by project implementation.

Facilities created by CVP/SWP for the purposes of water conservation and management include dams, powerplants, and an extensive canal system. Operation of these facilities involves the use of a variety of hazardous materials such as lubricants.

The Sacramento National Wildlife Refuge Complex consists of five national wildlife refuges and three wildlife management areas covering over 35,000 acres of wetlands and uplands, in addition to more than 30,000 acres of conservation easements. Many of the wetlands in the Sacramento Valley receive water not only from the Sacramento River, but also from agricultural runoff. Urban, industrial, agricultural, and natural sources of toxins contribute to water quality problems in the lower Sacramento River and Delta and can pose a hazard to fish and wildlife through processes such as bioaccumulation in the food chain.

A discussion of the current water quality and potential hazards to water quality associated with the project is presented in Chapter 7, "Water Quality."

9.2 Regulatory Framework

9.2.1 Federal

Federal Resource Conservation and Recovery Act

The Resource Conservation and Recovery Act (RCRA) is a Federal statute designed to provide "cradle to grave" control of hazardous waste by imposing management requirements on generators and transporters of hazardous wastes,

and on owners and operators of treatment, storage, and disposal facilities. The EPA is responsible for administering the RCRA.

Federal Comprehensive Environmental Response, Compensation, and Liability Act

The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), also known as the Superfund Act, provides for the liability, compensation, cleanup, and emergency response for hazardous substances released into the environment and the cleanup of inactive hazardous waste disposal sites. CERCLA authorized the NPL, which identifies contaminated sites that are eligible for remedial action. The scope of CERCLA is broad; it holds current and prior owners and operators of contaminated sites responsible, and its definition of a hazardous substance incorporates definitions from the Clean Air Act, the Clean Water Act, the Toxic Substances Control Act, and the RCRA (CERCLA Section 101(14)). EPA is the agency responsible for administering CERCLA.

Occupational Safety and Health Act

The Occupational Safety and Health Act defines occupational health and safety standards with the goal of providing employees with a safe working environment. The California Occupational Safety and Health Administration (Cal/OSHA) is the agency responsible for administering this Federal act. The Occupational Safety and Health Administration (OSHA) regulations apply to the workplace and cover activities ranging from confined space entry to toxic chemical exposure. Employers are required to provide a workplace free of recognized hazards that could cause serious physical harm. OSHA regulates workplace exposure to hazardous chemicals and activities through workplace procedures and equipment requirements (29 U.S.C. 651-678).

Hazardous Materials Transportation Act

The Hazardous Materials Transportation Act regulates interstate transport of hazardous materials and wastes. This act specifies driver training requirements, load labeling procedures, and container design and safety requirements. Transporters of hazardous wastes must also meet the requirements of other statutes, such as the RCRA. The Hazardous Materials Transportation Act requires that carriers report accidental releases of hazardous materials to the U.S. Department of Transportation at soon as is practical (49 CFR Subchapter C). Incidents that must be reported include deaths, injuries requiring hospitalization, and property damage exceeding $50,000. U.S. Department of Transportation, the Federal Highway Administration, and the Federal Railroad Administration are the agencies responsible for administering the Hazardous Materials Transportation Act.

Code of Federal Regulations, Title 36

Title 36 of the CFR governs parks, forests, and public property in the United States. Chapter 2, Section 260, pertains to prohibited activities within the

boundaries of Federally owned lands and waters administered by the USFS. The USFS is responsible for administering the regulations described as follows.

Sec. 261.5 Fire (General Prohibitions) The following are prohibited:

- Carelessly or negligently throwing or placing any ignited substance or other substance that may cause a fire
- Firing any tracer bullet or incendiary ammunition
- Causing timber, trees, slash, brush, or grass to burn except as authorized by permit
- Leaving a fire without completely extinguishing it
- Allowing a fire to escape from control
- Building, attending, maintaining, or using a campfire without removing all flammable material from around the campfire adequate to prevent its escape

Sec. 261.52 Fire (Prohibitions in Areas Designated by Order) When provided by an order, the following are prohibited:

- Building, maintaining, attending or using a fire, campfire, or stove fire
- Using an explosive
- Smoking, except within an enclosed vehicle or building, a developed recreation site, or while stopped in an area at least 3 feet in diameter that is barren or cleared of all flammable material
- Possessing, discharging, or using any kind of firework or other pyrotechnic device

Shasta-Trinity National Forest Land and Resource Management Plan

The STNF Land and Resource Management Plan (LRMP) contains goals, standards, and guidelines designed to guide the management of STNF. The following goals, standards, and guidelines relative to hazards and/or hazardous materials issues associated with the project area were excerpted from the LRMP (USFS 1995).

Facilities Goals (LRMP, p. 4-17)

- Provide and maintain those administrative facilities that effectively and safely serve the public and USFS work force.

Facilities Standards and Guidelines (LRMP, p. 4-17)

- Upgrade the surfacing on the forest's road system as necessary to protect the road and other resource values.

- Trails will be maintained as needed for specific management objectives. Erosion control and primary access will receive priority.

- Trails and trail bridges will be located, designed, constructed, and maintained so that they are suitable for the type of travel being served.

- Consider volcanic, seismic, flood, and slope stability hazards in the location and design of administrative and recreation facilities.

- Manage, construct, and maintain buildings and administrative sites to meet applicable codes and to provide the necessary facilities to support resource management.

- Monitor potable water sources and designated swimming areas according to the Safe Drinking Water Act and other regulatory health requirements.

Management Guide for the Shasta and Trinity Units of the Whiskeytown-Shasta-Trinity National Recreation Area

The STNF Management Guide contains management strategies intended to achieve or maintain a desired condition. These strategies take into account opportunities, management recommendations for specific projects, and mitigation measures needed to achieve specific goals. STNF is responsible for administering the following strategies related to hazards and/or hazardous materials issues associated with the project area.

Fire and Fuels (Management Guide, p. IV-1)

- Treatment of fuels created by project activities will be determined during project planning.

- Treatment of natural fuels for hazard reduction will be high priority in and around urban interface areas. Treatment of natural fuels near developed recreation sites will be a secondary priority, unless hazard and risk analysis shows a specific need.

Health and Safety (Management Guide, pp. IV-15 Through IV-16)

- Resorts/marinas are responsible for inspecting their own facilities to ensure that they comply with applicable laws, ordinances, and codes and standards for health and safety and are safe for public use. Copies of all health and safety inspections must be incorporated in the operation and maintenance plan annually and be available to the STNF.

- Marinas are required to anchor docks using underwater cables and anchor systems. Minor exceptions may be made, with STNF approval, in areas where low-speed boating is required, such as behind a marina in a semi-enclosed, restricted waterway. If cables and anchors are positioned in main travel-ways where they can come in contact with boats or people, the cables must be flagged and have warning lights so that they are visible day and night.

- Buoys and floats placed and maintained by marinas must meet the following criteria:

  – If the float or buoy is constructed of a material that will not damage a boat or cause personal injury on contact, the float or buoy must be of a contrasting color that can be easily seen. Examples are floats and buoys made of lightweight Styrofoam and plastic.

  – If the float or buoy is made of a material that could damage a boat or cause personal injury on contact, it must be of a contrasting color that can be easily seen, and must have a blinking yellow light visible from 360 degrees for night boating safety. Examples are floats and buoys made of steel or aluminum.

  – Log booms may be installed around marinas to suppress wave action at the docks. Log booms must not infringe on the main boating channels. Log booms must have yellow blinking lights installed every 100 feet on or immediately adjacent to the boom so that the boom's location is visible at night. Boating entrances through log booms or other breakwaters will display red and green navigation lights on either side of the log boom or breakwater for nighttime navigation.

  – All docks that are approved to extend out into a main boating travel-way, and are not protected by a lighted breakwater or other lighting system, must have at least one blinking yellow light for nighttime boating safety every 100 feet.

- No work that would leave pollutants in the lake when the area is inundated is permitted below the lake high-water line. Examples of this are water blasting and sand blasting pontoons and mechanical repairs that would allow oil and grease to drain on the ground.

- Resorts/marinas may restrict vehicle nighttime land access to their facilities if they can display to STNF that such action is needed to protect people and property.

Vegetation (Management Guide, p. IV-18)

- Prescribed burning, fuel break construction, and other forms of vegetation manipulation will be used to reduce fire hazards and improve forest health.

- Hazard trees in traditionally high-use recreation areas that pose safety hazards to people or property will be identified and removed.

U.S. Bureau of Land Management Resource Management Plan

The U.S. Bureau of Land Management (BLM) manages a number of public lands adjacent to the Sacramento River corridor downstream from Shasta Dam. The study area falls under two BLM districts (Northern California and Central California) and the resource management plans of three BLM field offices: Redding, Ukiah, and Mother Lode (BLM 2006a). The purpose of BLM's resource management plans is to provide an overall direction for managing and allocating public resources in each planning area. BLM is responsible for administering the following strategies related to hazards and/or hazardous materials issues common to the districts in the study area (BLM 1992, 2006b, 2008).

Wildfire Suppression Goal

- Provide an appropriate management response for all wildland fires, emphasizing firefighter and public safety.

Fuels Management Goals

- Reduce fire risk to the wildland-urban interface communities.
- Protect riparian and wetland areas.
- Improve ecological conditions and reduce the risk of catastrophic wildfire through the use of prescribed burning.
- Improve ecological conditions and reduce the risk of catastrophic wildfire through mechanical treatments.
- Increase the public's knowledge of the natural role of fire in the ecosystem, and hazards and risks associated with living in the wildland-urban interface.

Hazardous Materials

- Land use authorizations will not be issued for uses that would involve the disposal or storage of materials that could contaminate the land (e.g., hazardous waste disposal sites, landfills, rifle ranges).
- Minimize hazardous conditions on BLM lands to reduce risks to the public and ensure environmental health and safety.

9.2.2 State

Hazardous Waste Control Act

The California Hazardous Waste Control Act governs hazardous waste management and cleanup in the State (Health and Safety Code, Ch. 6.5–6.98).

The act mirrors the RCRA and imposes a "cradle to grave" regulatory system for handling hazardous waste in a manner that protects human health and the environment. It requires all businesses to report the quantity and locations of hazardous materials on an annual basis if the business stores (a) more than 55 gallons of a liquid or 500 pounds of a solid hazardous material, (b)more than 200 cubic feet of a compressed gas, or (c) a radioactive material that is handled in quantities for which an emergency plan is required. Businesses falling within these limits must prepare a HMBP, which includes spill prevention, containment and emergency response measures and a contingency plan.

County Environmental Health Departments and the California Environmental Protection Agency's (Cal/EPA) Certified Unified Program Agencies assume responsibility for enforcing local hazardous waste reporting requirements. Sites that store, handle, or transport specified quantities of hazardous materials are inspected annually. Cal/EPA, Department of Toxic Substances Control, regulates the generation, transportation, treatment, storage, and disposal of hazardous waste under the RCRA and the State Hazardous Waste Control Act.

Hazardous Substances Account Act

California enacted the Hazardous Substances Account Act (1981) to establish State authority to clean up hazardous substances releases, compensate persons injured from exposure to hazardous substances, and provide funds for payment of the State's mandatory 10 percent share of cleanup costs under the Federal Superfund law. Cal/EPA administers the State Superfund program and receives assistance from the California Department of Public Health.

Emergency Response Plan

California developed an Emergency Response Plan to facilitate and coordinate responses to emergencies. Emergency prevention and response to hazardous materials incidents are part of the State plan that is administered by the California Office of Emergency Services (OES). Coordinating agencies include Cal/EPA, California Highway Patrol (CHP), CDF, local fire departments, the California National Guard, the California Department of Transportation (Caltrans), DFG, regional water quality control boards, and other emergency service providers.

California Code of Regulations, Title 13, Vehicle Code

In addition to the RCRA hazardous waste transportation standards, California regulates the transportation of hazardous waste originating or passing through the state. State regulations are contained in the California Code of Regulations (CCR), Title 13, Vehicle Code. Hazardous waste must be regularly removed from generating sites by licensed hazardous waste transporters. Transported materials must be accompanied by hazardous waste manifests.

CHP and Caltrans are responsible for enforcing Federal and State regulations pertaining to the transport of hazardous materials through California. CHP enforces materials and hazardous waste labeling and packaging regulations that

prevent leakage and spills of material in transit and provides information to cleanup crews in the event of an incident. Vehicle and equipment inspection, shipment preparation, container identification, and shipping documentation are all part of the responsibility of CHP. CHP conducts regular inspections of licensed transporters to assure regulatory compliance. CHP and Caltrans also respond to hazardous materials transportation emergencies. Caltrans has emergency chemical spill identification teams at locations throughout the state.

Worker Safety Requirements

Regulations pertaining to the use of hazardous materials in California workplaces are provided in CCR Title 8 and include requirements for safety training, availability of safety equipment, accident and illness prevention programs, hazardous substance exposure warnings, and emergency action and fire prevention plan preparation. Cal/OSHA standards are more stringent than Federal OSHA regulations.

As described above, Cal/OSHA assumes primary responsibility for developing and enforcing workplace safety regulations in the state. Cal/OSHA enforces hazard communication program regulations that contain training and information requirements, including procedures for identifying and labeling hazardous substances, communicating information related to hazardous substances and their handling, and preparing health and safety plans to protect workers and employees at hazardous waste sites. The hazard communication program requires that material safety data sheets be available to employees and that employee information and training programs be documented.

Government Planning

California law requires that each county and city in the state adopt a general plan (Government Code Sec. 65300). The State-mandated general plans consist of development policies and objectives for the long-term physical development of counties and cities. Each general plan must include a safety element that addresses a variety of natural and human-caused hazards. At a minimum, the safety element must adopt policies related to fire safety, flooding, and geologic and seismic hazards (Government Code Sec.65302(g)).

California Building Code

In 2007, the California Building Code was amended to include regulations pertaining to fire safety. The amendments provide safety standards for new construction located in WUI areas. The building code requires landowners to maintain an area of defensible space around structures and requires the use of fire-resistant building materials. County building inspectors, CDF, and local fire agencies are responsible for enforcing the requirements (CCR Title 24, Part 2). On Federal lands, the Federal agency is responsible for ensuring that buildings and facilities meet public health and safety standards.

9.2.3 Regional and Local

County General Plans

The general plans for the counties in the primary and extended study areas contain general policies aimed at reducing the use of hazardous substances and the generation of hazardous waste and ensuring safe use and storage of hazardous materials and management of hazardous waste.

County Fire Management Plans

Fire Management Plans have been prepared for Tehama County and Shasta County (CDF and Tehama Fire-Safe Council 2005; SCFD 2007; CDF 2005). The plans tier from the California Fire Plan and are intended to be used for prefire planning, prioritization, and implementation. The plans outline cooperative efforts of local fire agencies, CDF, and fire safe councils.

9.3 Environmental Consequences and Mitigation Measures

9.3.1 Methods and Assumptions

This analysis addresses potential impacts associated with implementation of the project with respect to hazards and hazardous materials. This analysis is based on a review of planning documents applicable to the project area, consultation with appropriate agencies, and field reconnaissance.

9.3.2 Criteria for Determining Significance of Effects

An environmental document prepared to comply with NEPA must consider the context and intensity of the environmental effects that would be caused by, or result from, the projects. Under NEPA, the significance of an effect is used solely to determine whether an Environmental Impact Statement must be prepared. An environmental document prepared to comply with CEQA must identify the potentially significant environmental effects of a proposed project. A "[s]ignificant effect on the environment" means a substantial, or potentially substantial, adverse change in any of the physical conditions in the area affected by the project (State CEQA Guidelines, Section 15382). CEQA also requires that the environmental document propose feasible measures to avoid or substantially reduce significant environmental effects (State CEQA Guidelines, Section 15126.4(a)).

The following significance criteria are based on guidance provided by CEQA Guidelines (AEP 2010) and consider the context and intensity of the environmental effects as required under NEPA. Impacts concerning hazards and hazardous materials would be significant if they:

- Create a significant hazard to the public or the environment through the routine transport, use, or disposal of hazardous materials

- Create a significant hazard to the public or the environment through reasonably foreseeable upset and accident conditions involving the release of hazardous materials into the environment

- Emit hazardous emissions or involve the handling of hazardous or acutely hazardous materials, substances, or waste within one-quarter mile of an existing or proposed school

- Are located on a site that is included on a list of hazardous materials sites compiled pursuant to Government Code Section 65962.5 and, as a result, would create a significant hazard to the public or the environment

- Impair implementation of or physically interfere with an adopted emergency response plan or emergency evacuation plan

- Expose people or structures to a significant risk of loss, injury, or death involving wildland fires

9.3.3 Topics Eliminated from Further Consideration

Water safety hazards posed by the project alternatives to water-based recreationists are assessed in Chapter 18, "Recreation"; therefore, this topic has been eliminated from further analysis in this chapter. Similarly, the effects of hazardous materials on water quality are assessed in Chapter 7, "Water Quality."

9.3.4 Direct and Indirect Effects

Information on fire risk and severity was obtained from USFS and CDF. This information was used to identify specific types and locations of activities that could present a threat to the human environment as a result of wildland fires.

A regulatory database search was conducted for portions of the primary study area. The purpose of such a search was to identify sites that are associated with the documented use, generation, storage, or release of hazardous materials or petroleum products. The results also include regulatory lists of known or potential hazardous waste sites, landfills, hazardous waste generators, and disposal facilities, in addition to sites under investigation. Information provided in the database search was obtained from publicly available sources, including the following:

- Cortese List (California Department of Toxic Substances Control 2011)

- Leaking Tanks (SWRCB 2011)

- Comprehensive Environmental Response, Compensation and Liability Information System: EPA Superfund Sites (EPA 2011)

- Annual Work Plan (SWRCB et al. 2008)

No-Action Alternative

Shasta Lake and Vicinity, Upper Sacramento River (Shasta Dam to Red Bluff), Lower Sacramento and Delta, and CVP/SWP Service Areas

Impact Haz-1 (No-Action): Wildland Fire Risk Under the No-Action Alternative, no new facilities would be constructed in the primary or extended study areas and no changes in Reclamation's existing facilities or operations would occur that would directly or indirectly result in any increase in the risk of wildland fire in the project area. Therefore, the No-Action Alternative would not have an impact on wildland fire hazards in the project area. Mitigation is not required for the No-Action Alternative.

Impact Haz-2 (No-Action): Release Potentially Hazardous Materials or Hazardous Waste Under the No-Action Alternative, no new facilities would be constructed in the primary or extended study areas and no changes in Reclamation's existing facilities or operations would occur that would directly or indirectly result in any increase in hazards, hazardous materials, or hazardous waste in the project area. Therefore, the No-Action Alternative would not have an impact related to the release of hazardous materials or hazardous waste in the project area. Mitigation is not required for the No-Action Alternative.

Impact Haz-3 (No-Action): Expose Workers to Hazardous Materials Under the No-Action Alternative, no new facilities would be constructed in the primary or extended study areas and no changes in Reclamation's existing facilities or operations would occur that would directly or indirectly result in any increase in exposure of workers to hazards, hazardous materials, or hazardous waste in the project area. Therefore, the No-Action Alternative would not have an impact involving exposure of workers in the project area to hazardous materials. Mitigation is not required for the No-Action Alternative.

Impact Haz-4 (No-Action): Expose Sensitive Receptors to Hazardous Materials Under the No-Action Alternative, no new facilities would be constructed in the primary or extended study areas and no changes in Reclamation's existing facilities or operations would occur that would directly or indirectly result in any increase in hazards, hazardous materials, or hazardous waste in the project area. Therefore, the No-Action Alternative would have no impact on sensitive receptors in the project area. Mitigation is not required for the No-Action Alternative..

CP1 – 6.5-Foot Dam Raise, Anadromous Fish Survival and Water Supply Reliability

Shasta Lake and Vicinity and Upper Sacramento River (Shasta Dam to Red Bluff)

Impact Haz-1 (CP1): Wildland Fire Risk Project implementation could contribute to wildland fire risk. Project construction and operation, and the anticipated post-construction human activity in the primary study area would

increase the potential for fire ignition. Therefore, this impact is considered potentially significant.

Wildland fire in the primary study area would expose people, structures, infrastructure, and other resources to a significant risk of loss, injury, or death. Project design, implementation, and operation incorporate safety measures that prevent fire hazards. Although the construction details have not been finalized, this conclusion is based on the scope of activities involved and the fire hazard ratings (i.e., very high risk and extreme risk) in the primary study area and the relocation sites where project construction activities would occur. Construction activities would likely occur during the summer and fall months, which are generally considered a time of high fire hazard in northern California. Reclamation and its contractors would follow fire safety regulations and procedures to prevent accidental fires.

Project activities associated with the removal and relocation of utilities could pose a wildland fire hazard in the primary study area, although it is anticipated that 100 percent vegetation clearance beneath high-voltage power transmission lines (typically 60 to 230 kilovolts) will be maintained. Under CP1, approximately 31,000 feet (5.8 miles) of power transmission lines and 35,000 feet (6 miles) of telecommunications lines would require demolition and relocation to prevent inundation by the new reservoir elevation resulting from project implementation. In addition, six power towers would be demolished, and six new towers would be constructed in new locations. CP1 also involves several miles of road construction and demolition of several vehicle and railroad bridges.

Other utility relocations and/or construction proposed under CP1 include potable water facilities, gas/petroleum facilities, and wastewater facilities. Vegetation clearing would be required to varying degrees for most utility relocation/construction, some of which would be located in densely vegetated areas. During construction/relocation, the potential would exist for the ignition of fire by construction equipment operating in the area. Although the increased risk of ignition would be short term (i.e., during implementation), it would be significant. CP1 would also include demolition and construction of recreational and public service facilities.

Relevant safety codes/procedures related to fire prevention would be incorporated into the project design, and would be used during construction activities and project operation and maintenance. Safety codes and procedures would include the California Building Code; the Shasta County Fire Plan; USFS safety requirements regarding fire hazards; California Public Utilities Code General Order 95, which provides procedures for proper removal, disposal, and placement of poles, wires, and associated infrastructure; and the National Electric Safety Code (a voluntary code that provides safety procedures for electric utility installation and operation). Precautionary measures to prevent construction-related fires include locating utilities a safe distance from

vegetation and structures, proper construction of power lines, and construction worker safety training. Post-construction infrastructure operation and maintenance would follow current safety practices associated with fire prevention and would include clearing vegetation from power utility facilities and other sources using combustion engines (e.g., water pumps) on a regular basis.

Right-of-way easements obtained for transmission lines would be cleared of vegetation to provide for public and worker safety, and to provide reliable operations. The California Building Code, the National Electric Safety Code, and the Shasta County Fire Plan clearance requirements for power distribution facilities would be incorporated into the project design.

No new facilities or project construction would occur in the upper Sacramento River area, however, some aggregate material for the project might be extracted could occur downstream from Shasta Dam. In addition, flammable vegetation below Shasta Dam would readily carry a fire started elsewhere in the primary study area.

Project materials and workers traveling to the construction sites from the upper Sacramento River area could also increase the risk of fire hazard over their route. Operation of motor vehicles throughout the region, particularly when vegetation adjacent to roadways is dry, imparts a certain level of fire potential from accidental combustion (e.g., sparks), hot metal (e.g., tail pipes, motors), or traffic accidents which could result in fire.

Project activities, including those intended to mitigate impacts on vegetation, are expected to reduce the overall fuel loading around the Shasta Lake and vicinity portion of the primary study area, thereby reducing the long-term fire hazard. In addition, the project could result in additional water supplies in the primary study area, which could assist future fire responses in the primary study area.

Project activities would increase the risk of wildland fires. Therefore, this impact is considered potentially significant. Mitigation for this impact is proposed in Section 9.3.5.

Impact Haz-2 (CP1): Release Potentially Hazardous Materials or Hazardous Waste Project construction and operation would involve the transportation, use, or storage of hazardous materials. Local, State, and Federal safety codes and procedures related to hazardous material transport, handling, and disposal would be followed for project construction and operation to minimize the risk of a hazardous materials release. However, an accidental release resulting from project activities could expose the public and the environment to a significant safety hazard. Therefore, this impact is considered potentially significant.

Project facilities proposed for construction under CP1 would be located in the Shasta Lake and vicinity portion of the primary study area. Certain hazardous materials needed for construction and operation would need to be stored at the Shasta Dam facility and at other utility and infrastructure relocation sites around the primary study area. Certain hazardous materials would be used to operate equipment both during and after construction, and the construction, and operation, and maintenance of project facilities and infrastructure would require the use of potentially hazardous materials such as paint, concrete, and wood preservatives. In addition, industrial uses associated with the operation and maintenance of the modified Shasta Dam compound would require the use, storage, and routine transport of small quantities of hydraulic fluids, solvents, and other standard mechanical maintenance fluids.

Construction staging and equipment and materials storage, including storage of possible contaminants, and equipment maintenance in the primary study area would occur in areas specified by Reclamation. Staging areas would likely be located in disturbed areas or existing facilities that would be inundated after the dam is raised, such as campgrounds, recreation parking facilities, the top of Shasta Dam, and the parking area along the left wing dam. All staging areas would be located at least 100 feet from bodies of water, wherever possible. Equipment refueling and maintenance would not occur within 100 feet of water bodies, wherever possible.

Seven existing gas/petroleum facilities would be subject to inundation under CP1 and would be relocated subsequent to demolition. The existing fuel tanks would be excavated and all associated piping would be removed. Hazardous material tests and removal would be performed, as required, in accordance with Title 23 CFR, Division 3, Chapter 16: Underground Tank Regulations, and in accordance with Shasta County Environmental Health Division requirements. In addition to adherence to the directives of Title 23, relocated tanks would be designed and constructed in accordance with the Uniform Fire Code; California Air Resources Board; Shasta County Development Standards, Section 6.7 (December 1997); and Shasta County Environmental Health Division requirements. Relocated tanks would be located in cleared areas with code-mandated clearances from other facilities.

Aggregate material for the project could originate from the drawdown portion of Shasta Lake and from areas downstream from Shasta Dam (e.g., Churn Creek bottom, Clear Creek confluence, Keswick Reservoir). These materials could contain hazardous substances such as mercury or selenium. Hazardous materials released into area waterways, including Shasta Lake and many of upper Sacramento River tributaries, come from past land use activities (e.g., mining) or natural sources (e.g., asbestos, selenium) and are likely to be trapped in lake-bottom, river, or floodplain sediments.

Aggregate extraction could also require operation of heavy equipment next to and in Shasta Lake or the upper Sacramento River. Reclamation may use

aggregate supplies from Shasta Lake or the upper Sacramento River floodplain for dam construction materials in the general vicinity of Bridge Bay Marina and Lakeshore Drive. Several additional aggregate sources near the existing shoreline of Shasta Lake are also being considered (e.g., Bass Mountain, Stillwater Creek valley, Gray Rocks). Excavation and extraction of aggregate from these sources, or the augmentation of gravel in the Sacramento River, would require the use of construction equipment, which would involve the use of various hazardous materials such as fuel, oils, grease, and other petroleum products. These contaminants could be introduced into water systems, either directly or through surface runoff.

Project implementation could result in dam operations that would inundate abandoned or inoperative mines located next to Shasta Lake. Areas adjacent to the Bully Hill/Rising Star property contain hazardous materials that would affect Shasta Lake. The effects of CP1 on mines in the primary study area and the upper Sacramento River are discussed in Chapter 7, "Water Quality."

Four vehicle bridges would be removed under CP1: Charlie Creek Bridge, Doney Creek Bridge, McCloud River Bridge, and Didallas Creek Bridge. Bridge demolition, as well as the demolition of other structures and facilities that would be inundated under CP1, could require handling of hazardous waste including asbestos, lead paint, and wood preservatives. This hazardous waste, along with any additional forms of hazardous waste materials generated by project construction, would be removed to an approved landfill for disposal per permit requirements. Transport of hazardous materials would be conducted in accordance with CCR Title 26 and would be licensed by the CHP, pursuant to California Vehicle Code, Section 32000, which requires proper packaging and licensing by hazardous materials haulers.

Although the environmental commitments for all action alternatives include the development and implementation of a Construction Management Plan, Erosion and Sediment Control Plan, Stormwater Pollution Prevention Plan, and Revegetation Plan as well as water quality and fisheries conservation measures and compliance with all required permit terms and conditions, the accidental release of hazardous materials or waste could expose the public and the environment to a significant safety hazard. Therefore, this impact is considered potentially significant. Mitigation for this impact is proposed in Section 9.3.5.

Impact Haz-3 (CP1): Expose Workers to Hazardous Materials Project implementation could result in the exposure of workers to hazardous materials. The project would require the use of potentially hazardous materials to operate construction equipment and to construct various facilities. Reclamation and project contractors would follow local, State, and Federal regulations and procedures for properly transporting, handling, and storing hazardous materials and hazardous waste to decrease the risk of exposure; however, there is a possibility of accidents that could expose project workers to hazardous materials. Structures proposed for demolition, such as bridges, may contain

asbestos, lead paint, toxic wood preservatives, or other hazardous substances. Fuel tanks and utility infrastructure (e.g., transformers containing PCBs) proposed for relocation also would involve some risk of exposure to hazardous substances. However, at this time it appears that the quantities and types of hazardous materials and possible exposure levels to these materials in the workplace would not pose a significant risk to worker health and safety. Furthermore, there are no known hazardous waste sites in the primary study area. Therefore, this impact would be less than significant.

Project workers would be required to transport hazardous materials at various times, in various quantities, and for various stages of project development. I-5 and local roadways would be used to transport hazardous materials and hazardous waste to and from Shasta Lake and vicinity during construction and dam operations. Traffic accidents or equipment failure could expose project workers to hazardous materials. Reclamation and contractors would follow appropriate safety procedures to minimize these risks.

Project construction activities associated with utility line removal and relocation could expose workers to health risks associated with wood preservatives used on wooden utility poles and PCBs, which are commonly found in transformers. Approximately 66,000 feet of power and telecommunication lines and six power towers would be demolished and relocated to avoid inundation resulting from the proposed change in Shasta Lake's elevation. A large number of wooden utility poles would be demolished and relocated outside of the inundation area. Construction activities associated with utility demolition and relocation are estimated to take 3 to 4 years. During that time, workers handling utility poles and transformers would follow protocols to minimize exposure to hazardous material and hazardous waste.

Aggregate extraction from sites in the primary study area that may contain hazardous materials entrained in sediments, such as mercury, could result in the exposure of workers to toxic substances. During construction, workers involved in gravel extraction activities would follow protocols to minimize exposure to hazardous materials.

Shasta Dam operations could expose workers at the facility to hazardous materials. Dam operations require the use of fuels, oils, greases, and solvents. Additional amounts of hazardous materials, beyond the volumes required for operation of the existing structure, may be needed to operate the expanded raised dam structure. Reclamation would update its HMBP and would ensure that its employees follow Cal/EPA and OSHA standards for handling hazardous waste.

In summary, the quantities and types of hazardous materials and possible exposure levels to these materials in the workplace would not pose a significant risk to worker health and safety. Furthermore, there are no known hazardous

waste sites in the primary study area. Therefore, this impact is considered less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact Haz-4 (CP1): Expose Sensitive Receptors to Hazardous Materials Project implementation could expose sensitive receptors to hazardous materials and waste that would be transported through the primary study area. Travel routes to and from the primary study area are limited (i.e., there are few roads); thus, construction traffic would have to use I-5 and local roads, such as Shasta Dam Boulevard and/or Lake Boulevard. A school and park, as well as numerous homes, are located in Shasta Lake City at the intersection of Shasta Dam Boulevard and Lake Boulevard, about 4 miles from Shasta Dam. Project activity would occur while school is in session. The park is open to the public year around. This park is the primary venue for a number of youth and adult sport programs. Although Reclamation would implement measures to lessen the risk of hazardous materials exposure to sensitive receptors, this impact is considered potentially significant.

Aside from scattered residential and recreation areas throughout the primary study area, it does not appear that any other sensitive receptors (e.g., hospitals, schools) in the primary study area would be placed at risk of exposure to hazardous materials as a result of the project. Project implementation would follow local, State, and Federal regulations and procedures regarding the transport of hazardous materials. Mitigation for this impact is proposed in Section 9.3.5.

Lower Sacramento River and Delta and CVP/SWP Service Areas
Impact Haz-5 (CP1): Wildland Fire Risk No new facilities or project construction would occur in the extended study area that would affect the existing potential for wildland fire. Construction materials would be transported and workers would travel to the extended study area from outlying areas via I-5. The potential would exist for truck and vehicular traffic associated with the project to ignite a fire as the result of an accident, a spark, or overheating. However, traffic accidents and fires ignited along roadways typically receive quick local emergency assistance, which includes fire protection. This typical response significantly decreases the potential for a wildland fire being accidentally ignited by project-related traffic. Therefore, this impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact Haz-6 (CP1): Release Potentially Hazardous Materials or Hazardous Waste No new facilities or project construction would occur in the extended study area that would directly or indirectly result in the release of hazardous material or waste. Although hazardous materials used for or generated by the project in the primary study area may be transported through the extended study area, the potential for their release into the environment is less than significant. Hazardous waste generated by the project in the primary study area would likely be disposed of in landfills in the extended study area, and would likely include

utility poles, transformers, asbestos, or lead-based paint. Construction equipment would also generate petroleum product waste. Petroleum products would likely be reclaimed in the primary study area. Other hazardous waste would go to one of three EPA-certified commercial hazardous waste landfills in the state. They are all located in Kings, Kern, and Imperial counties.

Transport of hazardous materials would be conducted in accordance with CCR Title 26 and would be licensed by the CHP, pursuant to California Vehicle Code, Section 32000, which requires proper packaging and licensing by hazardous materials haulers and approved by Caltrans. Highly explosive hazardous waste and large amounts of liquid hazardous waste or are not anticipated to be transported out of the primary study area for disposal. This impacts is considered less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact Haz-7 (CP1): Expose Workers to Hazardous Materials Project implementation would not result in new facilities or construction in the extended study area. Workers may be required to transport hazardous materials through the extended study area for project purposes and could be exposed to the materials in the case of an accidental spill. However, hazardous material transport and safety procedures for hazardous material transported through the extended study area would be sufficient to minimize risks to workers. Workers involved in hazardous waste disposal activities would follow Cal/EPA and OSHA hazardous material and waste handling rules and regulations. Therefore, this impact is considered less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact Haz-8 (CP1): Expose Sensitive Receptors to Hazardous Materials or Hazardous Waste No new facilities or project construction would occur in the extended study area that would directly or indirectly result in the exposure of sensitive receptors to hazardous materials or hazardous waste. Therefore, this impact is considered less than significant.

Hazardous materials needed for construction or operation of the project and hazardous waste generated in the primary study area would be transported through the extended study area. Accidental spills of hazardous materials or waste during transport is possible; however, hazardous waste haulers and hazardous materials suppliers would adhere to all safety precautions and regulations pertaining to hazardous material and hazardous waste transport. These actions would minimize the risk of exposure to hazardous materials or hazardous waste by sensitive receptors in the extended study area. Therefore, this impact is considered less than significant. Mitigation for this impact is not needed, and thus not proposed.

CP2 – 12.5-Foot Dam Raise, Anadromous Fish Survival and Water Supply Reliability

Shasta Lake and Vicinity and Upper Sacramento River (Shasta Dam to Red Bluff)

Impact Haz-1 (CP2): Wildland Fire Risk This impact would be similar to Impact Haz-1 (CP1) for Shasta Lake and vicinity and the upper Sacramento River (Shasta Dam to Red Bluff). Activities that could result in wildland fire risks would be the same as those discussed for Impact Haz-1 (CP1). However, the larger inundation area proposed under CP2 would require that more utilities, public service, and recreational facilities to be demolished and relocated than under CP1, and would require more vegetation to be cleared within inundation area. The additional construction and mechanized vegetation clearing associated with CP2 would require prolonged operation of construction equipment in vegetated areas and increase the potential for fire ignition from motor vehicle operation and the presence of charged utility lines in areas with a high fire hazard potential. A proposed increase in the number of campground/day use recreation areas (216 versus 178 for CP1) would increase the potential for wildfire ignition. Therefore, this impact is considered potentially significant. Mitigation for this impact is proposed in Section 9.3.5.

Impact Haz-2 (CP2): Release Potentially Hazardous Materials or Hazardous Waste This impact would be similar to Impact Haz-2 (CP1) for Shasta Lake and vicinity and the upper Sacramento River (Shasta Dam to Red Bluff). However, the amount of potentially hazardous materials required for construction and operation of the project, and the volume of hazardous waste generated by project construction, could be greater for CP2 than for CP1. The number of bridge relocations, aggregate extraction or augmentation actions, and operations and maintenance of CP2 would be similar to those of CP1. Infrastructure relocation actions would require that land- and water- based construction and maintenance equipment operate in and adjacent to Shasta Lake and other potentially sensitive areas. Hazardous materials from leaking equipment, improper handling, or accidental spills could enter the lake, waterways, or adjacent land. Also under CP2, nine gas/petroleum tanks would be excavated and relocated to avoid inundation. Therefore, this impact is considered potentially significant. Mitigation for this impact is proposed in Section 9.3.5.

Impact Haz-3 (CP2): Expose Workers to Hazardous Materials This impact would be similar to Impact Haz-3 (CP1) for Shasta Lake and vicinity and the upper Sacramento River (Shasta Dam to Red Bluff). CP2 would require the use of potentially hazardous materials during construction, operation, and maintenance of the project. The larger scale of CP2 compared to CP1 would also generate a larger volume of hazardous waste resulting from utility line and infrastructure demolition. However, workers involved in hazardous waste disposal activities would follow Cal/EPA and OSHA hazardous material and waste handling rules and regulations. This impact is considered less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact Haz-4 (CP2): Expose Sensitive Receptors to Hazardous Materials This impact would be similar to Impact Haz-4 (CP1) for Shasta Lake and vicinity and the upper Sacramento River (Shasta Dam to Red Bluff). Project implementation could expose sensitive receptors to hazardous materials and waste that would be transported through the primary study area. Travel routes to and from the primary study area are limited (i.e., there are few roads); thus, construction traffic would have to use I-5 and local roads, such as Shasta Dam Boulevard and/or Lake Boulevard. A school and park, as well as numerous homes are located in Shasta Lake City at the intersection of Shasta Dam Boulevard and Lake Boulevard, about 4 miles from Shasta Dam. Although the scale of project actions proposed under CP2 would be larger than that of CP1, the primary study area would remain the same. Therefore, this impact is considered potentially significant. Mitigation for this impact is proposed in Section 9.3.5.

Lower Sacramento River and Delta and CVP/SWP Service Areas

Impact Haz-5 (CP2): Wildland Fire Risk This impact would be similar to Haz-5 (CP1) for the lower Sacramento River and Delta and the CVP/SWP service areas. No new facilities or project construction would occur in the extended study area that would affect the existing potential for wildland fire. The potential for an increased risk of fire resulting from haul trucks associated with the project would be negligible. Therefore, this impact is considered less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact Haz-6 (CP2): Release Potentially Hazardous Materials or Hazardous Waste This impact would be similar to Impact Haz-6 (CP1) for the lower Sacramento River and Delta and the CVP/SWP service areas. No new facilities or project construction would occur in the extended study area that would result in the direct or indirect release of hazardous material or waste. The potential for an increased risk of hazardous materials spills resulting from haul trucks associated with the project would be negligible. Therefore, this impact is considered less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact Haz-7 (CP2): Expose Workers to Hazardous Materials This impact would be similar to Impact Haz-7 (CP1) for the lower Sacramento River and Delta and the CVP/SWP service areas. Project implementation would not result in new facilities or construction in the extended study area. Workers involved in hazardous waste disposal activities would follow Cal/EPA and OSHA hazardous material and waste handling rules and regulations. Therefore, this impact is considered less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact Haz-8 (CP2): Expose Sensitive Receptors to Hazardous Materials or Hazardous Waste This impact would be similar to Impact Haz-8 (CP1) for the lower Sacramento River and Delta and the CVP/SWP service areas. No new facilities or project construction would occur in the extended study area that

would result in the direct or indirect exposure of sensitive receptors to hazardous materials or hazardous waste. The potential for the exposure of sensitive receptors to hazard materials or waste associated with the project would be negligible. Therefore, this impact is considered less than significant. Mitigation for this impact is not needed, and thus not proposed.

CP3 – 18.5-Foot Dam Raise, Anadromous Fish Survival and Water Supply Reliability

Shasta Lake and Vicinity and Upper Sacramento River (Shasta Dam to Red Bluff)

Impact Haz-1 (CP3): Wildland Fire Risk This impact would be similar to Impact Haz-1 (CP1) for Shasta Lake and vicinity and the upper Sacramento River (Shasta Dam to Red Bluff). However, the larger inundation area proposed under CP2 would require that more utilities, public service, and recreational facilities to be demolished and relocated than under CP1, and would require more vegetation to be cleared within inundation area. The larger scale of utility line and road construction, and the vegetation clearing and grubbing associated with CP3, would require prolonged operation of construction equipment in vegetated areas and increase the potential for fire ignition that comes from motor vehicle operation and the presence of charged utility lines in areas with a high fire hazard potential. A proposed increase in the number of campground/day use recreation areas (254 versus 178 (CP1) or 216 (CP2)) would also increase the potential for wildfire ignition. This impact is considered potentially significant. Mitigation for this impact is proposed in Section 9.3.5.

Impact Haz-2 (CP3): Release Potentially Hazardous Materials or Hazardous Waste This impact would be similar to Impact Haz-2 (CP1) for Shasta Lake and vicinity and the upper Sacramento River (Shasta Dam to Red Bluff). However, the amount of potentially hazardous materials required for construction and operation of the project and the volume of hazardous waste generated by project construction could be greater for CP3 than either CP1 or CP2. The number of bridge relocations, aggregate extraction or augmentation actions, and operations and maintenance of CP3 would be similar to those of CP1 and CP2. However, infrastructure relocation actions would require that land- and water-based construction and maintenance equipment operate in and adjacent to Shasta Lake and other potentially sensitive areas. Hazardous materials from leaking equipment, improper handling, or accidental spills could enter the lake, waterways, or adjacent land. Under CP3, nine gas/petroleum tanks would be excavated and relocated to avoid inundation. This impact is considered potentially significant. Mitigation for this impact is proposed in Section 9.3.5.

Impact Haz-3 (CP3): Expose Workers to Hazardous Materials This impact would be similar to Impact Haz-3 (CP1) for Shasta Lake and vicinity and the upper Sacramento River (Shasta Dam to Red Bluff). CP3 would require the use of potentially hazardous materials during construction, operation, and maintenance of the project. The larger scale of CP3 compared to CP1 or CP2

would also generate a larger volume of hazardous waste resulting from utility line demolition. However, workers involved in hazardous waste disposal activities would follow Cal/EPA and OSHA hazardous material and waste handling rules and regulations. Therefore, this impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact Haz-4 (CP3): Expose Sensitive Receptors to Hazardous Materials This impact would be similar to Impact Haz-4 (CP1) for Shasta Lake and vicinity and the upper Sacramento River (Shasta Dam to Red Bluff). Project implementation could expose sensitive receptors to hazardous materials and waste that would be transported through the primary study area. Travel routes to and from the primary study area are limited (i.e., there are few roads); thus, construction traffic would have to use I-5 and local roads, such as Shasta Dam Boulevard and/or Lake Street. A school and park, as well as numerous homes, are located in Shasta Lake City at the intersection of Shasta Dam Boulevard and Lake Boulevard, about 4 miles from Shasta Dam. Although the scale of project actions proposed under CP3 would be larger than that of CP1 or CP2, the primary study area would remain the same. Therefore, this impact is considered potentially significant. Mitigation for this impact is proposed in Section 9.3.5.

Lower Sacramento River and Delta and CVP/SWP Service Areas

Impact Haz-5 (CP3): Wildland Fire Risk This impact would be similar to Haz-5 (CP1) for the lower Sacramento River and Delta and the CVP/SWP service areas. No new facilities or project construction would occur in the extended study area that would affect the existing potential for wildland fire. The potential for an increased risk of fire resulting from haul trucks and construction traffic associated with the project would be negligible. Therefore, this impact is considered less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact Haz-6 (CP3): Release Potentially Hazardous Materials or Hazardous Waste This impact would be similar to Impact Haz-6 (CP1) for the lower Sacramento River and Delta and the CVP/SWP service areas. No new facilities or project construction would occur in the extended study area that would result in the direct or indirect release of hazardous material or waste. The potential for an increased risk of hazardous materials spills resulting from haul trucks associated with the project would be negligible. Therefore, this impact is considered less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact Haz-7 (CP3): Expose Workers to Hazardous Materials This impact would be similar to Impact Haz-7 (CP1) for the lower Sacramento River and Delta and the CVP/SWP service areas. Project implementation would not result in new facilities or construction in the extended study area. Workers involved in hazardous waste disposal activities would follow Cal/EPA and OSHA hazardous material and waste handling rules and regulations. Therefore, this impact is considered less than significant.

Impact Haz-8 (CP3): Expose Sensitive Receptors to Hazardous Materials or Hazardous Waste This impact would be similar to Impact Haz-8 (CP1) for the lower Sacramento River and Delta and the CVP/SWP service areas. No new facilities or project construction would occur in the extended study area that would result in the direct or indirect exposure of sensitive receptors to hazardous materials or hazardous waste. The potential for the exposure of sensitive receptors to hazardous materials or waste associated with the project would be negligible. Therefore, this impact is considered less than significant. Mitigation for this impact is not needed, and thus not proposed.

CP4 – 18.5-Foot Dam Raise, Anadromous Fish Focus with Water Supply Reliability

Shasta Lake and Vicinity and Upper Sacramento River (Shasta Dam to Red Bluff)

Impact Haz-1 (CP4): Wildland Fire Risk This impact would be similar to Impact Haz-1 (CP3), except that vehicles and equipment involved in the gravel augmentation activities and Reading Island habitat restoration project along the upper Sacramento River would slightly increase the potential for wildland fires. This impact is considered potentially significant. Mitigation for this impact is proposed in Section 9.3.5.

Impact Haz-2 (CP4): Release Potentially Hazardous Materials or Hazardous Waste This impact would be similar to Impact Haz-2 (CP3), except that vehicles and equipment involved in the gravel augmentation activities and Reading Island habitat restoration project along the upper Sacramento River would slightly increase the potential for release of hazardous materials or waste.

Under CP4, the major components described for CP3 would be implemented, but the project focus would be on increasing habitat for anadromous fish. Gravel may be augmented at points along the Sacramento River downstream from Shasta Dam to create fish habitat. Aggregate extraction and/or augmentation activities under CP4 could release hazardous substances (e.g., mercury) entrained in these gravels into the water. Also, gravel augmentation and the Reading Island habitat restoration project could cause hazardous materials from leaking equipment, improper handling, or accidental spills could enter nearby waterways or adjacent land. This impact is considered potentially significant. Mitigation for this impact is proposed in Section 9.3.5.

Impact Haz-3 (CP4): Expose Workers to Hazardous Materials This impact would be similar to Impact Haz-3 (CP3), except that gravel augmentation activities and the Reading Island habitat restoration project along the upper Sacramento River would slightly increase the potential for the exposure of workers to hazardous materials or hazardous waste. This impact is considered less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact Haz-4 (CP4): Expose Sensitive Receptors to Hazardous Materials This impact would be similar to Impact Haz-4 (CP1) and similar to Impact Haz-4 (CP3) for Shasta Lake and vicinity and the upper Sacramento River (Shasta Dam to Red Bluff). Under CP4, the major components described for CP3 would be implemented, but the project focus would be on increasing habitat for anadromous fish. No additional actions are proposed that would affect the potential for the exposure of sensitive receptors to hazardous materials or hazardous waste. This impact is considered potentially significant. Mitigation for this impact is proposed in Section 9.3.5.

Lower Sacramento River and Delta and CVP/SWP Service Areas

Impact Haz-5 (CP4): Wildland Fire Risk This impact would be similar to Haz-5 (CP1) for the lower Sacramento River and Delta and the CVP/SWP service areas. No new facilities or project construction would occur in the extended study area that would affect the existing potential for wildland fire. The potential for an increased risk of fire resulting from haul trucks or construction traffic associated with the project would be negligible. Therefore, this impact is considered less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact Haz-6 (CP4): Release Potentially Hazardous Materials or Hazardous Waste This impact would be similar to Impact Haz-6 (CP1) for the lower Sacramento River and Delta and the CVP/SWP service areas. No new facilities or project construction would occur in the extended study area that would result in the direct or indirect release of hazardous material or waste. The potential for an increased risk of hazardous materials spills resulting from haul trucks associated with the project would be negligible. Therefore, this impact is considered less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact Haz-7 (CP4): Expose Workers to Hazardous Materials This impact would be similar to Impact Haz-7 (CP1) for the lower Sacramento River and Delta and the CVP/SWP service areas. Project implementation would not result in new facilities or construction in the extended study area. Workers involved in hazardous waste disposal activities would follow Cal/EPA and OSHA hazardous material and waste handling rules and regulations. Therefore, this impact is considered less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact Haz-8 (CP4): Expose Sensitive Receptors to Hazardous Materials or Hazardous Waste This impact would be similar to Impact Haz-8 (CP1) for the lower Sacramento River and Delta and the CVP/SWP service areas. No new facilities or project construction would occur in the extended study area that would result in the direct or indirect exposure of sensitive receptors to hazardous materials or hazardous waste. The potential for the exposure of sensitive receptors to hazard materials or waste associated with the project

would be negligible. Therefore, this impact is considered less than significant. Mitigation for this impact is not needed, and thus not proposed.

CP5 – 18.5-Foot Dam Raise, Combination Plan

Shasta Lake and Vicinity and Upper Sacramento River (Shasta Dam to Red Bluff)

Impact Haz-1 (CP5): Wildland Fire Risk This impact would be similar to Impact Haz-1 (CP4) for Shasta Lake and vicinity and the upper Sacramento River (Shasta Dam to Red Bluff). This impact is considered potentially significant. Mitigation for this impact is proposed in Section 9.3.5.

Impact Haz-2 (CP5): Release Potentially Hazardous Materials or Hazardous Waste This impact would be similar to Impact Haz-2 (CP4) for Shasta Lake and vicinity and the upper Sacramento River (Shasta Dam to Red Bluff). Under CP5, the major components described for CP3 would be implemented, but as described under CP4, the project focus would be a combination of increasing water supply availability, enhancing environmental resources in the primary study area, and maintaining the existing level of recreational opportunities. No additional actions are proposed that would affect the potential for the release of hazardous materials or hazardous waste. This impact is considered potentially significant. Mitigation for this impact is proposed in Section 9.3.5.

Impact Haz-3 (CP5): Expose Workers to Hazardous Materials This impact would be similar to Impact Haz-3 (CP3) for Shasta Lake and vicinity and the upper Sacramento River (Shasta Dam to Red Bluff). Under CP5, the major components described for CP3 would be implemented, but the project focus would be a combination of increasing water supply availability, enhancing environmental resources in the primary study area, and maintaining the existing level of recreational opportunities. No additional actions are proposed that would affect the potential for the exposure of workers to hazardous materials or hazardous waste. This impact is considered less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact Haz-4 (CP5): Expose Sensitive Receptors to Hazardous Materials This impact would be similar to Impact Haz-4 (CP3) for Shasta Lake and vicinity and the upper Sacramento River (Shasta Dam to Red Bluff). Under CP5, the major components described for CP3 would be implemented, but the project focus would be a combination of increasing water supply availability, enhancing environmental resources in the primary study area, and maintaining the existing level of recreational opportunities. No additional actions are proposed that would affect the potential for the exposure of sensitive receptors to hazardous materials or hazardous waste. This impact is considered potentially significant. Mitigation for this impact is proposed in Section 9.3.5.

Lower Sacramento River and Delta and CVP/SWP Service Areas

Impact Haz-5 (CP5): Wildland Fire Risk This impact would be similar to Haz-5 (CP1) for the lower Sacramento River and Delta and the CVP/SWP

service areas. No new facilities or project construction would occur in the extended study area that would affect the existing potential for wildland fire. Therefore, this impact is considered less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact Haz-6 (CP5): Release Potentially Hazardous Materials or Hazardous Waste This impact would be similar to Impact Haz-6 (CP1) for the lower Sacramento River and Delta and the CVP/SWP service areas. No new facilities or project construction would occur in the extended study area that would result in the direct or indirect release of hazardous material or waste. Therefore, this impact is considered less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact Haz-7 (CP5): Expose Workers to Hazardous Materials This impact would be similar to Impact Haz-7 (CP1) for the lower Sacramento River and Delta and the CVP/SWP service areas. Project implementation would not result in new facilities or construction in the extended study area. Therefore, this impact is considered less than significant.

Impact Haz-8 (CP5): Expose Sensitive Receptors to Hazardous Materials or Hazardous Waste This impact would be similar to Impact Haz-8 (CP1) for the lower Sacramento River and Delta and the CVP/SWP service areas. No new facilities or project construction would occur in the extended study area that would result in the direct or indirect exposure of sensitive receptors to hazardous materials or hazardous waste. Therefore, this impact is considered less than significant. Mitigation for this impact is not needed, and thus not proposed.

9.3.5 Mitigation Measures

Table 9-1 presents a summary of mitigation measures for hazards and hazardous materials and waste.

Table 9-1. Summary of Mitigation Measures for Hazards and Hazardous Materials and Waste

Impact		No-Action Alternative	CP1	CP2	CP3	CP4	CP5
Impact Haz-1: Wildland Fire Risk (Shasta Lake and Vicinity and Upper Sacramento River)	LOS before Mitigation	NI	PS	PS	PS	PS	PS
	Mitigation Measure	None required.	Haz-1: Coordinate and Assist Public Services Agencies to Reduce Fire Hazards.				
	LOS after Mitigation	NI	LTS	LTS	LTS	LTS	LTS
Impact Haz-2: Release Potentially Hazardous Materials or Hazardous Waste (Shasta Lake and Vicinity and Upper Sacramento River)	LOS before Mitigation	NI	PS	PS	PS	PS	PS
	Mitigation Measure	None required.	Haz-2: Reduce Potential for Release of Hazardous Materials and Waste.				
	LOS after Mitigation	NI	LTS	LTS	LTS	LTS	LTS
Impact Haz-3: Expose Workers to Hazardous Materials (Shasta Lake and Vicinity and Upper Sacramento River)	LOS before Mitigation	NI	LTS	LTS	LTS	LTS	LTS
	Mitigation Measure	None required.	None needed; thus, none proposed.				
	LOS after Mitigation	NI	LTS	LTS	LTS	LTS	LTS
Impact Haz-4: Expose Sensitive Receptors to Hazardous Materials (Shasta Lake and Vicinity and Upper Sacramento River)	LOS before Mitigation	NI	PS	PS	PS	PS	PS
	Mitigation Measure	None required.	Haz-4: Reduce Potential for Exposure of Sensitive Receptors to Hazardous Materials or Waste.				
	LOS after Mitigation	NI	LTS	LTS	LTS	LTS	LTS
Impact Haz-5: Wildland Fire Risk (Lower Sacramento River, Delta, CVP/SWP Service Areas)	LOS before Mitigation	NI	LTS	LTS	LTS	LTS	LTS
	Mitigation Measure	None required.	None needed; thus, none proposed.				
	LOS after Mitigation	NI	LTS	LTS	LTS	LTS	LTS
Impact Haz-6: Release Potentially Hazardous Materials or Hazardous Waste (Lower Sacramento River, Delta, CVP/SWP Service Areas)	LOS before Mitigation	NI	LTS	LTS	LTS	LTS	LTS
	Mitigation Measure	None required.	None needed; thus, none proposed.				
	LOS after Mitigation	NI	LTS	LTS	LTS	LTS	LTS
Impact Haz-7: Expose Workers to Hazardous Materials (Lower Sacramento River, Delta, CVP/SWP Service Areas)	LOS before Mitigation	NI	LTS	LTS	LTS	LTS	LTS
	Mitigation Measure	None required.	None needed; thus, none proposed.				
	LOS after Mitigation	NI	LTS	LTS	LTS	LTS	LTS
Impact Haz-8: Expose Sensitive Receptors to Hazardous Materials (Lower Sacramento River, Delta, CVP/SWP Service Areas)	LOS before Mitigation	NI	LTS	LTS	LTS	LTS	LTS
	Mitigation Measure	None required.	None needed; thus, none proposed.				
	LOS after Mitigation	NI	LTS	LTS	LTS	LTS	LTS

Notes:
LOS = level of significance
LTS = less than significant
NI = no impact
PS = potentially significant

No-Action Alternative

No mitigation measures are required for this alternative.

CP1 – 6.5-Foot Dam Raise, Anadromous Fish Survival and Water Supply Reliability

No mitigation is required for Impacts Haz-3, or Impacts Haz-5 through Haz-8. Mitigation is provided below for other impacts of CP1 on hazards and hazardous materials. Mitigation is provided for the wildland fire hazard, the risk of hazardous material or hazardous waste releases, and the risk of exposing sensitive receptors to hazardous materials.

Mitigation Measure Haz-1 (CP1): Coordinate and Assist Public Services Agencies to Reduce Fire Hazards Reclamation will coordinate all proposed road closures, detours, and traffic control measures with SCSO and Tehama County Sheriff's Office, which are the designated OES for the primary study area.

Reclamation will also coordinate all proposed road closures, detours, and traffic control measures with USFS, Caltrans, CHP, the City of Shasta Lake, and the surrounding Shasta Lake communities.

Reclamation will appoint a public liaison to communicate construction schedules, road closures, and project activities with the public. The liaison will organize and conduct public meetings for communicating project information. The liaison will meet with all affected public services agencies to coordinate public meetings and information exchanges.

Reclamation will meet with public services agencies to determine that traffic controls for infrastructure, utility, and structure relocation do not impede emergency access for wildland fire response capabilities.

Reclamation will require that all project workers receive fire prevention safety training, which identifies local wildland fire hazards and informs workers of the relevant fire prevention procedures, rules, and regulations.

Implementation of this mitigation measure will reduce Impact Haz-1 (CP1) to less than significant.

Mitigation Measure Haz-2 (CP1): Reduce Potential for Release of Hazardous Materials and Waste Reclamation will update the Shasta Dam facilities HMBP (or like document). The update will provide information regarding the hazardous materials used for project implementation and hazardous waste that would be generated.

Reclamation will coordinate hazardous materials and waste information with SCSO and the Tehama County Sheriff's Office (the designated OES for the primary study area), USFS, the City of Shasta Lake, and the surrounding Shasta Lake communities. Transportation coordination efforts will also include CHP

and Caltrans, and will include disclosing and planning proposed hazardous material transportation routes to ensure use of the route(s) having the least impact.

Reclamation will appoint a public liaison to communicate hazardous material transportation routes related to project activities with the public. The liaison will organize and conduct public meetings, which will include discussions of hazardous waste transport in the primary and extended study areas. The liaison will meet with all affected public services agencies to coordinate public meetings and information exchanges.

Project workers who may come into contact with hazardous materials or waste will be required to receive hazardous material safety training, which identifies hazardous materials on the project site and informs workers of the relevant safety procedures, rules, and regulations that address hazardous waste handling, storage, and transportation.

Reclamation will ensure that project construction sites have staging areas that minimize potential hazardous waste releases and that meet best management practices for short-term construction site hazardous material storage.

Implementation of this mitigation measure will reduce Impact Haz-2 (CP1) to less than significant.

Mitigation Measure Haz-4 (CP1): Reduce Potential for Exposure of Sensitive Receptors to Hazardous Materials or Waste Reclamation will coordinate hazardous materials transportation routes with the SCSO and the Tehama County Sheriff's Office, which are the designated OES for the primary study area, USFS, Caltrans, CHP, the City of Shasta Lake, a representative from the Shasta Lake elementary school, and each county OES office that would be affected in the primary and extended study areas. Coordination efforts will include disclosing and planning proposed hazardous material transportation routes and schedules to allow for site-specific modifications that would lessen the potential impact on sensitive receptors.

Reclamation will appoint a public liaison to communicate hazardous material transportation routes related to project activities with the public. The liaison will organize and conduct public meetings, which will include a discussion of hazardous waste transport near local sensitive receptors. The liaison will meet with all affected public services agencies to coordinate public meetings and information exchanges.

Reclamation will identify sensitive receptor sites for all project workers who would use, handle, or transport hazardous materials, and require workers transporting hazardous materials past the sensitive receptors to proceed with extreme caution.

Reclamation will place road signs identifying sensitive receptor sites for hazardous material haulers and post reduced speed limits if local jurisdictions find it necessary to prevent potential impacts.

Implementation of this mitigation measure will reduce Impact Haz-4 (CP1) to less than significant.

CP2 – 12.5-Foot Dam Raise, Anadromous Fish Survival and Water Supply Reliability

No mitigation is required for Impacts Haz-3, or Impacts Haz-5 through Haz-8. Mitigation is provided below for other impacts of CP2 on hazards and hazardous materials. Mitigation is provided for the wildland fire hazard, the risk of hazardous material or hazardous waste releases, and the risk of exposing sensitive receptors to hazardous materials.

Mitigation Measure Haz-1 (CP2): Coordinate and Assist Public Services Agencies to Reduce Fire Hazards This mitigation measure is identical to Mitigation Measure Haz-1 (CP1). Implementation of this mitigation measure will reduce Impact Haz-1 (CP2) to less than significant.

Mitigation Measure Haz-2 (CP2): Reduce Potential for Release of Hazardous Materials and Waste This mitigation measure is identical to Mitigation Measure Haz-2 (CP1). Implementation of this mitigation measure will reduce Impact Haz-2 (CP2) to less than significant.

Mitigation Measure Haz-4 (CP2): Reduce Potential for Exposure of Sensitive Receptors to Hazardous Materials or Waste This mitigation measure is identical to Mitigation Measure Haz-4 (CP1). Implementation of this mitigation measure will reduce Impact Haz-4 (CP2) to less than significant.

CP3 – 18.5-Foot Dam Raise, Anadromous Fish Survival and Water Supply Reliability

No mitigation is required for Impacts Haz-3, or Impacts Haz-5 through Haz-8. Mitigation is provided below for other impacts of CP3 on hazards and hazardous materials. Mitigation is provided for the wildland fire hazard, the risk of hazardous material or hazardous waste releases, and the risk of exposing sensitive receptors to hazardous materials.

Mitigation Measure Haz-1 (CP3): Coordinate and Assist Public Services Agencies to Reduce Fire Hazards This mitigation measure is identical to Mitigation Measure Haz-1 (CP1). Implementation of this mitigation measure will reduce Impact Haz-1 (CP3) to less than significant.

Mitigation Measure Haz-2 (CP3): Reduce Potential for Release of Hazardous Materials and Waste This mitigation measure is identical to Mitigation Measure Haz-2 (CP1). Implementation of this mitigation measure will reduce Impact Haz-2 (CP3) to less than significant.

Mitigation Measure Haz-4 (CP3): Reduce Potential for Exposure of Sensitive Receptors to Hazardous Materials or Waste This mitigation measure is identical to Mitigation Measure Haz-4 (CP1). Implementation of this mitigation measure will reduce Impact Haz-4 (CP3) to less than significant.

CP4 – 18.5-Foot Dam Raise, Anadromous Fish Focus with Water Supply Reliability

No mitigation is required for Impacts Haz-3, or Impacts Haz-5 through Haz-8. Mitigation is provided below for other impacts of CP2 on hazards and hazardous materials. Mitigation is provided for the wildland fire hazard, the risk of hazardous material or hazardous waste releases, and the risk of exposing sensitive receptors to hazardous materials.

Mitigation Measure Haz-1 (CP4): Coordinate and Assist Public Services Agencies to Reduce Fire Hazards This mitigation measure is identical to Mitigation Measure Haz-1 (CP1). Implementation of this mitigation measure will reduce Impact Haz-1 (CP4) to less than significant.

Mitigation Measure Haz-2 (CP4): Reduce Potential for Release of Hazardous Materials and Waste This mitigation measure is identical to Mitigation Measure Haz-2 (CP1). Implementation of this mitigation measure will reduce Impact Haz-2 (CP4) to less than significant.

Mitigation Measure Haz-4 (CP4): Reduce Potential for Exposure of Sensitive Receptors to Hazardous Materials or Waste This mitigation measure is identical to Mitigation Measure Haz-4 (CP1). Implementation of this mitigation measure will reduce Impact Haz-4 (CP4) to less than significant.

CP5 – 18.5-Foot Dam Raise, Combination Plan

No mitigation is required for Impacts Haz-3, or Impacts Haz-5 through Haz-8. Mitigation is provided below for other impacts of CP2 on hazards and hazardous materials. Mitigation is provided for the wildland fire hazard, the risk of hazardous material or hazardous waste releases, and the risk of exposing sensitive receptors to hazardous materials.

Mitigation Measure Haz-1 (CP5): Coordinate and Assist Public Services Agencies to Reduce Fire Hazards This mitigation measure is identical to Mitigation Measure Haz-1 (CP1). Implementation of this mitigation measure will reduce Impact Haz-1 (CP5) to less than significant.

Mitigation Measure Haz-2 (CP5): Reduce Potential for Release of Hazardous Materials and Waste This mitigation measure is identical to Mitigation Measure Haz-2 (CP1). Implementation of this mitigation measure will reduce Impact Haz-2 (CP5) to less than significant.

Mitigation Measure Haz-4 (CP5): Reduce Potential for Exposure of Sensitive Receptors to Hazardous Materials or Waste This mitigation

measure is identical to Mitigation Measure Haz-4 (CP1). Implementation of this mitigation measure will reduce Impact Haz-4 (CP5) to less than significant.

9.3.6 Cumulative Effects

Potentially significant effects were identified in the areas of increased wildland fire risk, accidental releases of hazardous materials or hazardous waste; and potential exposure of sensitive receptors to hazardous materials or hazardous waste. The potential effects would be of greater magnitude and duration with the larger dam raises (i.e., CP3 through CP5 would have greater potential effects than CP1 and CP2).

Reasonably foreseeable actions in the Shasta Lake and vicinity area, such as the construction of Antlers Bridge or the Iron Mountain Mine Restoration Plan, may result in increased potential for wildland fire hazards or accidental releases of hazardous materials or hazardous waste within the primary study area. In addition, as described in the Climate Change Projection Appendix, climate change could result in less precipitation through the 2050s and warmer air temperature, thereby increasing the risk of wildland fire hazard in the vicinity of Shasta Lake.

Implementation of the proposed SLWRI alternatives would result in potentially significant impacts to wildland fire hazards, accidental releases of hazardous materials or hazardous waste, and exposure of sensitive receptors to hazardous materials or hazardous waste. Additive and interactive/multiplicative effects of implementing the proposed SLWRI alternatives with past, present, and reasonably foreseeable probable future projects could result in cumulatively considerable impacts. However, mitigation would be used to reduce impacts associated with the project to a less than significant level. Therefore, the potential for project-related impacts to be cumulatively considerable after mitigation would be less than significant.

The exposure of workers to hazards, hazardous materials, or hazardous waste would not be a cumulatively considerable effect. Implementation of the proposed SLWRI alternatives would not be likely to involve the same workers or occur in the same place or time. Therefore, project implementation would not likely be associated with significant cumulative effects in terms of exposing workers and other sensitive receptors to hazards, hazardous materials, or hazardous waste.

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Chapter 10
Agriculture and Important Farmland

10.1 Affected Environment

This section describes the affected environment related to existing agricultural land uses, Important Farmland, Williamson Act contract lands, and forest resources in the primary and extended study areas. See Chapter 12, "Botanical Resources and Wetlands," for detailed definitions of forest land habitats and Chapter 13, "Wildlife Resources," for a discussion of the relationship between agricultural land uses and wildlife uses. See Chapter 17, "Land Use and Planning," for a discussion of existing land uses within the primary and extended study area and the project's consistency with existing land uses.

10.1.1 Agriculture

Shasta Lake and Vicinity

The setting for agricultural resources in the Shasta Lake and vicinity portion of the primary study area consists of areas in Shasta County north of Shasta Dam, including lands surrounding the lake, that would be subject to inundation and areas where infrastructure would be removed, modified, or relocated under the five action alternatives.

Shasta Lake is surrounded by mountainous and rugged terrain. There are no known agricultural uses adjacent to the lake or in its immediate vicinity above Shasta Dam.

Upper Sacramento River (Shasta Dam to Red Bluff)

The upper Sacramento River portion of the primary study area consists of the portion of Shasta County south of Shasta Dam and downstream to Red Bluff in Tehama County. The valleys of the Sacramento River and its tributaries (Churn, Cottonwood, Anderson, Stillwater, Cow, Bear, Battle, and Clover creeks) contain some of the most productive agricultural land in Shasta and Tehama counties. In addition to the high quality of their soils, agricultural lands in this area enjoy a long growing season of 172-205 days. Water from the Anderson-Cottonwood Irrigation District (ACID), surface diversions of streams, or groundwater is available and good transportation access exists (Shasta County 2004). As of 2002, Shasta County's 1,126 farms encompassed a total of almost 333,828 acres and Tehama County's 1,573 farms were located on 862,440 acres. About 20,000 acres of Important Farmland are located in the Sacramento River corridor between Shasta Dam and the Red Bluff Diversion Dam. Please see Section 10.1.2, "Important Farmland," below for further discussion.

The majority of agricultural activity is located on the Sacramento Valley floor in the south-central portion of Shasta County and across central Tehama County. Small pockets of pastureland exist throughout Shasta County, including mountainous regions. Based on production value, the largest use of agricultural land in Shasta County is field crops, followed by livestock. Nursery stock is the third largest use. Approximately 13 percent of Shasta County land is devoted to some type of agricultural use.

Agricultural uses in the Tehama County portion of the Sacramento Valley consist mostly of orchard and nursery plant operations. The primary crops of Tehama County orchards are walnuts, prunes, almonds, or olives. These crops are largely concentrated in the floodplain alongside the Sacramento River (within and below the upper Sacramento River portion of the primary study area) and are irrigated with groundwater, as well as surface water from local creek diversions and the Sacramento River.

A drastic increase in orchard acreage has occurred since orchard production was initially reported by the National Agricultural Statistics Service in 1930. A combination of factors is responsible for this increase: the availability of irrigation water, advances in irrigation technologies, relatively good commodity prices for orchard crops, and the availability of processing facilities.

The upper Sacramento River portion of the primary study area (areas below Shasta Dam) is largely serviced by ACID. ACID's service area of approximately 32,000 acres extends south from the city of Redding in Shasta County into northern Tehama County. ACID does not provide water for municipal and industrial uses in these areas. Approximately 90 percent of ACID's customers irrigate pasture for haying or livestock; however, in most of the river corridor the water is used to irrigate orchard and other food crops. In total, ACID's service area accounts for about two-thirds of all irrigated pasture in the Redding basin.

ACID uses a rotation schedule to deliver irrigation water to its customers. Very little groundwater is used within the district for agricultural purposes, except occasionally during drought years. Water requirements are typically highest during summer (June, July, and August) because of the area's hot, dry climate. A groundwater management program is being developed; by 2005, 12 dual-completion groundwater monitoring wells had been installed within ACID boundaries. The small portion of groundwater used is limited primarily to deciduous crops and is pumped by privately owned wells. ACID's facilities and irrigation are important contributors to groundwater recharge in the Redding basin. Annual seepage associated with the ACID Main Canal is estimated to be approximately 44 thousand acre-feet (TAF).

Agricultural use within ACID's service area is primarily pasture, in addition to alfalfa and some deciduous orchard crops. Pasture use is typically in the range of 75 percent of the total crop mix served by ACID. Annual cropping patterns

have not varied substantially since the mid-1970s. Therefore, associated on-field water requirements and diversions for crops have been more a function of water-year type and climate than changes in cropping.

Agriculture thus accounts for an important segment of the economic base of Shasta and Tehama counties. In 2002, for example, the total market value of farm products in Shasta County was $52,197,800, a slight increase from the $51,691,000 produced in 2001. Minor increases in the annual production value of orchard crops and apiary products accounted for this increase. Field crops accounted for nearly 40 percent of this total, with livestock sales providing nearly one-third (32.1 percent) of the county's total agricultural production value. Shasta County ranked only 42nd among the 58 California counties in 2002 in the value of total agricultural production – $44,477,000, as reported by the California Department of Food and Agriculture (Shasta County 2004).

In addition to its economic contribution, the agriculture industry is in large part responsible for the rural character of Shasta and Tehama counties. Farmland can also play an important role in the support of wildlife values through the effects it has on conservation of wildlife habitats. As more farmland is developed for urban and suburban uses, the available habitat for most field and woodland edge species decreases, resulting in a subsequent decline or potential elimination of their populations. Agricultural lands also provide productive, privately maintained open space that contributes to the open, natural landscape of much of Shasta and Tehama counties.

Lower Sacramento River and Delta

The Sacramento River below Red Bluff Diversion Dam and its tributaries continue to provide water to crops grown in the river's floodplain and the valley floor, which broadens as it expands into the Central Valley. The river crosses Tehama, Butte, Glenn, Colusa, Sutter, Yolo, and Sacramento counties and is an important source of water for the irrigation and agricultural districts in those counties.

California's Central Valley is home to more than 4 million people; agriculture is the most important segment of the region's robust economy. The Sacramento and San Joaquin river basins provide drinking water for more than two-thirds of Californians and irrigation water for California's crops. The availability of irrigation water makes the Central Valley a major source of reliable, high-quality crops, such as almonds, walnuts, grapes, tomatoes, rice, and other orchard, vineyard, and field crops, marketed to the nation and the world (Reclamation and DWR 2005; DWR and Reclamation 2006).

As of 2002, California's 79,631 farms included a total of 27.6 million acres (NASS 2004). Of that acreage, the Sacramento Valley had more than 11,000 farms with about 4.3 million acres. Sacramento Valley portions of the Central Valley's watersheds support a wide variety of agricultural uses, including livestock grazing, irrigated grain and vegetable crops, and orchards (DWR and

Reclamation 2006). Most agricultural water demands in the Sacramento Valley are met in average water years. Farmers have been growing more crops per acre-foot of applied water by improving productivity and efficiency. However, in some areas, water sources once used for agriculture are now used for urban needs, environmental restoration, and groundwater replenishment. During droughts, water supplies are less reliable, heightening competition and at times leading to conflicts among water users. Water quality is degraded, making it difficult and costly to make the water drinkable. Irrigated agriculture and related businesses are adversely affected, in turn affecting California's economy. During droughts, groundwater levels decline, pumping costs increase, and many rural residents who depend on small water systems or wells run short of water (DWR and Reclamation 2006).

Table 10-1 provides examples of water supply distribution among uses in recent wet, above-normal, and dry years.

Delta agricultural lands were "reclaimed" when levees were constructed and marshy areas were drained. In less than 100 years, from 1850 to 1930, hundreds of thousands of acres of land went into agricultural production. Historically, asparagus, corn, alfalfa, and sugar beets were the Delta's dominant crops. However, a wide variety of crops have been grown in the Delta. In 2008, the Delta's main crops were corn, alfalfa, tomatoes, and wine grapes (DWR 2009).

CVP/SWP Service Areas

The CVP is the largest water storage and delivery system in California, covering 29 of the state's 58 counties. Operated by Reclamation, the CVP consists of 21 reservoirs capable of storing 12 million acre-feet of water, 11 powerplants, 500 miles of major canals and aqueducts, and many tunnels, conduits, and power transmission lines. The CVP irrigates about 3.25 million acres of farmland and supplies water to more than 2 million people through more than 250 water districts, individuals, and companies through water service contracts, Sacramento River water rights, and San Joaquin River exchange contracts. Most of the CVP service area is inside the Central Valley. About 90 percent of the south-of-Delta contractual delivery is for agricultural uses (Reclamation 2007).

The CVP plays a key role in California's economy, providing water for six of the top 10 agricultural counties in the nation's leading farm state. The CVP provides about 5 million acre-feet of water for farms, which is enough to irrigate about 3 million acres, or approximately one-third of the agricultural land in California (Reclamation 2009).

Most of the population of the CVP service area is concentrated within urban areas. The CVP service area includes various municipal and industrial water contractors and water districts that serve portions of the Sacramento and Stockton metropolitan areas and the San Francisco Bay Area (Reclamation 2007).

Table 10-1. California Water Balance Summary

Category	State Summary (MAF)			Sacramento River (TAF)			San Joaquin River (TAF)		
	1998 (171%)[a]	**2000 (97%)[a]**	**2001 (72%)[a]**	**1998 (168%)[a]**	**2000 (105%)[a]**	**2001 (67%)[a]**	**1998 (171%)[a]**	**2000 (97%)[a]**	**2001 (72%)[a]**
Total Supply (Precipitation and Imports)	336.9	194.7	145.5	90,351	58,217	36,564	40,727	28,497	20,010
Total Uses, Outflows, and Evaporation	331.1	200.5	159.8	86,859	59,469	40,124	38,922	28,527	22,707
Net Storage Changes in State	5.8	-5.8	-14.3	3,492	-1,252	-3,560	1,805	-30	-2,697
Distribution of Dedicated Supply (Includes Reuse) to Various Applied Water Uses									
Urban Uses	7.8	8.9	8.6	727.3	859.6	877.2	562.5	594.0	622.8
	(8%)	(11%)	(13%)	(3%)	(4%)	(5%)	(5%)	(5%)	(6%)
Agricultural Uses	27.3	34.2	33.7	6,458.2	8,713.9	8,567.1	5,458.1	7,034.1	7,154.2
	(29%)	(41%)	(52%)	(27%)	(38%)	(45%)	(47%)	(57%)	(67%)
Environmental Water [b]	59.4	39.4	22.5	16,397.8	13.487.6	9,587.7	5,604.5	4,637.1	2.930.1
	(63%)	(48%)	(35%)	(70%)	(58%)	(50%)	(48%)	(38%)	(27%)
Total Dedicated Supply	**94.5**	**82.5**	**64.8**	**23,583.3**	**23,061.1**	**19,032.0**	**11,625.1**	**12,265.2**	**10,707.1**

Source: DWR and Reclamation 2006

Notes:

[a] Percentage of normal precipitation. Water year 1998 was classified as a wet water year; 2000 was an above-normal water year; 2001 was a dry water year.

[b] Environmental water includes instream flows, wild and scenic flows, required Delta outflow, and managed wetlands water use. Some environmental water is reused by agricultural and urban water users.

Key:

MAF = million acre-feet

TAF = thousand acre-feet

Outside of the fast-growing population centers, most of the CVP service area is rural, with irrigated agriculture being the predominant land use and driver of the local and regional economies (Reclamation 2007). As California's population continues to grow at a notable pace, water and power supplies have become more scarce and expensive; as a result, existing supplies have become more valuable.

Through contracts with 29 water agencies, the SWP provides water in the Central Valley to Butte, Solano, Kings, and Kern counties; to several Southern California counties; to Alameda and Santa Clara counties in the south San Francisco Bay Area; and to Napa and Solano counties in the north San Francisco Bay Area. In addition, the SWP provides water rights deliveries to water rights holders along the Feather River (Butte and Plumas counties). Of the total water delivered throughout California, the SWP provides water to about 600,000 acres of farmland. Within the extended study area, the SWP supplies about 10 percent of the total agricultural water used (DWR 2011).

Local surface water supplies (those not delivered by either the CVP or SWP) provide about 40 percent of all agricultural water in the extended study area. More local surface water supplies are available on the east side of the valley because of the larger amount of precipitation in the Sierra Nevada. Locally owned water projects are especially important on the Yuba, Stanislaus, Tuolumne, Kings, and Merced rivers; but local sources on the west side, such as the Federal Solano Project, also are important.

As surface water flows through the San Joaquin Valley, numerous turnouts convey the water to farmland within the service areas of the SWP and CVP. The remaining water conveyed by the California Aqueduct is delivered to Southern California, home to about two-thirds of California's population (DWR 2011).

Groundwater provides an important supply of water for agriculture in normal years and often is used to reduce or eliminate shortages of surface water supplies during drought years. On average, groundwater provides about 20 percent of the total agricultural water use in the extended study area. Declining groundwater tables, subsidence, and loss of aquifer storage continue to be costly problems, particularly in the western and southern parts of the San Joaquin River region and the San Francisco Bay region, where less surface water is available.

10.1.2 Important Farmland

Important Farmland is classified by California Department of Conservation (DOC) as Prime Farmland, Farmland of Statewide Importance, Unique Farmland, and Farmland of Local Importance (see Section 10.2, "Regulatory Framework," for further discussion). In 2006, DOC estimated that California had approximately 30.8 million acres of agricultural land, of which approximately 12.4 million acres were identified as Important Farmland (DOC 2008a). Prime Farmland, and Important Farmland as a whole, decreased by

record amounts during the 2004 to 2006 period. Fewer new acres were brought into production to offset losses, resulting in a net decrease of 156,650 acres in irrigated farmland. The decrease in Prime Farmland (125,495 acres) was the largest documented in a 2-year update since the inception of DOC's Farmland Mapping and Monitoring Program. Figure 10-1 provides an overview of the distribution of Important Farmland in California, including the extended study area, as classified by DOC's Division of Land Resource Protection in 2008. The vast majority of the Important Farmland is located in the Central Valley, fed by the Sacramento and San Joaquin rivers and their tributaries (DOC 2008a).

Shasta Lake and Vicinity

According to the Shasta County Important Farmland map, published by DOC's Division of Land Resource Protection, there are no lands designated as Important Farmland adjacent to Shasta Lake or in the immediate vicinity above Shasta Dam (Figure 10-1).

Upper Sacramento River (Shasta Dam to Red Bluff)

The majority of Important Farmland in the primary study area is clustered in the former floodplain of the Sacramento River. As of 2006, Shasta County had 25,727 acres and Tehama County had 231,513 acres of Important Farmland (Table 10-2). Reading Island and the potential gravel augmentation sites are not located in Important Farmland.

Table 10-2. Acreage of Important Farmland in Shasta and Tehama Counties

Important Farmland Category	Shasta County	Tehama County	Total
Prime Farmland	13,282	63,707	76,989
Farmland of Statewide Importance	3,444	17,284	20,728
Unique Farmland	488	18,085	18,573
Farmland of Local Importance	8,513	132,437	140,950
Total	**25,727**	**231,513**	**257,240**

Sources: DOC 2008a, 2008b

Most of the Important Farmland in the primary study area is clustered in the former Sacramento River floodplain. According to the Important Farmland maps for Shasta and Tehama counties, the primary study area includes 459 acres of Important Farmland. Of this total, 115 acres are located in Shasta County and 344 acres are located in Tehama County (Table 10-3).

Table 10-3. Acreage of Important Farmland in Portions of Shasta and Tehama Counties Within the Primary Study Area

Important Farmland Category	Shasta County	Tehama County	Total
Prime Farmland	81	44	125
Farmland of Statewide Importance	9	–	9
Unique Farmland	17	41	58
Farmland of Local Importance	8	259	267
Total	**115**	**344**	**459**

Source: DOC 2008a

Lower Sacramento River and Delta

During the 2006 mapping cycle, urban land uses statewide increased by 102,010 acres. Housing was the largest component of new urban acreage in the lower Sacramento River portion of the extended study area; most of the increase was associated with single-family homes located at the periphery of existing cities. Retail and commercial developments and community infrastructure supporting new residential development also contributed substantially to urbanization. Overall, the Sacramento Valley accounted for 18 percent of the net decrease in irrigated farmland.

Other factors besides conversion to urban or other land uses (e.g., habitat restoration) also affect the acreage of irrigated farmland. Regionally, complex factors related to availability of surface and groundwater supplies, crop markets, and anticipation of urban development affect the acreage of irrigated farmland. More locally, changes in annual water supplies, drainage, access, and compatibility with adjacent land uses also affect the productivity and value, and thus use, of agricultural land. Potential conflicts of adjacent land uses with agricultural production include traffic, vandalism, dumping, and provision of habitat for pest organisms (EDAW 2006; Sokolow et al. 2010).

The periphery of the Delta is undergoing rapid urbanization associated with substantial population growth. Current and future population growth will increase the demand for developable land, particularly near the Bay Area, Stockton, and Sacramento. This demand results in the conversion of open space, primarily agricultural land, to residential and commercial uses. In the recent past, thousands of acres of agricultural lands were developed for residential and other urban uses. Between 2000 and 2006, about 75,000 acres of agricultural land were converted to urban and conservation uses in the Delta. Approximately 505,300 acres of Important Farmland were located in the Delta as of 2006 (CVFMPP and FloodSAFE 2010; DOC 2008a).

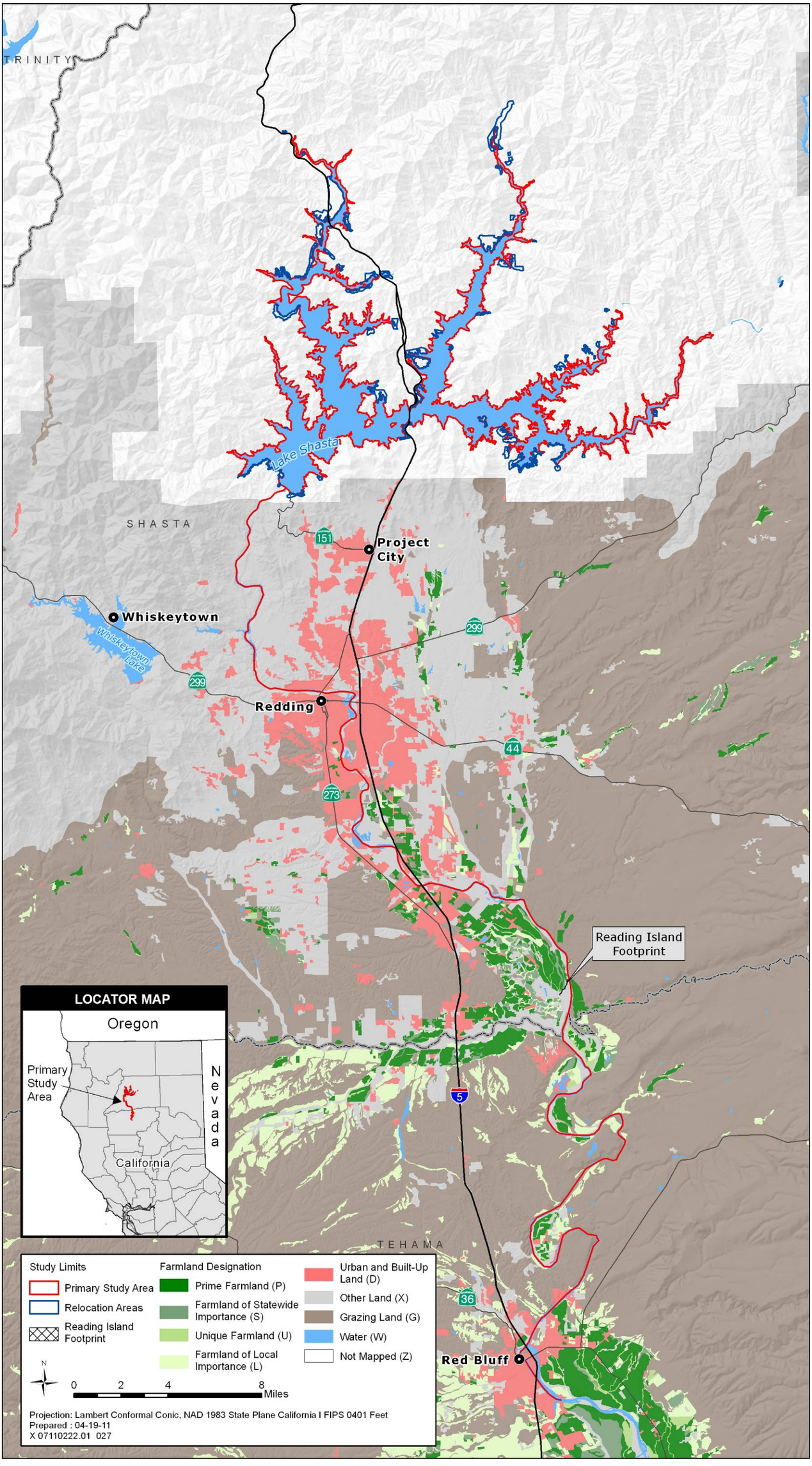


Figure 10-1. Important Farmland in the Primary Study Area

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CVP/SWP Service Areas

Declines in Important Farmland in the CVP/SWP service areas are similar to those discussed above for the lower Sacramento River and Delta. Urbanization has been responsible for 74 percent of Important Farmland and grazing land losses in the CVP/SWP service areas as a whole. As stated previously, urban land expanded by 102,010 acres during the 2006 mapping cycle. Riverside County alone accounted for 23 percent of the newly developed land. Southern California led all regions with 47 percent of the developed acres, while the San Joaquin Valley ranked second at 23 percent of the total. The Sacramento metropolitan area was third most active with 16 percent of new urban acres; Sacramento County's expansion of nearly 10,000 acres was a record high (DOC 2008a).

10.1.3 Williamson Act

As of January 1, 2007, 16.6 million acres were enrolled under the Williamson Act statewide. (Figure 10-2 shows Williamson Act lands in the primary study area.) This represents approximately half of California's farmland and nearly one-third of its privately owned land. The nonrenewal process is the most common mechanism for terminating Williamson Act contracts. Nonrenewal trends may be seen as an indicator of likely farmland conversion in particular locations. Statewide, nonrenewal initiations have increased each year since 2001 and reached a new high in 2007, with the San Joaquin Valley accounting for the largest increase in nonrenewal initiations. Overall, a total of 535,400 acres of contracted land was at some stage of the nonrenewal process in 2007 (DOC 2009a, 2009b).

10.1.4 Forest Land

Forest land is defined as native tree cover greater than 10 percent that allows for management of timber, aesthetics, fish and wildlife, recreation, and other public benefits (Public Resources Code (PRC) Section 12220(g)). Natural forest and woodland vegetation types in the study area typically have greater than 10 percent cover by native trees. (Figures 12-2a through 12-2f in Chapter 12, "Botanical Resources and Wetlands," display the distribution of natural forest and woodland vegetation.)

Forests serve as high-quality habitat for fish and wildlife species, sequester carbon to mitigate climate change, capture vital runoff for agricultural and domestic water supply, and provide a variety of outdoor recreation and education opportunities. Many rural communities depend on income and employment opportunities that result from working timber industries or on amenity values to attract new residents seeking a better lifestyle. In metropolitan areas, urban forests contribute to improved air quality, cooling of heat islands for energy conservation, and local employment (CDF 2010).

Shasta Lake and Vicinity

The study area for forest resources in the Shasta Lake and vicinity portion of the primary study area corresponds to the area that would be subject to inundation under the five action alternatives and areas where infrastructure would be removed, modified, or relocated.

The Shasta Lake and vicinity area is characterized by a variety of forest lands typical of transitional mixed woodland and low-elevation forests. Forest land within the Shasta Lake and vicinity portion of the primary study area includes blue oak woodland, Brewer's oak, California black oak forest, canyon live oak forest, Fremont cottonwood forest, ghost pine woodland, interior live oak woodland, knobcone pine forest, Oregon white oak woodland, ponderosa pine–Douglas fir forest, ponderosa pine forest, and valley oak woodland (see Figures 12-2a through 12-2f and Table 12-1 in Chapter 12, "Botanical Resources and Wetlands"). The inundation area and relocation areas (which could potentially be affected by the alternatives) contain approximately 4,669 acres of forest land and acres of forest land (Tables 10-1 and 10-2).

Table 10-4. Summary of Forest Land in the Impoundment and Relocation Areas

Forest Land	Area (Acres)
Blue oak woodland	12
Brewer oak scrub	79
California black oak forest	662
Canyon live oak forest	420
Fremont cottonwood forest	<1
Ghost pine woodland	463
Interior live oak woodland	9
Knobcone pine forest	313
Oregon white oak woodland	8
Ponderosa pine–Douglas fir forest	507
Ponderosa pine forest	2,194
Valley oak woodland	1
Total	4,669

Source: Data compiled by AECOM in 2011

The exact combination of vegetation varies, with dramatic changes often occurring in relation to aspect, slope, geologic substrate, or juxtaposition with other habitats.

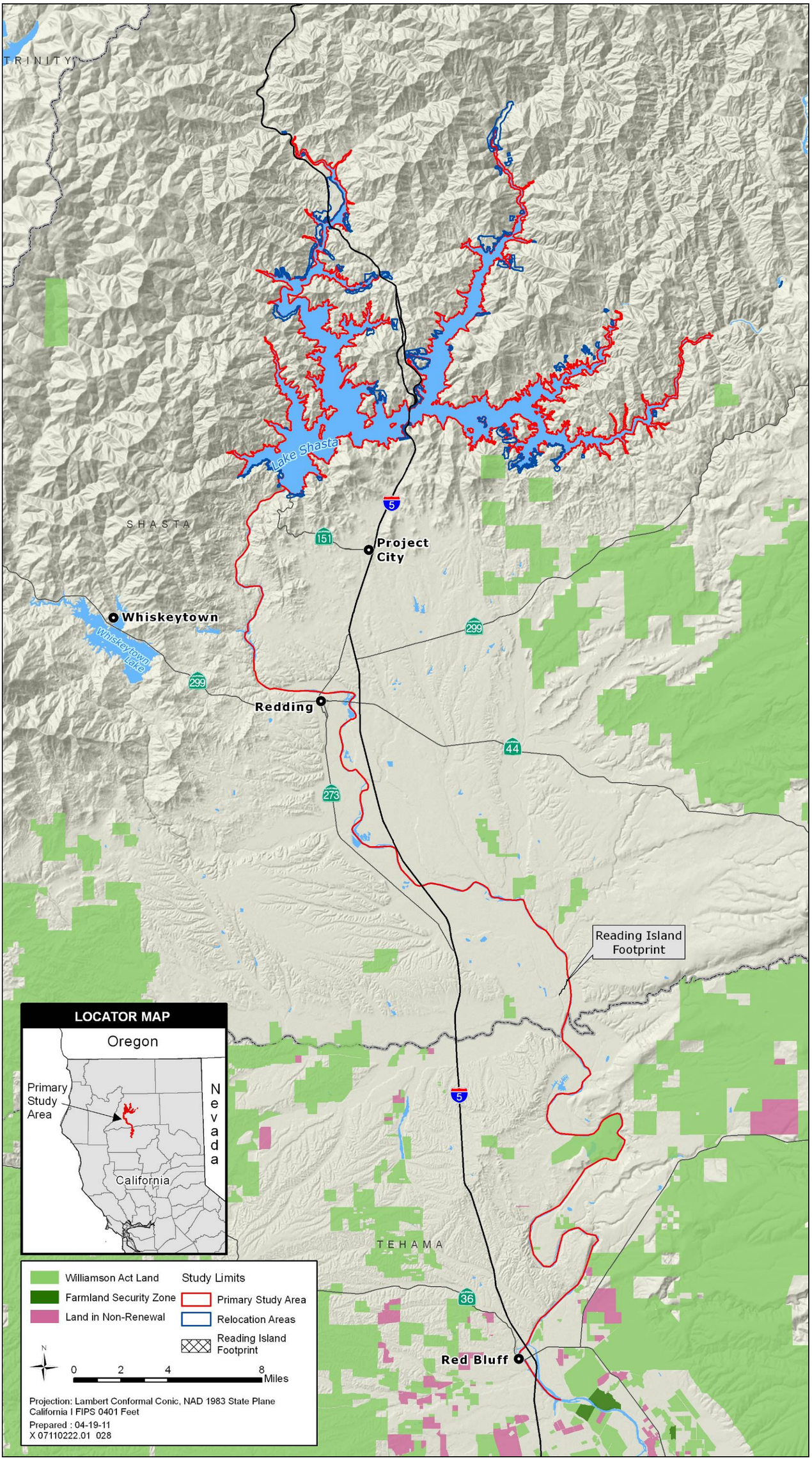


Figure 10-2. Williamson Act Lands in the Primary Study Area

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Upper Sacramento River (Shasta Dam to Red Bluff)

Forest land in the upper Sacramento River area from Shasta Dam to Red Bluff consists of riparian forest and oak woodland and savanna. Oak woodlands present in the primary study area include blue oak woodland, blue oak savanna, foothill pine-oak woodland, and valley oak woodland. Much of the Sacramento River from Shasta Dam to Redding is deeply entrenched in bedrock, which precludes development of extensive areas of riparian vegetation. The river corridor between Redding and Red Bluff, however, still maintains extensive areas of riparian forest communities.

Riparian plant communities present within the primary study area are located within the floodplain of the Sacramento River. These communities include Great Valley cottonwood riparian forest, Great Valley mixed riparian forest, and Great Valley valley oak riparian forest. Cottonwood- and willow-dominated riparian forest and woodland are present along active channels and on the lower flood terraces, whereas valley oak–dominated communities occur on higher flood terraces. In general, only narrow remnants of these riparian forests remain, often because levees are located close to river channels and the remaining riparian forest habitat is confined primarily to levee slopes. Riparian vegetation exists at Reading Island and some of the potential gravel augmentation sites.

Lower Sacramento River and Delta

Almost all of this forest land in the lower Sacramento River and Delta consists of riparian forests, including cottonwood-willow woodland and Valley oak riparian woodland. These areas are typically found in the lower Sacramento River and Delta as long, linear patches bordering waterways and agricultural or urban land. Riparian vegetation is most extensive on the water side of levees, but patches of riparian vegetation are also found on the interior of Delta islands along levee toes; along drainage channels; along pond margins; and in abandoned, low-lying fields. Forest land in riparian areas is managed primarily for habitat and water quality values, and to a lesser extent for recreation and other public benefits.

CVP/SWP Service Areas

Forest resources in the CVP and SWP service areas are similar to those discussed above for the upper Sacramento River (Shasta Dam to Red Bluff) and the lower Sacramento River and Delta. Agricultural and urban land uses have substantially reduced the area and connectivity of forest land in the CVP and SWP service areas. Substantial changes to the natural landscape in the region occurred in the late 1800s and early 1900s with land conversions to agriculture. In southern California, however, that pattern shifted dramatically compared to the pattern in the Central Valley, as urban growth in the region that started in the 1900s began to convert large areas of forest land to developed land uses.

10.2 Regulatory Framework

10.2.1 Federal

Farmland Protection Policy Act

The Farmland Protection Policy Act is intended to minimize the effect of Federal programs with respect to the conversion of farmland to nonagricultural uses. It ensures that, to the extent possible, Federal programs are administered to be compatible with State, local, and private programs and policies to protect farmland. The U.S. Department of Agriculture Natural Resources Conservation Service (NRCS) is the agency primarily responsible for implementing the Farmland Protection Policy Act.

The Farmland Protection Policy Act established the Farmland Protection Program and the Land Evaluation and Site Assessment system. NRCS administers the Farmland Protection Program, which is a voluntary program that provides funds to help purchase development rights to keep productive farmland in agricultural uses. The program provides matching funds to State, local, and tribal entities and nongovernmental organizations with existing farmland protection programs to purchase conservation easements. Participating landowners agree not to convert the land to nonagricultural uses and retain all rights to the property for future agriculture. A minimum 30-year term is required for conservation easements, and priority is given to applications with perpetual easements. NRCS provides up to 50 percent of the fair market value of the easement (NRCS 2006).

The Land Evaluation and Site Assessment system is a tool used to rank lands for suitability and inclusion in the Farmland Protection Program. The Land Evaluation and Site Assessment evaluates several factors: soil potential for agriculture, climate, location, market access, and adjacent land use. These factors are used to numerically rank land parcels based on local resource evaluation and site considerations (NRCS 2006).

10.2.2 State

California Important Farmland Inventory System and Farmland Mapping and Monitoring Program

The DOC Office of Land Conservation maintains a statewide inventory of farmlands. These lands are mapped by the Division of Land Resource Protection as part of the Farmland Mapping and Monitoring Program. The Farmland Mapping and Monitoring Program was established by the State of California in 1982 to continue the Important Farmland mapping efforts begun in 1975 by the U.S. Soil Conservation Service (now called NRCS). The intent of the U.S. Soil Conservation Service was to produce agricultural-resource maps based on soil quality and land use across the nation. DOC sponsors the Farmland Mapping and Monitoring Program and is also responsible for establishing agricultural easements in accordance with PRC Sections 10250-

10255. The maps are updated every 2 years with the use of aerial photographs, a computer mapping system, public review, and field reconnaissance.

As part of the nationwide agricultural-land-use mapping effort, U.S. Soil Conservation Service/NRCS developed a series of definitions known as Land Inventory and Monitoring criteria. The Land Inventory and Monitoring criteria classify the land's suitability for agricultural production. Suitability includes both the physical and chemical characteristics of soils and the actual land use. Important Farmland maps are derived from NRCS soil survey maps using the Land Inventory and Monitoring criteria and are available by county. The maps prepared by NRCS classify land into one of eight categories, which are defined as follows (DOC 2008a):

- **Prime Farmland** – land that has the best combination of physical and chemical characteristics for crop production. It has the soil quality, growing season, and moisture supply needed to produce sustained high yields of crops when treated and managed.

- **Farmland of Statewide Importance** – land of importance to the local economy, as defined by each county's local advisory committee and adopted by its board of supervisors. Farmland of Local Importance is land other than Prime Farmland that has a good combination of physical and chemical characteristics for crop production. This land has minor shortcomings, such as greater slopes or less ability to store soil moisture than Prime Farmland.

- **Unique Farmland** – land that does not meet the criteria for Prime Farmland or Farmland of Statewide Importance, but that has been used for the production of specific crops with high economic value. This land is usually irrigated, but may include nonirrigated orchards or vineyards as found in some climatic zones in California.

- **Farmland of Local Importance** – land that is either currently producing crops or has the capability of production, but does not meet the criteria of the categories above.

- **Grazing Land** – land on which the vegetation is suited to the grazing of livestock. The minimum mapping unit for Grazing Land is 40 acres.

- **Urban and Built-up Lands** – land occupied by structures with a density of at least one dwelling unit per 1.5 acres.

- **Land Committed to Nonagricultural Use** – vacant areas; existing lands that have a permanent commitment to development but have an existing land use of agricultural or grazing lands.

- **Other Lands** – Land that does not meet the criteria of the remaining categories. This optional designation allows local governments to provide detail on the nature of changes expected to occur in the future.

Important Farmland is classified by DOC as Prime Farmland, Farmland of Statewide Importance, Unique Farmland, and Farmland of Local Importance. The total acreages of Urban and Built-up Lands and Other Lands are calculated by DOC and are defined by DOC as agricultural land.

The designations for Prime Farmland, Farmland of Statewide Importance, Unique Farmland, and Farmland of Local Importance are defined together under the terms "Agricultural Land" and "Important Farmland" in CEQA (PRC Sections 21060.1 and 21095 and State CEQA Guidelines Appendix G). The conversion of these types of farmland could be considered an environmental impact.

Williamson Act Contracts

The California Land Conservation Act of 1965, commonly known as the Williamson Act, is the principal method for encouraging the preservation of agricultural lands in California. The Williamson Act enables local governments to enter into contracts with private landowners for the purpose of restricting specific parcels of land to agricultural or related open-space use for 10 years. In return, landowners receive property tax assessments that are based on farming and open-space uses as opposed to full market value. Local governments receive an annual subvention (subsidy) of forgone property tax revenues from the State via the Open Space Subvention Act of 1971.

The Williamson Act empowers local governments to establish "agricultural preserves" consisting of lands devoted to agricultural uses and other uses that are compatible with agriculture. Upon establishment of such preserves, the locality may offer to owners of included agricultural land the opportunity to enter into annually renewable contracts that restrict the land to agricultural use for at least 10 years (i.e., the contract continues to run for 10 years after the first date upon which the contract is not renewed). In return, the landowner is guaranteed a relatively stable tax base, founded on the value of the land for agricultural/open space use only and unaffected by its development potential.

Canceling a Williamson Act contract involves an extensive review and approval process, in addition to payment of fees of up to 12.5 percent of the property value. The local jurisdiction approving the cancellation must find that the cancellation is consistent with the purpose of the California Land Conservation Act or is in the public interest. Several subfindings must be made to support either finding, as defined in California Government Code Section 51282.

Farmland Security Zones

Farmland Security Zones (FSZ), also known as Super Williamson Act lands, were established by DOC with the same general intent as Williamson Act

contracts. An FSZ must be located in an agricultural preserve (area designated as eligible for a Williamson Act contract). Agricultural landowners in FSZs may enter into contracts with the county for 20-year increments, with an additional 35 percent tax benefit over and above the standard Williamson Act contract. The FSZ program has been adopted by 25 counties, although not all of those counties have executed contracts.

An FSZ must be located in an Agricultural Preserve (area designated as eligible for a Williamson Act contract) and designated as Prime Farmland, Farmland of Statewide Importance, Unique Farmland, or Farmland of Local Importance. Land protected in an FSZ cannot be annexed by a city or county government or school district. FSZ contracts constitute nearly 2 percent of statewide Williamson Act enrollment.

An FSZ can be terminated through a nonrenewal or cancellation. The nonrenewal allows a rollout process to occur over the remainder of the term of the contract, when the tax rates would gradually rise to the full rate by the end of the 20-year term. A cancellation must be applied for and approved by the director of the DOC, and specific criteria must be met. The cancellation must be in the public interest and consistent with Williamson Act criteria. If a cancellation is approved, fees equal to 25 percent of the full market value of the property must be paid.

Agricultural Water Management Plans

By the end of 2004, 62 water districts, three environmental interest groups, and more than 53 other interested groups had signed the Agricultural Water Management Memorandum of Understanding as members of the Agricultural Water Management Council. The agricultural signatories represent more than 4.75 million acres of irrigated agricultural land statewide.

In 2004, the council endorsed an additional three agricultural water management plans that had been submitted by agricultural water suppliers to the council. Subsequently, these plans have become the basis for the districts' water conservation efforts. The districts with endorsed agricultural water management plans are expected to prepare and submit a biannual progress report to the Agricultural Water Management Council, starting from the date their plan was endorsed. DWR staff members provide technical review and evaluation of these plans. DWR also reviewed two biannual progress reports for the council. DWR staff also provided technical assistance to water districts to prepare water management plans and helped implement efficient water management practices, as well as administrative and programmatic assistance to both the Agricultural Water Management Council and water districts.

1992 Delta Protection Act

The 1992 Delta Protection Act identified the Delta as a natural resource of statewide significance, formalized the State's commitment to preserve its diverse values, and established the Delta Protection Commission. The purpose

of the Delta Protection Act is to ensure protection, maintenance, and enhancement of the Delta environment; ensure orderly and balanced use of Delta land resources; and improve flood protection to increase public health and safety. The Delta Protection Commission has planning jurisdiction over portions of five counties: Contra Costa, Sacramento, San Joaquin, Solano, and Yolo.

In Section 29703a of the Delta Protection Act, the Delta Primary Zone is designated as an area for protection from intrusion of nonagricultural uses. In 1995, the Delta Protection Commission adopted its regional plan, *Land Use and Resource Management Plan for the Primary Zone of the Delta* (also known as the Delta Plan). The current Delta Plan was approved by the California Office of Administrative Law on October 7, 2010, and became effective November 6, 2010. Policies in the Delta Plan are developed to project the conversion of agricultural resources. Policy P-2 states that conversion of land to non–agriculturally oriented uses should occur first where productivity and agricultural values are lowest. Policy P-6 encourages acquiring agricultural conservation easements from willing sellers as mitigation for projects within each county. Use of environmental mitigation is to be promoted in agricultural areas only when it is consistent and compatible with ongoing agricultural operations and when developed in appropriate locations designated on a countywide or Deltawide habitat management plan (DPC 2010).

10.2.3 Regional and Local

Shasta and Tehama Counties

The general plans of Shasta and Tehama counties contain goals, policies, and implementation measures to protect agricultural lands, as summarized below.

Shasta County General Plan The *Shasta County General Plan* (Shasta County 2004) identifies goals, policies, and implementation measures aimed at conserving large contiguous areas of productive agricultural land, providing opportunities for the future expansion of such uses, and protecting them from development pressures that would adversely affect or hinder existing or future agricultural operations. This includes the objective to protect water resources and supply systems vital for the continuation of agriculture.

Tehama County General Plan The *Tehama County General Plan* (2009) encourages and supports agriculture and forest resources in Tehama County. The policies are within the Agriculture and Timber Element of the general plan and divided into the Land Use, Open Space and Conservation, and Economic Development Elements to aid in implementation of the general plan, but focus on agriculture nonetheless.

Other

Sacramento River Conservation Area The Sacramento River Conservation Area seeks to promote the reestablishment of the 100-year floodplain along the Sacramento River. In 1986, the California Legislature passed Senate Bill 1086,

which called for a management plan for the Sacramento River that would help restore, protect, and enhance the riparian and aquatic habitat. After much debate, the *Upper Sacramento River Fisheries and Riparian Habitat Management Plan* was developed (Resources Agency 1989). This plan called for fish bypass structures on the Sacramento River and its tributaries, as well as the Shasta Dam temperature control structure. After implementation of these projects began, the advisory council reconvened to complete additional work. This effort led to the *Sacramento River Conservation Area Handbook* (Resources Agency 2003), which would guide riparian habitat management along the river. In 1999, a memorandum of agreement was signed by most entities involved in management activities along the river. The U.S. Bureau of Land Management has acquired roughly 15,000 acres of riparian lands along the Sacramento River.

10.3 Environmental Consequences and Mitigation Measures

10.3.1 Methods and Assumptions

Implementation of the project would result in construction, maintenance, and operational impacts that could substantially affect agricultural and forest resources. This analysis evaluates potential construction and operational activities that could directly or indirectly affect existing agricultural and forest resources in the primary study area. Indirect impacts on the extended study area could result from alteration of flow regimes downstream from Shasta Lake and downstream from other reservoirs with altered operations, as well as increased inundation width of the Sacramento River during the growing season. In addition, water supply reliability in the CVP and SWP service areas could increase, which could in turn reduce limitations on growth and increase development that could adversely affect agricultural and forest resources.

Evaluation of the project's potential impacts on agricultural resources was based on a review of the planning documents pertaining to the project areas, including goals and policies from the general plans of Shasta and Tehama counties. DOC's Important Farmland and Williamson Act maps were used to determine the agricultural significance of the lands in the primary study area. In addition, the results of CalSim-II simulations were reviewed to assess changes in flow regime in the primary and extended study areas.

Forest land that could be inundated or affected by the alternatives was determined from vegetation mapping as described in Chapter 12, "Botanical Resources and Wetlands." These forest lands include blue oak–foothill pine, blue oak, and closed-cone pine-cypress woodlands; and Douglas-fir, montane hardwood, montane hardwood-conifer, montane riparian, Ponderosa pine, and valley-foothill riparian forests. The following analysis summarizes information provided in Chapter 12, "Botanical Resources and Wetlands" as it relates to the potential conversion of forest land to nonforest uses.

10.3.2 Criteria for Determining Significance of Effects

An environmental document prepared to comply with NEPA must consider the context and intensity of the environmental effects that would be caused by, or result from, the proposed action. Under NEPA, the significance of an effect is used solely to determine whether an environmental impact statement must be prepared. An environmental document prepared to comply with CEQA must identify the potentially significant environmental effects of a proposed project. A "[s]ignificant effect on the environment" means a substantial, or potentially substantial, adverse change in any of the physical conditions within the area affected by the project" (State CEQA Guidelines, Section 15382). CEQA also requires that the environmental document propose feasible measures to avoid or substantially reduce significant environmental effects (State CEQA Guidelines, Section 15126.4(a)).

The following significance criteria were developed based on guidance provided by the State CEQA Guidelines, and consider the context and intensity of the environmental effects as required under NEPA. Impacts of an alternative on agriculture and Important Farmland would be significant if project implementation would do any of the following:

- Convert Prime Farmland, Unique Farmland, or Farmland of Statewide Importance (Farmland), as shown on the maps prepared pursuant to the Farmland Mapping and Monitoring Program of the California Resources Agency, to nonagricultural use

- Conflict with existing zoning for agricultural use, or a Williamson Act contract

- Conflict with existing zoning for, or cause rezoning of, forest land (as defined in PRC Section 12220(g)), timberland (as defined in PRC Section 4526), or timberland zoned Timberland Production (as defined in PRC Section 51104(g))

- Result in the loss of forest land or conversion of forest land to nonforest use

- Involve other changes in the existing environment that, because of their location or nature, could result in conversion of farmland, to nonagricultural use or the conversion of forest land to nonforest use

10.3.3 Topics Eliminated from Further Consideration

None of the lands in the primary study area are zoned as forest land, timberland, or timberland zoned Timberland Production by the *Shasta County General Plan* (2004) or *Tehama County General Plan* (2009). Increasing water supply reliability within the lower Sacramento River to the Delta and within the CVP and SWP service areas would not conflict with existing zoning or directly result in the rezoning of forest land, timberland, or timberland zoned Timberland

Production. Therefore, no effects related to conflicts with existing zoning or causing rezoning of forest land are expected to occur in the study area; therefore, potential effects related to this issue area are not discussed further in this PDEIS.

10.3.4 Direct and Indirect Effects

No-Action Alternative

Under the No-Action Alternative, the existing Shasta Dam would be operated in the same manner as under current operations. Shasta Dam would not be enlarged and no infrastructure would be removed, modified, or relocated. Changes to the reservoir flow regime caused by changes in demand and other factors would be small, with a reduction in Shasta Lake storage of 2–4 percent during the fall of some years. Shasta Lake storage under the No-Action Alternative would be within -2 percent and 1 percent of Shasta Lake storage under existing conditions at most times.

Under the No-Action Alternative, changes to the flow regime of the upper Sacramento River as a result of changes in demand and other factors would be small; mean monthly flows in the Sacramento River would be within 5 percent of flows under existing conditions at most times. (Flows could increase by a greater amount during late summer and early fall of below-normal, dry, and critical years.)

Under the No-Action Alternative, the flow regime in the lower Sacramento River and Delta would not change as a result of Shasta Lake operations. It is anticipated that if the project alternatives were not implemented, CVP and SWP operations would continue under existing regulatory requirements. CVP and SWP water storage, conveyance, and deliveries would change because of several reasonably foreseeable actions that would occur with or without enlarging Shasta Dam. Overall, CalSim-II modeling results suggest that there would be only a very small decrease in flows greater than 15,000 cubic feet per second.

Shasta Lake and Vicinity

Impact Ag-1 (No-Action): Direct and Indirect Conversion of Important Farmland to Nonagricultural Uses and Cancellation of Williamson Act Contracts in the Vicinity of Shasta Lake No new facilities would be constructed at Shasta Lake and no operational changes would occur that would directly convert Important Farmland to nonagricultural uses or result in the cancellation of Williamson Act contracts in the vicinity of Shasta Lake. However, California's demand for water for irrigation and other uses is expected to continue to increase while the water supply will likely become less reliable. This trend could lead to increased pressure to convert Important Farmland to other nonagricultural uses and cancel Williamson Act contracts, resulting in an indirect impact. Therefore, this impact would be potentially significant.

Under the No-Action Alternative, Shasta Dam would not be enlarged; no infrastructure would be removed, modified, or relocated; and no changes in Reclamation's Shasta operations would occur. Changes to reservoir flow regime and reservoir storage caused by changes in demand and other factors would be small, and generally the same as under existing conditions at most times. Therefore, implementing the No-Action Alternative would not directly convert agricultural land to nonagricultural uses or result in the cancellation of Williamson Act contracts.

The demand for water for irrigation and other uses in California is expected to continue to increase in the future; at the same time, the water supply may become less reliable because of increasing environmental water requirements for special-status species, decreasing water quality, and climate change. Therefore, the No-Action Alternative could have an indirect, adverse impact on agricultural land uses and Important Farmland in the primary study area. Insufficient water supply, especially during drought periods, could indirectly lead to increased pressure on farmers to convert Important Farmland to other nonagricultural uses, or could cause land designated as Important Farmland to be fallowed. Additionally, the conversion of Important Farmland could also involve cancellation or expiration of many Williamson Act contracts.

The magnitude and extent of the agricultural land that could be converted from changes in water supply is unknown; however, any loss of Important Farmland would be significant because there are no measures to fully mitigate the loss of Important Farmland. Based on a review of future demand projections used in CalSim-II modeling and estimated deliveries under the No-Action Alternative, this impact would be potentially significant. Mitigation is not required for the No-Action Alternative.

Impact Ag-2 (No-Action): Direct and Indirect Conversion of Forest Land to Nonforest Uses in the Vicinity of Shasta Lake No new facilities would be constructed at Shasta Lake and no operational changes would occur that would result in the direct or indirect conversion of forest land to nonforest uses. No impact would occur.

Under the No-Action Alternative, Shasta Dam would not be enlarged; no infrastructure would be removed, modified, or relocated; and no changes in Reclamation's Shasta operations would occur. Changes to reservoir flow regime and reservoir storage caused by changes in demand and other factors would be small and generally the same as under existing conditions at most times. Therefore, the No-Action Alternative would not result in the direct or indirect conversion to nonforest uses of blue oak–foothill pine, blue oak, and closed-cone pine-cypress woodlands; Douglas-fir, montane hardwood, montane hardwood-conifer, montane riparian, Ponderosa pine, and valley-foothill riparian forests; or other forest land. No impact would occur. Mitigation is not required for the No-Action Alternative.

Upper Sacramento River (Shasta Dam to Red Bluff)

Impact Ag-3 (No-Action): Direct and Indirect Conversion of Important Farmland to Nonagricultural Uses and Cancellation of Williamson Act Contracts Along the Upper Sacramento River Under the No-Action Alternative, changes to the flow regime of the upper Sacramento River resulting from changes in demand and other factors would be small; mean monthly flows in the Sacramento River would be within 5 percent of flows under existing conditions at most times. Implementing the No-Action Alternative would not directly convert Important Farmland to nonagricultural uses or result in the cancellation of Williamson Act contracts in the upper Sacramento River region (Shasta Dam to Red Bluff). However, California's demand for water for irrigation and other uses is expected to continue to increase while the water supply will likely become less reliable. This trend could lead to increased pressure to convert Important Farmland to other nonagricultural uses and cancel Williamson Act contracts, resulting in an indirect impact. Therefore, this impact would be potentially significant.

Under the No-Action Alternative, changes to the flow regime of the upper Sacramento River resulting from changes in demand and other factors would be small; mean monthly flows in the Sacramento River would be within 5 percent of flows under existing conditions at most times. Therefore, implementing the No-Action Alternative would not directly convert agricultural land to nonagricultural uses or result in the cancellation of Williamson Act contacts.

California's demand for water for irrigation and other uses is expected to continue to increase in the future; at the same time, the water supply may become less reliable because of increasing environmental water requirements for special-status species, population growth that place further demands on existing water supply resources, decreasing water quality, and climate change. Therefore, the No-Action Alternative could have an indirect, adverse impact on agricultural land uses and Important Farmland in the primary study area. Insufficient water supply, especially during drought periods, could indirectly lead to increased pressure on farmers to convert Important Farmland to other nonagricultural uses or cause land designated as Important Farmland to be fallowed. Additionally, conversion of Important Farmland could involve canceling many Williamson Act contracts or allowing such contracts to expire.

The magnitude and extent of the agricultural land that could be converted from changes in water supply is unknown; however, any loss of Important Farmland would be significant because there are no measures to fully mitigate the loss of Important Farmland. Based on a review of future demand projections used in CalSim-II modeling and estimated deliveries under the No-Action Alternative, this impact would be potentially significant. Mitigation is not required for the No-Action Alternative.

Impact Ag-4 (No-Action): Direct and Indirect Conversion of Forest Land to Nonforest Uses Along the Upper Sacramento River No operational changes

would occur that would directly convert forest land to nonforest uses along the upper Sacramento River. However, water storage, conveyance, and deliveries would change because of several reasonably foreseeable actions that would occur with or without enlargement of Shasta Dam. The resulting changes in flow regime would likely result in minimal adverse effects on riparian forest and oak woodland habitats. Furthermore, management and restoration plans and programs would implement actions that would largely offset those adverse effects. Therefore, this impact would be less than significant.

Under the No-Action Alternative, no changes in Reclamation's Shasta operations would occur that would directly convert riparian and oak woodland habitats along the upper Sacramento River to nonforest uses. However, water storage, conveyance, and deliveries would change because of several reasonably foreseeable actions that would occur with or without enlargement of Shasta Dam. As a consequence of these actions, the flow regime of the upper Sacramento River would change between 2005 and 2030. As described in Chapter 12, "Botanical Resources and Wetlands," this change in flow regime would likely result in minimal adverse effects on forest land, which along the upper Sacramento River consist of riparian forest and oak woodlands, and these effects would not be sufficient to alter the extent of these forest lands.

As discussed in Chapter 12, "Botanical Resources and Wetlands," under the No-Action Alternative several management and restoration plans and programs would be implemented. These actions would cause beneficial effects likely to be of a magnitude similar to or greater than the anticipated adverse effects of small changes in flow regime; thus, implementation of the plans and programs would largely offset those adverse effects. Therefore, this impact would be less than significant. Mitigation is not required for the No-Action Alternative.

Lower Sacramento River and Delta and CVP/SWP Service Areas

Impact Ag-5 (No-Action): Direct and Indirect Conversion of Important Farmland to Nonagricultural Uses and Cancellation of Williamson Act Contracts in the Extended Study Area Under the No-Action Alternative, changes to the flow regime of the lower Sacramento River, Delta, and CVP and SWP service areas as a result of changes in demand and other factors would be small; mean monthly flows in the Sacramento River would be within 5 percent of flows under existing conditions at most times. Implementing the No-Action Alternative would not directly convert Important Farmland to nonagricultural uses or result in the cancellation of Williamson Act contracts along the lower Sacramento River, in the Delta, or in the CVP and SWP service areas. However, California's demand for water for irrigation and other uses is expected to continue to increase while the water supply will likely become less reliable. This trend could lead to increased pressure to convert Important Farmland to other nonagricultural uses and cancel Williamson Act contracts, resulting in an indirect impact. Therefore, this impact could be potentially significant.

This impact would be similar to Impact Ag-3 (No-Action) for the upper Sacramento River (Shasta Dam to Red Bluff). For the same reasons as described above for Impact Ag-3 (No-Action), this impact would be potentially significant. Mitigation is not required for the No-Action Alternative.

Impact Ag-6 (No-Action): Direct and Indirect Conversion of Forest Land to Nonforest Uses in the Extended Study Area No operational changes would occur under the No-Action Alternative that would directly convert forest land to nonforest uses along the upper Sacramento River. However, water storage, conveyance, and deliveries would change because of several reasonably foreseeable actions that would occur with or without enlargement of Shasta Dam. The resulting changes in flow regime would likely result in minimal adverse effects on forest land, which consists of riparian forest and oak woodlands along the lower Sacramento River and in the Delta. Management and restoration plans and programs would implement actions that would largely offset those adverse effects. Therefore, this impact would be less than significant.

This impact would be similar to Impact Ag-4 (No-Action) for the upper Sacramento River (Shasta Dam to Red Bluff). For the same reasons as described above for Impact Ag-4 (No-Action), this impact would be less than significant. Mitigation is not required for the No-Action Alternative.

CP1 – 6.5-Foot Dam Raise, Anadromous Fish Survival and Water Supply Reliability

By increasing storage at Shasta Lake, this alternative would change the full pool elevation and seasonal pool elevations at Shasta Lake, and the flow regime downstream in the Sacramento River and potentially several other reservoirs and downstream waterways. The full pool elevation of Shasta Lake would increase by 8.5 feet and would periodically inundate this elevation zone. Existing facilities would be relocated from this periodically inundated zone to higher areas.

Potential impacts of CP1 on the upper Sacramento River's flow and stages and on deliveries of water supplies to the CVP and SWP service areas would be small. On average, in each month, changes in mean monthly flow relative to existing (2005) and No-Action Alternative (2030) conditions would be reductions or increases of about 5 percent or less. Generally, the relative magnitude of effects on river flows diminishes with distance downstream because of the influence of inflows from tributaries and the effects of diversions and flood bypasses.

Shasta Lake and Vicinity

Impact Ag-1 (CP1): Direct and Indirect Conversion of Important Farmland to Nonagricultural Uses and Cancellation of Williamson Act Contracts in the Vicinity of Shasta Lake No lands adjacent to Shasta Lake or in the immediate

vicinity above Shasta Dam are designated by DOC as Important Farmland or under Williamson Act contracts. No impact would occur.

No lands adjacent to Shasta Lake or in the immediate vicinity above Shasta Dam are designated by DOC as Important Farmland or under Williamson Act contracts. Therefore, inundation of land and removal, modification, or relocation of infrastructure under CP1 would not directly or indirectly convert agricultural land to nonagricultural uses or result in the cancellation of Williamson Act contacts. No impact would occur. Mitigation for this impact is not needed, and thus not proposed.

Impact Ag-2 (CP1): Direct and Indirect Conversion of Forest Land to Nonforest Uses in the Vicinity of Shasta Lake Inundation of land and removal, modification, or relocation of infrastructure under CP1 would result in the conversion of forest land to nonforest uses. This impact would be significant.

A total of 1,051 acres of forest land would be affected by inundation under CP1 (Table 10-5). Also, approximately 107 acres of land in the relocation areas would be affected by removal, modification, or relocation of infrastructure under CP1 (acreages were calculated based on infrastructure relocation information presented in Chapter 2, "Alternatives"); and most of this acreage would involve conversion of forest land to nonforest uses. This impact would be significant. Mitigation for this impact is not proposed because no feasible mitigation is available to reduce the impact to a less than significant level.

Table 10-5. Acreage of Forest Land that Would Be Affected by Inundation Under CP1

Forest Land	Area (Acres)
Blue oak–foothill pine	10
Blue oak woodland	1
Closed-cone pine–cypress	247
Douglas-fir	<1
Montane hardwood	187
Montane hardwood–conifer	234
Montane riparian	26
Ponderosa pine	345
Total	1,051

Source: Data compiled by AECOM in 2011

Upper Sacramento River (Shasta Dam to Red Bluff)

Impact Ag-3 (CP1): Direct and Indirect Conversion of Important Farmland to Nonagricultural Uses and Cancellation of Williamson Act Contracts Along the Upper Sacramento River Within the upper Sacramento River portion of the primary study area, inundation of agricultural lands, including Important Farmland and Williamson Act contract lands, could result from increases in

mean monthly river flows. In general, the flow increases that would occur in some years would be expected to be small (5 percent or less) and would affect areas periodically inundated under existing and No-Action Alternative conditions. The effects of increased flow would diminish with distance downstream. CP1 also would increase the reliability of the water supply by increasing firm water supplies for irrigation purposes, primarily during drought periods. Therefore, implementing CP1 would not directly or indirectly result in the conversion of Important Farmland to nonagricultural uses or the cancellation of Williamson Act contracts. This impact would be less than significant.

Within the upper Sacramento River portion of the primary study area, inundation or soil saturation of agricultural lands, including Important Farmland and Williamson Act contract lands, could result from increases in mean monthly river flows associated with project implementation and operation. Based on CalSim-II model simulations, the increases in flow that would occur in some years under CP1 would be expected to be small (5 percent or less) relative to existing (2005) and No-Action Alternative (2030) conditions. These increased flows would affect small areas periodically inundated under existing conditions or under the No-Action Alternative. In addition, the effects would diminish with distance downstream because of the influence of inflows from tributaries and the effects of diversions and flood bypasses. As a result, implementing CP1 would not directly result in the conversion of Important Farmland to nonagricultural uses or the cancellation of Williamson Act contracts.

CP1 would increase the reliability of the water supply by increasing firm water supplies for irrigation purposes, primarily during drought periods. A substantial portion of this water would substitute for groundwater pumping, allow for changes in agricultural irrigation practices, or return idle cropland to production. Therefore, implementing CP1 would not indirectly result in the conversion of Important Farmland to nonagricultural uses or the cancellation of Williamson Act contracts.

For the reasons described above, this impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact Ag-4 (CP1): Direct and Indirect Conversion of Forest Land to Nonforest Uses Along the Upper Sacramento River Altered flow regimes associated with project implementation under CP1 could adversely affect forest land along the upper Sacramento River. The altered flow regime could affect oak woodland communities by prolonging inundation and changing the availability of soil moisture; however, these effects are speculative, and may not all prove to be adverse. Changes in the magnitude of intermediate and large flows would likely be sufficient to alter the dynamics and structure of forests in the riparian corridor along the upper Sacramento River in the future; however, changes in flow regime would not reduce the extent of riparian forest. Therefore, implementing CP1 would not result in the conversion of forest land to nonforest uses. This impact would be less than significant.

Forest land along the upper Sacramento River from Shasta Dam to Red Bluff consists of riparian forest and oak woodlands. These habitats could be affected by changes in flow and stage along the upper Sacramento River in some years. In most years, changes in mean monthly flow would be reductions or increases of 5 percent or less. The areas affected would be areas periodically inundated under existing and No-Action Alternative conditions. Generally, these effects diminish with distance downstream because of the influence of inflows from tributaries and of diversions and flood bypasses.

The altered flow regime of the upper Sacramento River associated with implementation of CP1 could affect oak woodland communities by prolonging inundation and changing the availability of soil moisture. This effect would occur during years when mean monthly stage during March–October differs from existing and No-Action Alternative conditions. Implementing CP1 could increase the average elevation of the water surface in this zone slightly (but would not increase the zone's elevational range). Because of the important influence of water availability and soil aeration on plant growth and survival, these changes have the potential to result in the loss of oak woodlands. These effects, however, are speculative, and may not all prove to be adverse.

The flow regime of a river or stream strongly influences the structure and species composition of riparian forests. CP1 would not alter the general annual pattern of flows, but it would reduce the magnitude, duration, and frequency of intermediate and large flows. Reductions in the magnitude of intermediate and large flows would likely be sufficient to alter the dynamics and structure of forests in the riparian corridor along the upper Sacramento River; however, changes in flow regime would not reduce the extent of riparian forest.

For the reasons described above, implementing CP1 would not result in the conversion of forest land to nonforest uses. Therefore, this impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Lower Sacramento River and Delta and CVP/SWP Service Areas
Impact Ag-5 (CP1): Direct and Indirect Conversion of Important Farmland to Nonagricultural Uses and Cancellation of Williamson Act Contracts in the Extended Study Area Within the extended study area, inundation or soil saturation of agricultural lands, including lands designated as Important Farmland and under Williamson Act contract, could result from increased mean monthly river flows. Increases in Sacramento River stage (elevation) would be small. These increased flows would affect areas periodically inundated or saturated under existing conditions or under the No-Action Alternative. The effects of this inundation would diminish with distance downstream. CP1 also would increase the reliability of the water supply by increasing firm water supplies for irrigation purposes, primarily during drought periods. Therefore, implementing CP1 would not directly or indirectly result in the conversion of Important Farmland to nonagricultural uses or the cancellation of Williamson Act contracts. This impact would be less than significant.

Within the extended study area, inundation or soil saturation of agricultural lands, including lands designated as Important Farmland and under Williamson Act contract, could be more extensive during some months because of increased mean monthly river flows associated with project implementation and operation. However, these increased flows would affect areas periodically inundated or saturated under existing conditions and/or the No-Action Alternative. In addition, the effects of inundation would diminish with distance downstream because of the influence of inflows from tributaries and the effect of diversions and flood bypasses. As a result, the direct conversion of agricultural land to nonagricultural uses or cancellation of Williamson Act contacts is unlikely to be substantial.

CP1 would increase the reliability of the water supply by increasing firm water supplies for irrigation purposes, primarily during drought periods. A substantial portion of this water would substitute for groundwater pumping, allow for changes in agricultural irrigation practices, or return idle cropland to production. Therefore, implementing CP1 would not indirectly result in the conversion of Important Farmland to nonagricultural uses or the cancellation of Williamson Act contracts.

For the reasons described above, this impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact Ag-6 (CP1): Direct and Indirect Conversion of Forest Land to Nonforest Uses in the Extended Study Area Altered flow regimes associated with project implementation under CP1 could adversely affect riparian forest and oak woodlands. The altered flow regime could affect oak woodlands by prolonging inundation and changing soil moisture in some years; however, these effects are speculative, and may not all prove to be adverse. Changes in the magnitude of intermediate and large flows would likely be sufficient to alter the dynamics and structure of the riparian forests along the upper Sacramento River in the future; however, changes in flow regime would not reduce the extent of riparian forest. Therefore, implementing CP1 would not result in the conversion of forest land to nonforest uses. This impact would be less than significant.

This impact would be similar to Impact Ag-4 (CP1) for the upper Sacramento River (Shasta Dam to Red Bluff). For the same reasons as described above for Impact Ag-4 (CP1), this impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

CP2 – 12.5-Foot Dam Raise, Anadromous Fish Survival and Water Supply Reliability

Like CP1, by increasing storage at Shasta Lake, CP2 would change the reservoir's full pool elevation and seasonal pool elevations, and the flow regime in the Sacramento River and potentially several other reservoirs and downstream waterways.

The full pool elevation of Shasta Lake would increase by 14.5 feet and the pool elevation would average as much as 12–17 feet higher than under existing (2005) and No-Action Alternative (2030) conditions at various times of the year. The greatest change would occur during the wettest years. Raising the dam 12.5 feet would increase the reservoir's surface area at full pool by about 1,750 acres (6 percent). In general, the effect of this increase would be slight, given that the reservoir would exceed the current full pool elevation only during wetter-than-normal years.

In general, the proposed changes in flow and river stage on the upper Sacramento River associated with CP2 are similar to but slightly greater than the changes associated with CP1, as outlined above.

Shasta Lake and Vicinity

Impact Ag-1 (CP2): Direct and Indirect Conversion of Important Farmland to Nonagricultural Uses and Cancellation of Williamson Act Contracts in the Vicinity of Shasta Lake No lands adjacent to Shasta Lake or in the immediate vicinity above Shasta Dam are designated by DOC as Important Farmland or under Williamson Act contracts. No impact would occur.

This impact would be the same as Impact Ag-1 (CP1). No impact would occur. Mitigation for this impact is not needed, and thus not proposed.

Impact Ag-2 (CP2): Direct and Indirect Conversion of Forest Land to Nonforest Uses in the Vicinity of Shasta Lake Inundation of land and removal, modification, or relocation of infrastructure under CP2 would result in the conversion of forest land to nonforest uses. This impact would be significant.

A total of 1,440 acres of forest land would be affected by inundation under CP2 (Table 10-6). Also, approximately 116 acres of land in the relocation areas would be affected by removal, modification, or relocation of infrastructure under CP2 (acreages were calculated based on infrastructure relocation information presented in Chapter 2, "Alternatives"); and most of this acreage would involve conversion of forest land to nonforest uses. This impact would be significant. Mitigation for this impact is not proposed because no feasible mitigation is available to reduce the impact to a less than significant level.

Table 10-6. Acreage of Forest Land that Would Be Affected by Inundation Under CP2

Forest Land	Area (Acres)
Blue oak–foothill pine	15
Blue oak woodland	2
Closed-cone pine–cypress	343
Douglas-fir	<1
Montane hardwood	260
Montane hardwood–conifer	332
Ponderosa pine	488
Total	1,440

Source: Data compiled by AECOM in 2011

Upper Sacramento River (Shasta Dam to Red Bluff)

Impact Ag-3 (CP2): Direct and Indirect Conversion of Important Farmland to Nonagricultural Uses and Cancellation of Williamson Act Contracts Along the Upper Sacramento River Within the upper Sacramento River portion of the primary study area, inundation of agricultural lands, including Important Farmland and Williamson Act contract lands, could result from increases in mean monthly river flows. In general, the flow increases that would occur in some years would be expected to be small and would affect areas periodically inundated under existing and No-Action Alternative conditions. The effects of increased flow would diminish with distance downstream. CP2 also would increase the reliability of the water supply by increasing firm water supplies for irrigation purposes, primarily during drought periods. Therefore, implementing CP2 would not directly or indirectly result in the conversion of Important Farmland to nonagricultural uses or the cancellation of Williamson Act contracts. This impact would be less than significant.

This impact would be similar to but slightly greater than Impact Ag-3 (CP1), because alteration of the flow regime of the Sacramento River would be slightly greater under CP2 than under CP1. This impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact Ag-4 (CP2): Direct and Indirect Conversion of Forest Land to Nonforest Uses Along the Upper Sacramento River Altered flow regimes associated with project implementation under CP2 could adversely affect forest land along the upper Sacramento River. The altered flow regime could affect oak woodland communities by prolonging inundation and changing the availability of soil moisture; however, these effects are speculative, and may not all prove to be adverse. Changes in the magnitude of intermediate and large flows would likely be sufficient to alter the dynamics and structure of forests in

the riparian corridor along the upper Sacramento River in the future; however, changes in flow regime would not reduce the extent of riparian forest. Therefore, implementing CP2 would not result in the conversion of forest land to nonforest uses. This impact would be less than significant.

This impact would be similar to but slightly greater than Impact Ag-4 (CP1), because alteration of the flow regime of the Sacramento River would be slightly greater under CP2 than under CP1. This impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Lower Sacramento River and Delta and CVP/SWP Service Areas

Impact Ag-5 (CP2): Direct and Indirect Conversion of Important Farmland to Nonagricultural Uses and Cancellation of Williamson Act Contracts in the Extended Study Area Within the extended study area, inundation or soil saturation of agricultural lands, including lands designated as Important Farmland and under Williamson Act contract, could result from increased mean monthly river flows. Increases in Sacramento River stage (elevation) would be small. These increased flows would affect areas periodically inundated or saturated under existing conditions or under the No-Action Alternative. The effects of this inundation would diminish with distance downstream. CP2 also would increase the reliability of the water supply by increasing firm water supplies for irrigation purposes, primarily during drought periods. Therefore, implementing CP2 would not directly or indirectly result in the conversion of Important Farmland to nonagricultural uses or the cancellation of Williamson Act contracts. This impact would be less than significant.

This impact would be similar to but slightly greater than Impact Ag-5 (CP1), because alteration of the flow regime of the Sacramento River would be slightly greater under CP2 than under CP1. This impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact Ag-6 (CP2): Direct and Indirect Conversion of Forest Land to Nonforest Uses in the Extended Study Area Altered flow regimes associated with project implementation under CP2 could adversely affect riparian forest and oak woodlands. The altered flow regime could affect oak woodlands by prolonging inundation and changing soil moisture in some years; however, these effects are speculative, and may not all prove to be adverse. Changes in the magnitude of intermediate and large flows would likely be sufficient to alter the dynamics and structure of the riparian forests along the upper Sacramento River in the future; however, changes in flow regime would not reduce the extent of riparian forest. Therefore, implementing CP2 would not result in the conversion of forest land to nonforest uses. This impact would be less than significant.

This impact would be similar to but slightly greater than Impact Ag-6 (CP1), because alteration of the flow regime of the Sacramento River would be slightly

greater under CP2 than under CP1. This impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

CP3 – 18.5-Foot Dam Raise, Anadromous Fish Survival and Water Supply

Like both of the alternatives discussed above, by increasing storage at Shasta Lake, CP3 would change the reservoir's full pool elevation and seasonal pool elevations and the flow regime in the Sacramento River and potentially several other reservoirs and downstream waterways.

The full pool elevation of Shasta Lake would increase by 20.5 feet and the pool elevation would average as much as 18-24 feet higher than under existing (2005) and No-Action (2030) conditions at various times of the year. The greatest change would occur during the wettest years. Raising the dam 18.5 feet would increase the reservoir's surface area at full pool by about 2,570 acres (9 percent). In general, the effect of this increase would be slight, given that the reservoir would exceed the current full pool elevation only during wetter-than-normal years.

In general, the changes in flow and river stage on the upper Sacramento River associated with CP3 would be more substantial than the changes associated with CP1 and CP2. However, these anticipated changes are still within a few percentage points of the changes associated with CP1 and CP2, as outlined above.

Shasta Lake and Vicinity

Impact Ag-1 (CP3): Direct and Indirect Conversion of Important Farmland to Nonagricultural Uses and Cancellation of Williamson Act Contracts in the Vicinity of Shasta Lake No lands adjacent to Shasta Lake or in the immediate vicinity above Shasta Dam are designated by DOC as Important Farmland or under Williamson Act contracts. No impact would occur.

This impact would be the same as Impact Ag-1 (CP1). No impact would occur. Mitigation for this impact is not needed, and thus not proposed.

Impact Ag-2 (CP3): Direct and Indirect Conversion of Forest Land to Nonforest Uses in the Vicinity of Shasta Lake Inundation of land and removal, modification, or relocation of infrastructure under CP3 would result in the conversion of forest land to nonforest uses. This impact would be significant.

A total of 2,068 acres of forest land would be affected by inundation under CP3 (Table 10-7). Also, approximately 133 acres of land in the relocation areas would be affected by removal, modification, or relocation of infrastructure under CP3 (acreages were calculated based on infrastructure relocation information presented in Chapter 2, "Alternatives"); and most of this acreage would involve conversion of forest land to nonforest uses. This impact would be significant. Mitigation for this impact is not proposed because no feasible mitigation is available to reduce the impact to a less than significant level.

Table 10-7. Acreage of Forest Land that Would Be Affected by Inundation Under CP3

Forest Land	Area (Acres)
Blue oak–foothill pine	16.59
Blue oak woodland	6.81
Closed-cone pine–cypress	484.62
Douglas-fir	0.36
Montane hardwood	371.24
Montane hardwood–conifer	485.20
Ponderosa pine	702.82
Total	2,067.64

Source: Data compiled by AECOM in 2011

Upper Sacramento River (Shasta Dam to Red Bluff)

Impact Ag-3 (CP3): Direct and Indirect Conversion of Important Farmland to Nonagricultural Uses and Cancellation of Williamson Act Contracts Along the Upper Sacramento River Within the upper Sacramento River portion of the primary study area, inundation of agricultural lands, including Important Farmland and Williamson Act contract lands, could result from increased mean monthly river flows. In general, the flow increases that would occur in some years would be expected to be small (5 percent or less) and would affect areas periodically inundated under existing and No-Action Alternative conditions. The effects of increased flow would diminish with distance downstream. CP3 also would increase the reliability of the water supply by increasing firm water supplies for irrigation purposes, primarily during drought periods. Therefore, implementing CP3 would not directly or indirectly result in the conversion of Important Farmland to nonagricultural uses or the cancellation of Williamson Act contracts. This impact would be less than significant.

This impact would be similar to Impact Ag-3 (CP1); however, the extent of the impact would be greater under CP3 than under CP1 and CP2 because it would entail greater alterations of flow regimes. This impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact Ag-4 (CP3): Direct and Indirect Conversion of Forest Land to Nonforest Uses Along the Upper Sacramento River Altered flow regimes associated with project implementation under CP3 could adversely affect forest land along the upper Sacramento River. The altered flow regime could affect oak woodland communities by prolonging inundation and changing the availability of soil moisture; however, these effects are speculative, and may not all prove to be adverse. Changes in the magnitude of intermediate and large flows would likely be sufficient to alter the dynamics and structure of forests in the riparian corridor along the upper Sacramento River in the future; however, changes in flow regime would not reduce the extent of riparian forest.

Therefore, implementing CP3 would not result in the conversion of forest land to nonforest uses. This impact would be less than significant.

This impact would be similar to Impact Ag-4 (CP1); however, the extent of the impact would be greater under CP3 than under CP1 and CP2 because it would entail greater alterations of flow regimes. This impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Lower Sacramento River and Delta and CVP/SWP Service Areas

Impact Ag-5 (CP3): Direct and Indirect Conversion of Important Farmland to Nonagricultural Uses and Cancellation of Williamson Act Contracts in the Extended Study Area Within the extended study area, inundation or soil saturation of agricultural lands, including lands designated as Important Farmland and under Williamson Act contract, could result from increased mean monthly river flows. Increases in Sacramento River stage (elevation) would be small. These increased flows would affect areas periodically inundated or saturated under existing conditions or under the No-Action Alternative. The effects of this inundation would diminish with distance downstream. CP3 also would increase the reliability of the water supply by increasing firm water supplies for irrigation purposes primarily during drought periods. Therefore, implementing CP3 would not directly or indirectly result in the conversion of Important Farmland to nonagricultural uses or the cancellation of Williamson Act contracts. This impact would be less than significant.

This impact would be similar to Impact Ag-5 (CP1); however, the extent of the impact would be greater under CP3 than under CP1 and CP2 because it would entail greater alterations of flow regimes. This impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact Ag-6 (CP3): Direct and Indirect Conversion of Forest Land to Nonforest Uses in the Extended Study Area Altered flow regimes associated with project implementation under CP3 could adversely affect riparian forest and oak woodlands. The altered flow regime could affect oak woodlands by prolonging inundation and changing soil moisture in some years; however, these effects are speculative, and may not all prove to be adverse. Changes in the magnitude of intermediate and large flows would likely be sufficient to alter the dynamics and structure of the riparian forests along the upper Sacramento River in the future; however, changes in flow regime would not reduce the extent of riparian forest. Therefore, implementing CP3 would not result in the conversion of forest land to nonforest uses. This impact would be less than significant.

This impact would be similar to Impact Ag-6 (CP1); however, the extent of the impact would be greater under CP3 than under CP1 and CP2 because it would entail greater alterations of flow regimes. This impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

CP4 – 18.5-Foot Dam Raise, Anadromous Fish Focus with Water Supply Reliability

Like each of the alternatives discussed above, by increasing storage at Shasta Lake, CP4 would change the reservoir's full pool elevation and seasonal pool elevations, and the flow regime in the Sacramento River and potentially several other reservoirs and downstream waterways.

As under CP3, the full pool elevation of Shasta Lake would increase by 20.5 feet and the pool elevation would average as much as 18–24 feet higher than under existing (2005) and No-Action Alternative (2030) conditions at various times of the year. The greatest change would occur during the wettest years. However, the dedicated Shasta Lake storage of 378 TAF is unique to CP4 and would result in a different drawdown scenario than under CP3. In general, Shasta Lake storage would be 100–140 TAF greater under CP4 than under CP3 at various times of the year, with the greatest difference occurring during October and November. This equates to an increase in pool elevation of about 3 to 5 feet throughout the year.

Raising the dam 18.5 feet would increase the reservoir's surface area at full pool by about 2,570 acres (9 percent). In general, the effect of this increase would be slight, given that the reservoir would exceed the current full pool elevation only during wetter-than-normal years.

The changes in flow and river stage on the upper Sacramento River associated with CP4 would be the same as the changes associated with CP1, as outlined above, in that the operated storage of 256 TAF would be the same for CP1 and CP4.

CP4 includes a gravel augmentation program to restore Sacramento River flow through Anderson Slough, with the primary purpose of recreating habitat for anadromous salmonid fish species.

Shasta Lake and Vicinity

Impact Ag-1 (CP4): Direct and Indirect Conversion of Important Farmland to Nonagricultural Uses and Cancellation of Williamson Act Contracts in the Vicinity of Shasta Lake No lands adjacent to Shasta Lake or in the immediate vicinity above Shasta Dam are designated by DOC as Important Farmland or under Williamson Act contracts. No impact would occur.

This impact would be the same as Impact Ag-1 (CP1). No impact would occur. Mitigation for this impact is not needed, and thus not proposed.

Impact Ag-2 (CP4): Direct and Indirect Conversion of Forest Land to Nonforest Uses in the Vicinity of Shasta Lake Inundation of land and removal, modification, or relocation of infrastructure under CP4 would result in the conversion of forest land to nonforest uses. This impact would be significant.

This impact would be the same as Impact Ag-2 (CP3) and would be significant. Mitigation for this impact is not proposed because no feasible mitigation is available to reduce the impact to a less than significant level.

Upper Sacramento River (Shasta Dam to Red Bluff)

Impact Ag-3 (CP4): Direct and Indirect Conversion of Important Farmland to Nonagricultural Uses and Cancellation of Williamson Act Contracts Along the Upper Sacramento River Within the upper Sacramento River portion of the primary study area, inundation of agricultural lands, including Important Farmland and Williamson Act contract lands, could result from increases in mean monthly river flows. In general, the flow increases that would occur in some years would be expected to be small (5 percent or less) and would affect areas periodically inundated under existing and No-Action Alternative conditions. The effects of increased flow would diminish with distance downstream. CP4 also would increase the reliability of the water supply by increasing firm water supplies for irrigation purposes, primarily during drought periods. In addition, there is no Important Farmland or Williamson Act contract land in the area proposed for gravel augmentation. Therefore, implementing CP4 would not directly or indirectly result in the conversion of Important Farmland to nonagricultural uses or the cancellation of Williamson Act contracts. This impact would be less than significant.

This impact would be similar to Impact Ag-3 (CP1). In addition, there is no Important Farmland or Williamson Act contract land in the area proposed for gravel augmentation. This impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact Ag-4 (CP4): Direct and Indirect Conversion of Forest Land to Nonforest Uses Along the Upper Sacramento River Altered flow regimes associated with project implementation under CP4 could adversely affect forest land along the upper Sacramento River. The altered flow regime could affect oak woodland communities by prolonging inundation and changing the availability of soil moisture; however, these effects are speculative, and may not all prove to be adverse. Changes in the magnitude of intermediate and large flows would likely be sufficient to alter the dynamics and structure of forests in the riparian corridor along the upper Sacramento River in the future; however, changes in flow regime would not reduce the extent of riparian forest. Therefore, implementing of CP4 would not result in the conversion of forest land to nonforest uses. This impact would be less than significant.

This impact would be similar to Impact Ag-4 (CP1) and would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Lower Sacramento River and Delta and CVP/SWP Service Areas

Impact Ag-5 (CP4): Direct and Indirect Conversion of Important Farmland and Cancellation of Williamson Act Contracts to Nonagricultural Uses in the Extended Study Area Within the extended study area, inundation or soil

saturation of agricultural lands, including lands designated as Important Farmland and under Williamson Act contract, could result from increased mean monthly river flows. Increases in Sacramento River stage (elevation) would be small. These increased flows would affect areas periodically inundated or saturated under existing conditions or under the No-Action Alternative. The effects of this inundation would diminish with distance downstream. CP4 also would increase the reliability of the water supply by increasing firm water supplies for irrigation purposes, primarily during drought periods. Therefore, implementing CP4 would not directly or indirectly result in the conversion of Important Farmland to nonagricultural uses or the cancellation of Williamson Act contracts. This impact would be less than significant.

This impact would be similar to Impact Ag-5 (CP1) and would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact Ag-6 (CP4): Direct and Indirect Conversion of Forest Land to Nonforest Uses in the Extended Study Area Altered flow regimes associated with project implementation under CP4 could adversely affect riparian forest and oak woodlands. The altered flow regime could affect oak woodlands by prolonging inundation and changing soil moisture in some years; however, these effects are speculative, and may not all prove to be adverse. Changes in the magnitude of intermediate and large flows would likely be sufficient to alter the dynamics and structure of the riparian forests along the upper Sacramento River in the future; however, changes in flow regime would not reduce the extent of riparian forest. Therefore, implementing CP4 would not result in the conversion of forest land to nonforest uses. This impact would be less than significant.

This impact would be similar to Impact Ag-6 (CP1) and would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

CP5 – 18.5-Foot Dam Raise, Combination Plan

Like each of the alternatives discussed above, by increasing storage at Shasta Lake, CP5 would increase the reservoir's full pool elevation and seasonal pool elevations and change the flow regime in the Sacramento River and potentially several other reservoirs and downstream waterways.

The full pool elevation of Shasta Lake would increase by 20.5 feet and the pool elevation would average as much as 18-24 feet higher than under existing (2005) and No-Action Alternative (2030) conditions at various times of the year. The greatest change would occur during the wettest years. Raising the dam 18.5 feet would increase the reservoir's surface area at full pool by about 2,570 acres (9 percent). In general, the effect of this increase would be slight, given that the reservoir would exceed the current full pool elevation only during wetter-than-normal years.

Changes in flow and river stage on the upper Sacramento River associated with CP5 would be the same as those associated with CP3, as outlined above.

CP5 includes a gravel augmentation program to restore Sacramento River flow through Anderson Slough, with the primary purpose of recreating habitat for anadromous salmonid fish species. Also under consideration under this alternative are rehabilitation of the boat ramp for motorized boat use and construction of a handicap fishing access area.

Shasta Lake and Vicinity

Impact Ag-1 (CP5): Direct and Indirect Conversion of Important Farmland to Nonagricultural Uses and Cancellation of Williamson Act Contracts in the Vicinity of Shasta Lake No lands adjacent to Shasta Lake or in the immediate vicinity above Shasta Dam are designated by DOC as Important Farmland or under Williamson Act contracts. No impact would occur.

This impact would be the same as Impact Ag-1 (CP1). No impact would occur. Mitigation for this impact is not needed, and thus not proposed.

Impact Ag-2 (CP5): Direct and Indirect Conversion of Forest Land to Nonforest Uses in the Vicinity of Shasta Lake Inundation of land and removal, modification, or relocation of infrastructure under CP5 would result in the conversion of forest land to nonforest uses. This impact would be significant.

This impact would be similar to Impact Ag-2 (CP3) and would be significant. Mitigation for this impact is not proposed because no feasible mitigation is available to reduce the impact to a less than significant level.

Upper Sacramento River (Shasta Dam to Red Bluff)

Impact Ag-3 (CP5): Direct and Indirect Conversion of Important Farmland to Nonagricultural Uses and Cancellation of Williamson Act Contracts Along the Upper Sacramento River Within the upper Sacramento River portion of the primary study area, inundation of agricultural lands, including Important Farmland and Williamson Act contract lands, could result from increased mean monthly river flows. In general, the increases in flow that would occur in some years would be expected to be small (5 percent or less) and would affect areas periodically inundated under existing and No-Action Alternative conditions. The effects of increased flow would diminish with distance downstream. CP5 also would increase the reliability of the water supply by increasing firm water supplies for irrigation purposes, primarily during drought periods. There is no Important Farmland or land under Williamson Act contract within the areas proposed for gravel augmentation and improvements to recreational facilities. Therefore, implementing CP5 would not directly or indirectly result in the conversion of Important Farmland to nonagricultural uses or the cancellation of Williamson Act contracts. This impact would be less than significant.

This impact would be similar to Impact Ag-3 (CP1). In addition, there is no Important Farmland or land under Williamson Act contract within the areas proposed for gravel augmentation and recreational facility improvements. This impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact Ag-4 (CP5): Direct and Indirect Conversion of Forest Land to Nonforest Uses Along the Upper Sacramento River Altered flow regimes associated with project implementation under CP5 could adversely affect forest land along the upper Sacramento River. The altered flow regime could affect oak woodland communities by prolonging inundation and changing the availability of soil moisture; however, these effects are speculative, and may not all prove to be adverse. Changes in the magnitude of intermediate and large flows would likely be sufficient to alter the dynamics and structure of forests in the riparian corridor along the upper Sacramento River in the future; however, changes in flow regime would not reduce the extent of riparian forest. Therefore, implementing CP5 would not result in the conversion of forest land to nonforest uses. This impact would be less than significant.

This impact would be similar to Impact Ag-4 (CP1) and would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Lower Sacramento River and Delta and CVP/SWP Service Areas

Impact Ag-5 (CP5): Direct and Indirect Conversion of Important Farmland to Nonagricultural Uses and Cancellation of Williamson Act Contracts in the Extended Study Area Within the extended study area, inundation or soil saturation of agricultural lands, including lands designated as Important Farmland and under Williamson Act contract, could result from increased mean monthly river flows. Increases in Sacramento River stage (elevation) would be small. These increased flows would affect areas periodically inundated or saturated under existing conditions or under the No-Action Alternative. The effects of this inundation would diminish with distance downstream. CP5 also would increase the reliability of the water supply by increasing firm water supplies for irrigation purposes primarily during drought periods. Therefore, implementing CP5 would not directly or indirectly result in the conversion of Important Farmland to nonagricultural uses or the cancellation of Williamson Act contracts. This impact would be less than significant.

This impact would be similar to Impact Ag-5 (CP1) and would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact Ag-6 (CP5): Direct and Indirect Conversion of Forest Land to Nonforest Uses in the Extended Study Area Altered flow regimes associated with project implementation under CP5 could adversely affect riparian forest and oak woodlands. The altered flow regime could affect oak woodlands by prolonging inundation and changing soil moisture in some years; however, these effects are speculative, and may not all prove to be adverse. Changes in

the magnitude of intermediate and large flows would likely be sufficient to alter the dynamics and structure of the riparian forests along the upper Sacramento River in the future; however, changes in flow regime would not reduce the extent of riparian forest. Therefore, implementing CP5 would not result in the conversion of forest land to nonforest uses. This impact would be less than significant.

This impact would be similar to Impact Ag-6 (CP1) and would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

10.3.5 Mitigation Measures

Table 10-8 presents a summary of mitigation measures for agricultural and forest resources.

Table 10-8. Summary of Mitigation Measures for Agriculture and Important Farmland

Impact		No-Action Alternative	CP1	CP2	CP3	CP4	CP5
Impact Ag-1: Direct and Indirect Conversion of Important Farmland to Nonagricultural Uses and Cancellation of Williamson Act Contracts in the Vicinity of Shasta Lake	LOS before Mitigation	PS	NI	NI	NI	NI	NI
	Mitigation Measure	None required.	None needed; thus, none proposed.				
	LOS after Mitigation	SU	NI	NI	NI	NI	NI
Impact Ag-2: Direct and Indirect Conversion of Forest Land to Nonforest Uses in the Vicinity of Shasta Lake	LOS before Mitigation	NI	S	S	S	S	S
	Mitigation Measure	None required.	No feasible mitigation is available to reduce impact.				
	LOS after Mitigation	NI	SU	SU	SU	SU	SU
Impact Ag-3: Direct and Indirect Conversions of Important Farmland to Nonagricultural Uses and Cancellation of Williamson Act Contracts Along the Upper Sacramento River	LOS before Mitigation	PS	LTS	LTS	LTS	LTS	LTS
	Mitigation Measure	None required.	None needed; thus, none proposed.				
	LOS after Mitigation	SU	LTS	LTS	LTS	LTS	LTS

Table 10-8. Summary of Mitigation Measures for Agriculture and Important Farmland (contd.)

Impact		No-Action Alternative	CP1	CP2	CP3	CP4	CP5
Impact Ag-4: Direct and Indirect Conversion of Forest Land to Nonforest Uses Along the Upper Sacramento River	LOS before Mitigation	LTS	LTS	LTS	LTS	LTS	LTS
	Mitigation Measure	None required.	None needed; thus, none proposed.				
	LOS after Mitigation	LTS	LTS	LTS	LTS	LTS	LTS
Impact Ag-5: Direct and Indirect Conversion of Important Farmland to Nonagricultural Uses and Cancellation of Williamson Act Contracts in the Extended Study Area	LOS before Mitigation	PS	LTS	LTS	LTS	LTS	LTS
	Mitigation Measure	None required.	None needed; thus, none proposed.				
	LOS after Mitigation	SU	LTS	LTS	LTS	LTS	LTS
Impact Ag-6: Direct and Indirect Conversion of Forest Land to Nonforest Uses in the Extended Study Area	LOS before Mitigation	LTS	LTS	LTS	LTS	LTS	LTS
	Mitigation Measure	None required.	None needed; thus, none proposed.				
	LOS after Mitigation	LTS	LTS	LTS	LTS	LTS	LTS

Notes:
LOS = level of significance
LTS = less than significant
NI = no impact
PS = potentially significant
S = significant
SU = significant and unavoidable

No-Action Alternative

Under the No-Action Alternative, no action would be taken, including implementation of mitigation measures; rather, existing conditions would continue to change into the future. No mitigation measures are required to reduce the indirect effects of agricultural land conversion in the study area under the No-Action Alternative. Thus, Impacts Ag-1 (No-Action), Ag-3 (No-Action), and Ag-5 (No-Action) would be significant and unavoidable.

CP1 – 6.5-Foot Dam Raise, Anadromous Fish Survival and Water Supply Reliability

No mitigation is needed for Impacts Ag-1 (CP1), Ag-3 (CP1), Ag-4 (CP1), Ag-5 (CP1), and Ag-6 (CP1). No feasible mitigation measures are available at the time of preparation of this PDEIS to reduce Impact Ag-2 (CP1) to a less than significant level (i.e., to mitigate conversion of forest land to nonforest uses in the vicinity of Shasta Lake). Therefore, Impact Ag-2 (CP1) would be significant and unavoidable.

CP2 – 12.5-Foot Dam Raise, Anadromous Fish Survival and Water Supply Reliability

No mitigation is needed for Impacts Ag-1 (CP2), Ag-3 (CP2), Ag-4 (CP2), Ag-5 (CP2), and Ag-6 (CP2). As discussed above for CP1, no feasible mitigation measures are available at the time of preparation of this PDEIS to reduce Impact Ag-2 (CP2) to a less than significant level (i.e., to mitigate conversion of forest land to nonforest uses in the vicinity of Shasta Lake). Therefore, Impact Ag-2 (CP2) would be significant and unavoidable.

CP3 – 18.5-Foot Dam Raise, Anadromous Fish Survival and Water Supply

No mitigation is needed for Impacts Ag-1 (CP3), Ag-3 (CP3), Ag-4 (CP3), Ag-5 (CP3), and Ag-6 (CP3). As discussed above for CP1, no feasible mitigation measures are available at the time of preparation of this PDEIS to reduce Impact Ag-2 (CP3) to a less than significant level (i.e., to mitigate conversion of forest land to nonforest uses in the vicinity of Shasta Lake). Therefore, Impact Ag-2 (CP3) would be significant and unavoidable.

CP4 – 18.5-Foot Dam Raise, Anadromous Fish Focus with Water Supply Reliability

No mitigation is needed for Impacts Ag-1 (CP4), Ag-3 (CP4), Ag-4 (CP4), Ag-5 (CP4), and Ag-6 (CP4). As discussed above for CP1, no feasible mitigation measures are available at the time of preparation of this PDEIS to reduce Impact Ag-2 (CP4) to a less than significant level (i.e., to mitigate conversion of forest land to nonforest uses in the vicinity of Shasta Lake). Therefore, Impact Ag-2 (CP4) would be significant and unavoidable.

CP5 – 18.5-Foot Dam Raise, Combination Plan

No mitigation is needed for Impacts Ag-1 (CP5), Ag-3 (CP5), Ag-4 (CP5), Ag-5 (CP5), and Ag-6 (CP5). As discussed above for CP1, no feasible mitigation measures are available at the time of preparation of this PDEIS to

reduce Impact Ag-2 (CP5) to a less than significant level (i.e., to mitigate conversion of forest land to nonforest uses in the vicinity of Shasta Lake). Therefore, Impact Ag-2 (CP5) would be significant and unavoidable.

10.3.6 Cumulative Effects

California's demand for water for irrigation and other uses is expected to continue to increase, while the water supply will likely become less reliable. This trend could lead to increased pressure to convert Important Farmland to other nonagricultural uses and cancel Williamson Act contracts, resulting in an indirect impact; this indirect impact would be potentially significant.

No operational changes would occur that would directly convert forest land to nonforest uses along the upper Sacramento River. However, CVP and SWP water storage, conveyance, and deliveries would change because of several reasonably foreseeable actions that would occur with or without enlargement of Shasta Dam. The resulting changes in flow regime would likely result in minimal adverse effects on riparian forest and oak woodlands. Several management and restoration plans and programs would implement actions that would largely offset those adverse effects. Although there would be reasonably foreseeable projects that would restore forest land or put land into agricultural production, there would be an overall significant cumulative effect on Important Farmlands and forest lands.

The effects of climate change on operations at Shasta Lake could potentially result in changes to conditions for agricultural land and forest land in downstream areas. As described in the Climate Change Projection Appendix, climate change could affect future demand for agricultural water by leading to increased rates of evapotranspiration and increasing the length of the growing season. On the other hand, increased precipitation could decrease overall water demand, depending on what adaptation strategies are used by agriculture and municipalities and how much more efficiently plants use water when carbon dioxide concentrations are higher. Changes in crop type, planting cycles, time of planting, and crop productivity may occur as the result of climate change, though consensus has not been reached on how changes will occur. As stated previously in this section, increases in California's demand for water and forecast reductions in water supply could lead to increased pressure to convert Important Farmland to other nonagricultural uses and cancel Williamson Act contracts.

In addition, changes to forest land and land cover could affect climate change. As stated in the Climate Change Projection Appendix, deforestation and land cover conversion have also been identified as contributing to global warming by reducing the Earth's capacity to remove carbon dioxide from the air and altering the Earth's albedo or surface reflectance, allowing more solar radiation to be absorbed.

In the primary study area, forest land would be affected by inundation of land and removal, modification, or relocation of infrastructure in the vicinity of Shasta Dam. Implementing any of the five project alternatives (CP1–CP5) would result in the conversion of forest land to nonforest uses in the vicinity of Shasta Dam. No feasible mitigation exists to create a similar large area of forest land to replace the area of forest land that would be inundated or converted to nonforest uses by relocation of facilities. Therefore, each of the five project alternatives would result in a cumulatively considerable incremental contribution to a cumulative impact related to conversion of forest land to nonforest uses. However, it is determined that there is not an overall significant cumulative impact related to conversion of forest land to nonforest uses because most of this area remains substantially in forest land and has not been converted to nonforest uses. Therefore, this impact would not be cumulatively significant.

In the extended study area, altered flow regimes associated with implementation of any of the five project alternatives could affect forest land. The altered flow regime could affect oak woodlands by prolonging inundation and changing the availability of soil moisture in some years; however, these effects are speculative, and may not all prove to be adverse. Changes in the magnitude of intermediate and large flows would likely be sufficient to alter the dynamics and structure of the riparian forest along the upper Sacramento River in the future; however, changes in flow regime would not reduce the extent of riparian forest. Therefore, implementing any of the five project alternatives would not result in the conversion of forest land to nonforest uses. Therefore, the five project alternatives would not result in a cumulatively considerable incremental contribution to a significant cumulative impact related to conversion of forest land to nonforest uses.

As stated previously climate change could result in changes to conditions for agricultural land and forest land in downstream areas. However, implementing any of the five project alternatives would promote improvements in the reliability of CVP water supply deliveries. Thus, the project alternatives would not result in a cumulatively considerable incremental contribution to a significant cumulative impact related to future demands for agricultural water.

The five project alternatives would result in a cumulatively considerable incremental contribution to a cumulative impact related to conversion of forest land to nonforest uses; however, there is not an overall significant cumulative impact related to conversion of forest land to nonforest uses because most of this area remains substantially in forest land and has not been converted to nonforest uses. Thus, when added to the anticipated effects of climate change, raising Shasta Dam would not have a significant cumulative effect on climate change resulting from changes to forest land and land cover.

Chapter 11
Fisheries and Aquatic Ecosystems

11.1 Affected Environment

This section describes the affected environment related to fisheries and aquatic ecosystems for the dam and reservoir modifications proposed under the SLWRI. For a more in-depth description of the affected environment, see the *Fisheries and Aquatic Ecosystems Technical Report*.

11.1.1 Aquatic Habitat

Shasta Lake and Vicinity

Water resources development, including the construction of dams and diversions, has affected the hydrology, geomorphology, and ecology of the watershed. Before the construction of Shasta Dam, the Sacramento River typically experienced large fluctuations in flow driven by winter storms, with late-summer flows averaging 3,000 cubic feet per second (cfs) or less. These fluctuations and periodic flows moved large amounts of sediment and gravel out of the mountainous tributaries and down the Sacramento River. The completion of Shasta Dam in 1945 resulted in general dampening of historic high and low flows, reducing the timing, magnitude, and duration of winter floods while maintaining higher summer flows between 7,000 and 13,000 cfs. The annual volume of flow in the Sacramento River continues to vary significantly from year to year. However, average monthly flows following the construction of Shasta Dam no longer exhibit pronounced seasonal winter highs and summer lows. This is primarily because of winter flood control operations that have reduced peak flood flows, and summer releases made for water supply purposes.

The current composition and distribution of fish species inhabiting the study area reflect habitat conditions, the historic fishery, the operational effects of Shasta Dam, effects of dams on several of the upstream tributaries, and the introduction of nonnative species.

The distribution and productivity of organisms and aquatic habitats of Shasta Lake are greatly affected by the reservoir's dynamic seasonal surface elevation fluctuations and thermal stratification. The reservoir's flood control, water storage, and water delivery operations typically result in declining water elevations during the summer through the fall months, rising or stable elevations during the winter months, and rising elevations during the spring months and

sometimes into the early-summer months, while storing precipitation and snowmelt runoff. During summer months, the relatively warm surface layer favors warm-water fishes such as bass and catfish. Deeper layers are cooler and are suitable for cold-water species. Shasta Lake is classified as a cool-water, mesotrophic, monomictic reservoir because it is moderately productive and has one period of mixing each year, although it never completely turns over (Bartholow et al. 2001). Shasta Lake tributary fish species comprise several native and nonnative species and have been managed to favor naturally produced ("wild") and stocked (hatchery-cultured) native and nonnative trout species (Rode 1989, Moyle 2002, Rode and Dean 2004). Major assemblages of non-fish aquatic animal species include benthic macroinvertebrates and zooplankton communities. Climate conditions and reservoir storage volume are the two most influential factors affecting cold-water habitat and primary productivity in Shasta Lake (Bartholow et al. 2001). Cold-water habitat provided by Shasta Lake is a function of the total storage and associated surface area provided by Shasta Lake. This relationship is influenced by variation in the water surface elevation (WSEL) throughout the year. Variation in WSEL is a function of water demand, water quality requirements, and inflow, and WSEL can change based on the water-year type. Typically, primary production in reservoirs is associated with storage volumes when all other factors are held constant (Stables et al. 1990). Increased storage and the corresponding increase in surface area results in a greater total biomass and a greater abundance of plankton and fish, because available habitat area is increased.

Upper Sacramento River (Shasta Dam to Red Bluff)

This river reach has cool water temperatures because of regulated releases from Shasta and Keswick Dams, and a stable, largely confined channel with little meander. Riffle habitat with gravel substrates and deep pool habitats are abundant in comparison with reaches downstream, although they are still insufficient to support healthy salmonid populations. Immediately below Keswick Dam, the river is deeply incised in bedrock with very limited riparian vegetation and limited functioning riparian ecosystems. Water temperatures are generally cool, even in late summer, because of regulated releases from Shasta and Keswick Dams. Near Redding, the river flows into the valley and the floodplain broadens. Historically, this area appears to have had wide expanses of riparian forests, but much of the river's riparian zone is currently subject to urban encroachment and noxious weed problems. This encroachment becomes quite extensive in the Anderson/Redding area, with homes placed directly within or adjacent to the riparian zone.

Despite net losses of gravel since construction of Shasta Dam, substrates in much of this reach contain gravel needed for spawning by salmonids, mostly derived from the Central Valley Project Improvement Act (CVPIA) gravel augmentation program. This reach provides much of the remaining spawning and rearing habitat of several listed anadromous salmonids, even though the amount of gravel available is insufficient. For this reason, it is one of the most sensitive and important stream reaches in the State.

Three water control structures, Keswick Dam, Anderson-Cottonwood Irrigation District, and Red Bluff Diversion Dam (RBDD), are located along the Sacramento River in this reach. Currently, revisions are being made at RBDD to improve fish passage. The main tributaries to the Sacramento River between Shasta Dam and Red Bluff are Battle, Bear, Clear, Cow, and Cottonwood creeks. The primary land uses along the Sacramento River between Shasta Dam and RBDD are urban, residential, and agricultural.

Lower Sacramento River and Delta

The roughly 300 miles of the Sacramento River can be subdivided into distinct reaches. The reaches in the lower Sacramento and Sacramento–San Joaquin River Delta (Delta) study area are discussed separately because of differences in morphology, water temperature, and aquatic habitat functions.

Sacramento River from Red Bluff Diversion Dam to Colusa In this reach, the Sacramento River functions as a large alluvial river with active meander migration through the valley floor. The river is classified as a meandering river, where relatively stable, straight sections alternate with more sinuous, dynamic sections (Resources Agency 2003). The active channel is fairly wide in some stretches and the river splits into multiple forks at many different locations, creating gravel islands, often with riparian vegetation. Historic bends in the river are visible throughout this reach and appear as scars of the historic channel locations with the riparian corridor and oxbow lakes still present in many locations. The channel remains active and has the potential to migrate in times of high water. Point bars, islands, high and low terraces, instream woody cover, early successional riparian plant growth, and other evidence of river meander and erosion are common in this reach. The channel has varying widths, and aquatic habitats consist of willow riffles, deep runs, deep pools at meander bends, glides, and willow vegetated floodplain areas that become inundated during high flows.

Sacramento River from Colusa to the Delta The general character of the Sacramento River changes drastically downstream from Colusa from a dynamic and active meandering channel to a confined, narrow channel restricted from migration. While setback levees exist along portions of the river upstream from Colusa, the levees become much narrower along the river edge as the river continues south to the Delta. Surrounding agricultural lands encroach directly adjacent to the levees, which have cut the river off from the majority of its riparian corridor, especially on the eastern side of the river. The majority of the levees in this reach are lined with riprap, allowing the river no erodible substrate. The channel width is fairly uniform and river bends are static as a result of confinement by levees. Therefore, aquatic habitats are fairly homogenous because depth profiles and substrate composition are fairly uniform throughout the reach. Multiple water diversion structures in this reach move floodwaters into floodplain bypass areas during high-flow events.

Tributaries to the Lower Sacramento River Lower reaches of primary tributaries are included because of the potential for project effects on flows and associated flow-related effects on fish species of management concern. However, potential changes in flows are diminished in these areas because of operation of upstream CVP and SWP reservoirs and increasing effects of inflows from tributaries and of diversions and flood bypasses.

Lower Feather River Aquatic habitats found in the lower Feather River vary as the river flows from releases at the DWR Oroville Dam facilities down to the confluence with the Sacramento River at Verona. At the upper extent, the approximate 8-mile low-flow (about 600 cfs) section contains mainly riffles and runs, which provide spawning habitat for the majority of Feather River Chinook salmon (*Oncorhynchus tshawytscha*) and steelhead (*O. mykiss*). Also present in the low-flow channel is a series of remnant gravel pit pools/ponds that connect to the main channel. This stretch is fairly confined by levees as it flows through the city of Oroville. From the downstream end of the low-flow channel, the Feather River is fairly active and meanders its way south to Marysville. However, this stretch is bordered by active farmland, which confines the river into an incised channel in certain stretches. Relatively large areas of adjacent farmlands are in the process of being restored to floodplain habitat with the relocation of levees to become setback levees.

Lower American River Flows in the lower American River (below Folsom and Nimbus dams) are generally cold and clear, providing habitat for anadromous and resident fish species. The river is fairly low gradient and is composed of riffle, run, glide, and pool habitats. Dams along the watershed have reduced gravel inputs to the system, but the lower American River contains large gravel bars and forks in many locations, leaving gravel/cobble islands within the channel. The majority of the lower American River is surrounded by the American River Parkway, preserving the surrounding riparian zone. The river channel does not migrate to a large degree because of the geologic composition that has allowed the river to incise deep into sediments, leaving tall cliffs and bluffs adjacent to the river.

Lower San Joaquin and Stanislaus Rivers The lower San Joaquin River is characterized by a relatively wide (approximately 300 feet) channel with little canopy or overhead vegetation and minimal bank cover. Aquatic habitat in the San Joaquin River is characterized primarily by slow-moving glides and pools, is depositional in nature, and has limited water clarity and habitat diversity. Many of the fish species using the lower San Joaquin River use this lower segment of the river to some degree, even if only as a migratory pathway to and from upstream spawning and rearing areas. The lower river also is used by certain fish species (e.g., delta smelt (*Hypomesus transpacificus*)) that make little to no use of areas in the upper segment of the river (see Delta discussion below). Aquatic habitats in the lower Stanislaus River vary longitudinally and provide fish spawning, rearing, and/or migratory habitat for a diverse assemblage of common Central Valley native and nonnative fish species.

Aquatic habitats include riffles, runs, pools, and glides. Floodplain and associated riparian habitat also varies with the development of levees and encroachment of agriculture and urban uses. Flows in both river systems are highly altered and are managed for flood control and water supply purposes.

Sacramento River Floodplain Bypasses There are three major floodplain bypasses – Butte Basin, Sutter Bypass, and Yolo Bypass – with a total of 10 overflow structures along the mainstem Sacramento River (six weirs, three flood relief structures, and an emergency overflow roadway) that provide access to broad, inundated floodplain habitat during wet years.

Unlike other Sacramento River and Delta habitats, floodplains and floodplain bypasses are seasonally dewatered (as high flows recede) during late spring through autumn. This prevents introduced fish species from establishing year-round dominance except in perennial water sources (Sommer et al. 2003). Moreover, many of the native fish are adapted to spawn and rear in winter and early spring (Moyle 2002) during the winter flood pulse. Introduced fish typically spawn during late spring through summer when the majority of the floodplain is not available to them.

Butte Basin The Butte Basin lies east of the Sacramento River and extends from the Butte Slough outfall gates near Meridian to Big Chico Creek near Chico Landing. Flood flows are diverted out of the Sacramento River into the Butte Basin and Sutter Bypass via several designated overflow areas (i.e., low points along the east side of the river) that allow high flood flows to exit the Sacramento River channel.

Sutter Bypass The Sutter Bypass is a narrow floodwater bypass conveying Sacramento River flood flows from the Butte Basin and the Tisdale Weir. The bypass area is an expansive land area in Sutter County used mainly for agriculture. In times of high water, Sacramento River water enters the bypass through the Butte Slough outfall and the Tisdale Weir (when the stage exceeds 45.45 feet) and inundates the bypass with as much as 12 feet of water. The Sutter Bypass, in turn, conveys flows to the lower Sacramento River region at the Fremont Weir near the confluence with the Feather River and into the Sacramento River and the Yolo Bypass (USACE and The Reclamation Board 2002).

Yolo Bypass The Yolo Bypass is an approximate 59,000-acre land area that conveys Sacramento River flood waters around Sacramento during times of high runoff. Flow is diverted from the Sacramento River into the bypass when the stage exceeds 33.5 feet (corresponding to 56,000 cfs at Verona). Diversion of the majority of Sacramento River, Sutter Bypass, and Feather River floodwaters to the Yolo Bypass from Fremont Weir controls Sacramento River flood stages at Verona. During large flood events, up to 80 percent of Sacramento River flows are diverted into the bypass.

Sacramento-San Joaquin Delta The Delta and Suisun Bay, on the western edge of the Delta, are located at the confluence of the Sacramento and San Joaquin rivers and may be considered to represent the most important, complex, and controversial geographic area for both anadromous and resident fisheries production and distribution of California water resources for numerous beneficial uses (Hanson 2009). The Delta's channels are used to transport water from upstream reservoirs to the south Delta, where Federal and State facilities (Jones Pumping Plant and Harvey O. Banks Delta Pumping Plant, respectively) pump water into CVP and SWP canals, respectively.

Environmental conditions in the Delta depend primarily on the physical structure of Delta channels, inflow volume and source, Delta Cross Channel (DCC) operations, Delta exports and diversions, and tides. The CVP affects Delta conditions primarily through control of upstream storage and diversions, Delta exports and diversions, and DCC operations. These factors also determine outflow and the location of the entrapment zone, which is an area of high organic carbon that is critically important to a number of fish and invertebrate species, as well as to the overall ecology of the Delta and Suisun Bay. In addition to these physical factors, environmental conditions such as water temperature, predation, food production and availability, competition with introduced exotic fish and invertebrate species, and pollutant concentrations all contribute to interactive, cumulative conditions that have substantial effects on Delta fish populations.

Water development has changed the volume and timing of freshwater flows through the San Francisco Bay/Sacramento–San Joaquin River Delta (Bay-Delta). Over the past several decades, the volume of the Bay-Delta's freshwater supply has been reduced by upstream diversions, in-Delta use, and Delta exports. As a result, the proportion of Delta outflow depleted by upstream and Delta diversions has grown substantially. In wet years, diversions reduce outflow by 10 to 30 percent. In dry years, diversions may reduce outflow by more than 50 percent.

Water development has also altered the seasonal timing of flows passing into and through the Bay-Delta. Flows have decreased in April, May, and June and have increased slightly during the summer and fall (SFEP 1992). Seasonal flows influence the transport of eggs and young organisms (e.g., zooplankton, fish eggs, larvae) through the Delta and into San Francisco Bay. Flows during April, May, and June play an especially important role in determining the reproductive success and survival of many estuarine species including salmon, striped bass, American shad, delta smelt, longfin smelt, splittail, and others (Stevens and Miller 1983, Stevens et al. 1985, Herbold 1994, Meng and Moyle 1995).

An estimated 25 percent of all warm-water and anadromous sport fishing and 80 percent of California's commercial fishery depend on species that live in or migrate through the Delta. The Delta serves as a migration path for all Central

Valley anadromous species returning to their natal rivers to spawn. Adult Chinook salmon move through the Delta during most months of the year. Salmon and steelhead juveniles depend on the Delta as transient rearing habitat during migration through the system to the ocean and could remain for several months, feeding in marshes, tidal flats, and sloughs. In addition, Delta outflow influences abundance and distribution of fish and invertebrates in the bay through changes to salinity, currents, nutrient levels, and pollutant concentrations. Delta smelt is a key species driving many of the ongoing water management decisions in the Delta.

Trinity River Sacramento River flow is augmented in average water years by transfer of up to 1 million acre-feet of Trinity River water through Clear Creek and Spring Creek tunnels to Keswick Reservoir (Reclamation 2004). Flows in the Trinity River (below Lewiston Dam) are generally cold, providing habitat for anadromous and resident fish species. Aquatic habitats in the river consist of riffle, run, glide, and pool habitats. Fish habitat values have increased in quantity and quality through restoration activities that have taken place over the last several years. Implementation of the Trinity River Restoration Program is expected to further increase the value of the habitat below Lewiston Dam over the next 10 to 15 years (NMFS 2000).

CVP/SWP Service Areas

The CVP/SWP service areas contain primarily highly altered aquatic habitat types, including reservoirs, canals, ditches, and other manmade water conveyance structures/facilities. Agricultural land and urban development are the dominate land uses within these service areas. As a result of all these factors, the aquatic communities that occupy the habitats are highly adapted to these disturbed environments and are dominated by nonnative species.

11.1.2 Fish Species

Special-status aquatic species within the primary and extended study areas are listed in Table 11-1. These include animals that are legally protected or are otherwise considered sensitive by Federal, State, or local resource conservation agencies and organizations, and fish species of primary management concern (recreationally and/or commercially important species). The *Fisheries and Aquatic Ecosystems Technical Report* describes life histories and environmental/habitat requirements of special-status species, and information on seasonal timing of important life stages. The following text describes the fishes in the primary and extended area that include special-status fish as well as other important species.

Table 11-1. Special-Status Aquatic Species Potentially Occurring in the Primary and Extended Study Areas

Species	Status[1]				Habitat	Potential to Occur in the Primary and Extended Study Areas
	USFWS/ NMFS	DFG	USFS	MSCS Goals		
Central Valley steelhead *Oncorhynchus mykiss*	T			R	Requires cold, freshwater streams with suitable gravel for spawning; rears in seasonally inundated floodplains, rivers, tributaries, and Delta.	Occurs in the primary and extended study areas in the Sacramento River, tributaries, and Sacramento-San Joaquin River Delta (Delta).
Sacramento winter-run Chinook salmon *Oncorhynchus tshawytscha*	E	E		R	Requires cold, freshwater streams with suitable gravel for spawning; rears in seasonally inundated floodplains, rivers, tributaries, and Delta.	Occurs in the primary and extended study areas in the Sacramento River, tributaries, and Delta.
Central Valley spring-run Chinook salmon *Oncorhynchus tshawytscha*	T	T		R	Requires cold, freshwater streams with suitable gravel for spawning; rears in seasonally inundated floodplains, rivers, tributaries, and Delta.	Occurs in the primary and extended study areas in the Sacramento River, tributaries, and Delta.
Central Valley fall/late fall-run Chinook salmon *Oncorhynchus tshawytscha*		SSC	S	R	Requires cold, freshwater streams with suitable gravel for spawning; rears in seasonally inundated floodplains, rivers, tributaries, and Delta.	Occurs in the primary and extended study areas in the Sacramento River, tributaries, and Delta.
Southern Oregon Northern California Coasts coho salmon *Oncorhynchus kisutch*	T	T			Requires cold, freshwater streams with suitable gravel for spawning; rears in inundated floodplains, edgewater, off-channel habitat, rivers, tributaries, and estuaries.	Occurs in the extended study area in the Trinity River.

Table 11-1. Special-Status Aquatic Species Potentially Occurring in the Primary and Extended Study Areas (contd.)

Species	Status[1]				Habitat	Potential to Occur in the Primary and Extended Study Areas
	USFWS/ NMFS	DFG	USFS	MSCS Goals		
Klamath Mountain Province steelhead *Oncorhynchus mykiss*			S		Requires cold, freshwater streams with suitable gravel for spawning; rears in seasonally inundated floodplains, rivers, tributaries, and Delta	Occurs in the extended study area in the Trinity River.
Southern DPS of the North American Green sturgeon *Acipenser medirostris*	T			R	Requires cold, freshwater streams with suitable gravel for spawning; rears in seasonally inundated floodplains, rivers, tributaries, and Delta.	Occurs in the primary and extended study areas in the Sacramento River, tributaries, and Delta.
Delta smelt *Hypomesus transpacificus*	T	E		R	Spawns in tidally influenced freshwater wetlands and seasonally submerged uplands; rears in seasonally inundated floodplains, tidal marsh, and Delta.	Occurs in the extended study area in the Delta.
Longfin smelt *Spirinchus thaleichthys*		T		R	Primary habitat is the open water of estuaries, both in seawater and freshwater areas, typically in the middle or deeper areas of the water column; spawn in estuaries in fresh or slightly brackish water over sandy or gravel substrates.	Occurs in the extended study area in the Delta.

Table 11-1. Special-Status Aquatic Species Potentially Occurring in the Primary and Extended Study Areas (contd.)

Species	Status[1]				Habitat	Potential to Occur in the Primary and Extended Study Areas
	USFWS/ NMFS	DFG	USFS	MSCS Goals		
Sacramento splittail *Pogonichthys macrolepidotus*	DT	SSC		R	Spawning and juvenile rearing from winter to early summer in willow weedy areas inundated during seasonal flooding in the lower reaches and flood bypasses of the Sacramento River, including the Yolo Bypass.	Occurs in the primary and extended study area in the Delta and Sacramento River and tributaries.
Hardhead *Mylopharodon conocephalus*		SSC	S	m	Spawning occurs in pools and side pools of rivers and creeks; juveniles rear in pools of rivers and creeks, and willow to deeper water of lakes and reservoirs.	Occurs in the primary and extended study areas in freshwater portions of Sacramento River and tributaries.
San Joaquin roach *Lavinia symmetricus* sp.		SSC			Spawning occurs in pools and side pools of small rivers and creeks; juveniles rear in pools of small rivers and creeks.	Occurs in the extended study area in the San Joaquin River and tributaries and Delta.
Rough sculpin (*Cottus asperrimus*)					Prefers sand or gravel substrate in cool streams or reservoirs. Spawns in streams.	Potentially occurs in the Shasta Lake and Vicinity portion of the primary study area in the Pit River and tributaries upstream from Shasta Lake.
Rainbow trout (*Oncorhynchus mykiss*)					Requires cold, freshwater streams with suitable gravel for spawning; rears in seasonally inundated floodplains, rivers, tributaries.	Occurs in Shasta Lake, Keswick Reservoir, and tributaries.

Table 11-1. Special-Status Aquatic Species Potentially Occurring in the Primary and Extended Study Areas (contd.)

Species	Status[1]				Habitat	Potential to Occur in the Primary and Extended Study Areas
	USFWS/ NMFS	DFG	USFS	MSCS Goals		
Redband trout (*Oncorhynchus mykiss stonei*)			S		Requires cold, freshwater streams with suitable gravel for spawning; rears in seasonally inundated floodplains, rivers, tributaries.	Occurs upstream from McCloud Dam.
Bull trout *Salvelinus confluentus*	T	E			Requires cold, freshwater streams with suitable gravel for spawning; rears in seasonally inundated floodplains, rivers, tributaries.	Previously found in the McCloud River. Now considered extirpated from California.
California floater *Anodonta californiensis*			S		Potentially occurring in willow areas of clean, clear ponds, lakes and rivers with silty substrate	Potentially occurs in Shasta Lake, Keswick Reservoir, and tributaries.
Nugget pebblesnail *Fluminicola seminalis*			M		Potentially occurring in mixed conifer and conifer/woodland habitats (seeps, springs, and/or riverine habitats)	Potentially occurs in the Shasta Lake and Vicinity portion of the primary study area in large creeks and rivers tributary to Shasta Lake.
Potem pebblesnail *Fluminicola* sp. 14			M		Potentially occurring in mixed conifer and conifer/woodland habitats (seeps, springs, and/or riverine habitats)	Potentially occurs in the Shasta Lake and Vicinity portion of the primary study area in tributaries to Shasta Lake.
Flat-top pebblesnail *Fluminicola* sp. 15			M		Potentially occurring in mixed conifer and conifer/woodland habitats (seeps, springs, and/or riverine habitats)	Potentially occurs in the Shasta Lake and Vicinity portion of the primary study area in tributaries to Shasta Lake.

Table 11-1. Special-Status Aquatic Species Potentially Occurring in the Primary and Extended Study Areas (contd.)

Species	Status[1]				Habitat	Potential to Occur in the Primary and Extended Study Areas
	USFWS/ NMFS	DFG	USFS	MSCS Goals		
Shasta pebblesnail *Fluminicola* sp. 16			M		Potentially occurring in mixed conifer and conifer/woodland habitats (seeps, springs, and/or riverine habitats)	Potentially occurs in the Shasta Lake and Vicinity portion of the primary study area in spring complexes associated with the Sacramento River upstream from Shasta Lake.
Disjunct pebblesnail *Fluminicola* sp. 17			M		Potentially occurring in mixed conifer and conifer/woodland habitats (seeps, springs, and/or riverine habitats)	Potentially occurs in the Shasta Lake and Vicinity portion of the primary study area in spring complexes associated with the Sacramento River upstream from Shasta Lake.
Globular pebblesnail *Fluminicola* sp. 18			M		Potentially occurring in mixed conifer and conifer/woodland habitats (seeps, springs, and/or riverine habitats)	Potentially occurs in the Shasta Lake and Vicinity portion of the primary study area in tributaries to Shasta Lake.
Cinnamon juga *Juga* (*Orebasis*) sp. 3			M		Potentially occurring in mixed conifer and conifer/woodland habitats (seeps, springs, and/or riverine habitats)	Potentially occurs in the Shasta Lake and Vicinity portion of the primary study area in spring complexes associated with the Sacramento River upstream from Shasta Lake.
Canary duskysnail *Lyogyrus* sp. 3			M		Potentially occurring in mixed conifer and conifer/woodland habitats (seeps, springs, and/or riverine habitats)	Potentially occurs in the Shasta Lake and Vicinity portion of the primary study area in spring complexes associated with the Pit River upstream from Shasta Lake.

Table 11-1. Special-Status Aquatic Species Potentially Occurring in the Primary and Extended Study Areas (contd.)

Species	Status[1]				Habitat	Potential to Occur in the Primary and Extended Study Areas
	USFWS/ NMFS	DFG	USFS	MSCS Goals		
Knobby rams-horn *Vorticefex* sp. 1			M		Potentially occurring in mixed conifer and conifer/woodland habitats (seeps, springs, and/or riverine habitats)	Potentially occurs in the Shasta Lake and Vicinity portion of the primary study area in spring complexes associated with the Pit River upstream from Shasta Lake.

Sources: Vogel and Marine 1991, Moyle 2002, Wang 1986, NMFS 2005

Notes:

[1] Legal Status Definitions

Federal Listing Categories (USFWS & NMFS)
- DT Recently delisted from threatened status
- E Endangered (legally protected)
- T Threatened (legally protected)

State Listing Categories (DFG)
- E Endangered (legally protected)
- SSC Species of Special Concern
- T Threatened (legally protected)

U.S. Forest Service (USFS)
- M Survey and Manage
- S Sensitive

Multi-Species Conservation Strategy Goals
- R Recovery. Recover species' populations within the MSCS focus area to levels that ensure the species' long-term survival in nature.
- m Maintain. Ensure that any adverse effects on the species that could be associated with implementation of CALFED actions will be fully offset through implementation of actions beneficial to the species (CALFED 2000).

Key:
Delta = Sacramento-San Joaquin Delta
DFG = California Department of Fish and Game
DPS = Distinct Population Segment
MSCS = CALFED Bay-Delta Program's Multi-Species Conservation Strategy
NMFS = National Marine Fisheries Service
USFS = U.S. Forest Service
USFWS = U.S. Fish and Wildlife Service

Shasta Lake and Vicinity

Shasta Lake fish species include native and nonnative species, which are dominated by mostly introduced warm-water and cold-water species (Weidlein 1971) (Table 11-2). Major assemblages of non-fish aquatic animal species include benthic macroinvertebrates and zooplankton communities.

Table 11-1 lists special-status aquatic species within the primary and extended study areas. These include animals that are legally protected or are otherwise considered sensitive by Federal, State, or local resource conservation agencies and organizations, and fish species of primary management concern (recreationally and/or commercially important species).

Table 11-2. Fish Species Known to Occur in the Primary Study Area

Common Name	Scientific Name	Distribution Within the Primary Study Area		
		Shasta Lake Tributaries	Shasta Lake/ Keswick Reservoir	Sacramento River – Keswick Dam to RBDD
Chinook salmon	*Oncorhynchus tshawytscha*		X	
winter-run				X
spring-run				X
fall-run				X
late fall-run				X
Rainbow trout	*Oncorhynchus mykiss*	X	X	X
Steelhead trout	*Oncorhynchus mykiss*			X
Brown trout	*Salmo trutta*	X	X	X
Green sturgeon	*Acipenser medirostris*			X
White sturgeon	*Acipenser transmontanus*	X	X	X
Pacific lamprey	*Lampetra tridentata*			X
Western brook lamprey	*Lampetra richardsoni*			X
Sacramento sucker	*Catostomus occidentalis*	X	X	X
Sacramento pikeminnow	*Ptychocheilus grandis*	X	X	X
Hardhead	*Mylopharodon conocephalus*	X	X	X
Sacramento blackfish	*Orthodon microlepidotus*	X	X	
California roach	*Hesperolecus symmetricus*	X		X
Speckled dace	*Rhinichthys osculus*	X	X	
Golden shiner	*Notemigonus crysoleucas*	X	X	
Carp	*Cyprinus carpio*	X	X	X
Channel catfish	*Ictalurus punctatus*	X	X	X
White catfish	*Ameiurus catus*		X	X
Brown bullhead	*Ameiurus nebulosus*		X	X
Black bullhead	*Ameiurus melas*		X	X
Riffle sculpin	*Cottus gulosus*	X	X	
Prickly sculpin	*Cottus asper*			X
Rough sculpin	*Cottus asperrimus*	X		
Pit sculpin	*Cottus pitensus*	X		
Bigeye marbled sculpin	*Cottus klamathensis macrops*	X		
Largemouth bass	*Micropterus salmoides*		X	
Smallmouth bass	*Micropterus dolomieui*	X	X	X
Spotted bass	*Micropterus punctulatus*	X	X	
Black crappie	*Pomoxis nigromaculatus*		X	
White crappie	*Pomoxis annulauris*		X	
Bluegill sunfish	*Lepomis macrochirus*		X	
Green sunfish	*Lepomis cyanellus*	X	X	
Threadfin shad	*Dorosoma petenense*		X	
Tule perch	*Hysterocarpus traski*	X	X	X
Tui chub	*Siphateles bicolor*	X	X	

Source: Moyle 2002; Reclamation 2004

Key:

DPS = Distinct Population Segment

Cold-Water Species Shasta Lake and its tributaries provide very productive habitats for cold-water fish species, which typically prefer or require temperatures cooler than 70 degrees Fahrenheit (°F). During the cooler months, cold-water species such as rainbow trout, brown trout, and landlocked Chinook salmon may be found rearing throughout the lake; however, these species do not

spawn in the lake, preferring to spawn in tributary streams, however, few Chinook salmon stocked in Shasta Lake have ever been observed to spawn in the reservoir tributaries (J. Zustak, USFWS, pers. comm., 2009). During the summer months, these cold-water species may be found rearing in association with the cold, deep hypolimnion and metalimnion layers within the reservoir, although the fish may make frequent forays into the epilimnion to feed on small prey fish and return to cooler depths to digest their prey (Finnell and Reed 1969, Koski and Johnson 2002, Moyle 2002, Quinn 2005).

Native species such as white sturgeon, hardhead, riffle sculpin, Sacramento sucker, and Sacramento pikeminnow tend to reside in cooler water strata in the reservoir and in and near tributary inflows (Moyle 2002). Trout may also congregate near the mouths of the reservoir's tributaries, including the upper Sacramento River, McCloud River, Pit River, and Squaw Creek, at various times of the year seeking thermal refuge, foraging, and spawning, when conditions are favorable for these species.

Hatchery- and pen-reared trout and salmon are stocked in Shasta Lake several times each year to support the sport fishery. About 60,000 pounds of juvenile rainbow trout and about 50,000 subcatchable Chinook salmon are planted annually (S. Baumgartner, DFG, pers. comm., 2008).

Climate conditions and reservoir storage volume are the two most influential factors affecting cold-water habitat and primary productivity in Shasta Lake (Bartholow et al. 2001). Cold-water habitat provided by Shasta Lake is a function of the total storage and associated surface area provided by Shasta Lake. This relationship is influenced by variation in the WSEL throughout the year. Variation in WSEL is a function of water demand, water quality requirements, and inflow, and WSEL can change based on the water-year type. Typically, primary production in reservoirs is associated with storage volumes when all other factors are held constant (Stables et al. 1990). Increased storage and the corresponding increase in surface area results in a greater total biomass and a greater abundance of plankton and fish, because available habitat area is increased.

Warm-Water Species The warm-water fish habitats of Shasta Lake occupy two ecological zones: the littoral (shoreline/rocky/vegetated) and the pelagic (open water) zones. The littoral zone lies along the reservoir shoreline down to the maximum depth of light penetration on the reservoir bottom, and supports populations of spotted bass, smallmouth bass, largemouth bass, black crappie, bluegill, channel catfish, and other warm-water species.

The upper, surface layer of the pelagic zone is the principal plankton-producing region of the reservoir. Plankton comprises the base of the food web for most of the reservoir's fish populations. Operation of the Shasta Dam temperature control device (TCD), which helps conserve the reservoir's cold-water pool by accessing warmer water for storage releases in the winter, spring, and early

summer, may reduce zooplankton biomass in the epilimnion. However, operations of the TCD may result in some increased plankton production at deeper levels as a result of a slight warming of the hypolimnetic layers within the reservoir during the fall months (Bartholow et al. 2001).

Warm-water species, such as largemouth bass, smallmouth bass, spotted bass, and other sunfishes, were introduced into Shasta Lake and have become well established with naturally sustaining populations. Spotted bass are currently the dominant warm-water species in Shasta Lake (S. Baumgartner, DFG, pers. comm., 2006). These warm-water fishes feed primarily on invertebrates while young and become predaceous on other fishes, including engaging in some cannibalism, as they grow. In Shasta Lake, threadfin shad, crayfish, and other invertebrates are most abundant in the diets of these fish (Saito et al. 2001). Spawning activity usually begins during late March or April when temperatures rise to around 60°F. Males generally build the nests in sand, fine gravel, rubble, or debris-covered bottoms at depths between 1 and 20 feet, which varies by species. Spotted bass and catfishes typically spawn at greater depths than the other warm-water species in Shasta Lake. Eggs generally hatch in 3 to 5 days at the predominant springtime water temperatures in Shasta Lake, and males guard the eggs and larvae for up to 4 weeks (Moyle 2002). Fry and juveniles disperse into willow water and prefer areas with vegetation and large rubble as protective cover from predators (Moyle 2002, Ratcliff 2006).

The primary factors affecting warm-water fish abundance and production in Shasta Lake include seasonal reservoir fluctuations, availability of high-quality littoral habitat, and annual climate variations (Ratcliff 2006). The effect of sport fishery harvests on Shasta Lake fish populations is not well understood, although it is generally thought that overfishing of naturally reproducing populations by sport fisheries seldom limits fish abundance (Moyle 2002).

Reservoir level fluctuations, associated shoreline erosion, and suppression of shoreline and emergent vegetation are thought to generally be the most significant factors affecting warm-water fish production in reservoirs, including Shasta Lake (Moyle 2002, Ratcliff 2006). Water level variations influence physical, chemical, and biological processes, which in turn affect fish populations. Reservoir drawdowns reduce water depths and influence thermal stratification and the resulting temperature, dissolved oxygen (DO), and water chemistry profiles.

The typical seasonality of reservoir fluctuations on Shasta Lake can affect year-to-year reproductive success of littoral-spawning fishes, especially the black bass species, by influencing nesting behavior (e.g., abandonment of nests) and dewatering of nests containing eggs in years when reservoir levels decline during the spring and early summer months. Under these same conditions, juveniles may be forced to move to areas with less protection from predation or lower food production. In years when the reservoir rises rapidly and/or extensively during the spring and early summer months, submergence of active

bass nests by more than 15 to 20 feet often results in high egg mortality (Stuber et al. 1982, Moyle 2002).

Shoreline and littoral vegetation are important warm-water fish habitat components for sustainable fishery production (Ratcliff 2006). Structural diversity (e.g., submerged trees, brush, rock, boulders, and rubble) provides shelter and feeding areas for fish. During construction of the reservoir, many trees and brush fields were cleared prior to inundation. Portions of the Pit River and Squaw Creek arms were not cleared, as evidenced by the large number of inundated trees observable in certain areas. Clearing efforts reduced the potential structural diversity of the inundated habitat. Vegetative clearing in many reservoirs has resulted in rocks, boulders, and man-made features (e.g., bridge pilings, riprap, marinas) being the only structural habitat features available, especially for bass and other warm-water fishes.

Annual reservoir fluctuations create highly variable conditions for establishment and maintenance of shoreline and littoral-zone vegetation and aquatic invertebrate communities that subsequently impose limitations on warm-water fish production. Exposed shoreline reservoir areas generally require 3 to 4 years to reestablish terrestrial vegetation. The absence of established, rooted aquatic vegetation is a common aquatic habitat factor that limits populations and fishery production for many fish species in reservoirs (Ploskey 1986, Moyle 2002).

The Shasta-Trinity National Forest (STNF), in cooperation with other Federal and State agencies and local nongovernmental organizations, has implemented a habitat improvement program at Shasta Lake. The objective of this program is to increase cover for warm-water fish. As the fishery management agency for Shasta Lake, DFG prepared a Draft Management Plan for Shasta Lake in 1991. This plan, which has not been finalized, acknowledges the benefit to warm-water fish of structural enhancement projects.

STNF, DFG, and nongovernmental organizations have used a variety of materials and techniques to construct structural enhancements (e,g., willow planting, brush structures) to provide warm-water fish habitat within the drawdown zone of Shasta Lake. The materials and techniques have varied because of differences in funding, available materials, site conditions (reservoir levels), longevity, and desired outcome.

According to STNF aquatic biologists, brush structures constructed from whiteleaf manzanita (*Arctostaphylos manzanita)* have been the STNF's preferred means of structural enhancement since about 1990. These structures have been constructed in areas where manzanita is available near the shoreline, typically in manner that provides varying degree of structural habitat as water levels change over time. The biologists have indicated that these structures have typically resulted in a threefold to tenfold increase in the abundance of warm-water fish in the treated areas (J. Zustak, USFWS, pers. comm., 2007).

Tributary Species The lower reaches of the tributaries draining to the reservoir provide spawning habitat for adfluvial fishes (i.e., fish that spawn in streams, but rear and grow to maturity in lakes) residing in Shasta Lake, as well as, stream-resident fishes, with rainbow trout the principal game species. Most native fish species found in Shasta Lake may also inhabit the lower reaches of the tributaries. Several tributaries to Shasta Lake (e.g., Squaw Creek[1], Little Backbone Creek) have been subjected to discharge from abandoned upslope copper mines. The Shasta Lake West Watershed analysis (Bachmann 2000) suggests that these creeks are "biologically dead" as a result of acid mine discharge from these mines. This watershed analysis also stated that "fish kills" have occurred in Shasta Lake in the vicinity of such tributaries during high runoff conditions.

The four main tributaries to Shasta Lake, which include the Sacramento River, McCloud River, Squaw Creek, and Pit River, are renowned for their high-quality recreational trout fisheries. Each of these streams drains considerable watershed areas comprising mixed conifer forests in the reaches above Shasta Lake. With the exception of the Pit River, which has a series of hydroelectric project dams that begin immediately upstream from Shasta Lake, each of these tributaries has more than 30 miles of high-quality, fish-bearing riverine habitat between the Shasta Lake and upstream dams on the Sacramento and McCloud rivers and steep headwater reaches on Squaw Creek.

For the most part, land use along the main Shasta Lake tributaries upstream from the reservoir is a mix of federal and privately managed forest and timberlands and except for sparse residential development, several small municipalities, and the hydropower projects on the Pit, McCloud, and Sacramento rivers much of the area is lightly developed. The Sacramento River above Shasta Lake is paralleled by a major interstate highway and railroad transportation corridor. In July 1991, a railroad accident spilled 19,000 gallons of the fumigant pesticide metam sodium into the Sacramento River near the town of Dunsmuir, approximately 35 stream miles upstream from Shasta Lake. Metam sodium is highly toxic and killed aquatic and riparian vegetation, aquatic macroinvertebrates, and fish and amphibians along the entire length of the river to Shasta Lake, where a massive chemical containment and neutralization effort was mounted. Ecological recovery efforts were implemented shortly after this spill incident and populations of fish, aquatic macroinvertebrates, and the vegetation adjacent to the stream have attained levels that appear to be in a natural dynamic equilibrium consistent with full recovery, although some amphibian and mollusk population remained depressed at least 15 years later (Cantara Trustee Council 2007).

There are about 2,903 miles of ephemeral, intermittent, and perennial stream channels that contribute to the main Shasta Lake tributaries within the study

[1] This refers to a stream draining the terrain and entering Shasta Lake northwest of Shasta Dam, a historic mining district; not to be confused with the Squaw Creek drainage forming the "Squaw Creek Arm" of the lake.

area. Most of these sub-tributaries are relatively short and steep and may be classified as confined, headwater channels that contribute water, sediment, and organic and inorganic material to Shasta Lake. Most (64 percent) of these stream channels are intermittent and have a slope greater than 10 percent. About 14 percent of the stream channels are perennial, with slopes of less than 7 percent. In the Pacific coast and Cascade ranges, stream channels with gradients up to about 4 percent to 7 percent and possessing sufficient flows typically exhibit a good potential to support habitation by fish and other aquatic organisms; although, steeper slopes do not necessarily, in and of themselves, preclude habitation by fish, particularly trout, sculpins, and dace (Naiman 1998; Reeves et al. 1998). About 79 percent of the tributaries with good fish-bearing potential in the study area occur within the Sacramento River, Squaw Creek, and Pit River arms (see Chapter 4, "Geology, Geomorphology, Minerals, and Soils," for more detail).

Most of the lower gradient, potentially fish-bearing reaches of tributary streams to Shasta Lake are near their confluence with the reservoir. The gradient of most of these tributaries rapidly increases upstream from the shoreline, and natural barriers to fish are common. These barriers are most often created by cascades, waterfalls, and steep reaches of stream channel (i.e., greater than 7-percent slope) that are more than one-quarter mile in length. Stream channel data generated from field inventories and analysis using Reclamation's geographic information system Digital Elevation Model indicate that most barriers on the perennial tributaries occur near the reservoir (see Chapter 4, "Geology, Geomorphology, Minerals, and Soils," for more detail).

Upper Sacramento River (Shasta Dam to Red Bluff)

Keswick Reservoir The USFWS conducts a propagation and captive broodstock program for endangered winter-run Chinook salmon at the Livingston Stone National Fish Hatchery located at the base of Shasta Dam on the Sacramento River upstream from Keswick Reservoir. The program consists of collecting adult winter-run Chinook salmon from the mainstem Sacramento River, holding and spawning the adults, rearing the juveniles in the hatchery environment and then releasing them back into the mainstem Sacramento River downstream from Keswick Dam. The overriding goal of the programs is to supplement the endangered population and provide an "insurance policy" against extinction. The propagation program (initiated in 1989), and the captive broodstock program (initiated in 1991) are recognized in both of NMFS's Draft Recovery Plans (1993, 2009) for this endangered species. Water is supplied to the hatchery from Shasta Dam.

Keswick Reservoir is operated by Reclamation as a reregulating facility. Levels in Keswick Reservoir are subject to operational changes at Whiskeytown and Shasta lakes. The reservoir provides habitat for a variety of aquatic organisms, including native and nonnative fish. Table 11-1 includes the fish species known to occur in Keswick Reservoir. In addition to water released from Shasta Dam and Whiskeytown Lake, this reservoir is the recipient of surface flows and

sediment from Spring Creek, as well as groundwater, emanating from the Iron Mountain Mine. Additional information on the relationship between Spring Creek and Keswick Reservoir is provided in Chapter 9, "Hazards and Hazardous Materials."

Keswick Dam to Red Bluff The upper Sacramento River (Keswick Dam to Red Bluff) provides vital fish spawning, rearing, and/or migratory habitat for a diverse assemblage of native and nonnative species. Native species present in this reach of the river can be separated into anadromous (i.e., species that spawn in freshwater after migrating as adults from marine habitat) and resident species. Native anadromous species include four runs of Chinook salmon, steelhead, green and white sturgeon (*Acipenser medirostris* and *A. transmontanus*), and Pacific lamprey (*Lampetra tridentata*). Native resident species include Sacramento pikeminnow (*Ptychocheilus grandis*), Sacramento splittail, Sacramento sucker (*Catostomus occidentalis*), hardhead (*Mylopharodon conocephalus*), California roach (*Lavinia symmetricus*), and rainbow trout (*O. mykiss*). Nonnative resident species include largemouth bass (*Micropterus salmoides*), smallmouth bass (*Micropterus dolomieu*), white and black crappie (*Pomoxis annularis* and *P. nigromaculatus*), channel catfish (*Ictalurus punctatus*), white catfish (*Ameiurus catus*), black bullhead (*Ameirus melas*), brown bullhead (*Ameirus nebulosus*), bluegill (*Lepomis* macrochirus), green sunfish (*Lepomois cyanellus*), and golden shiner (*Notemigonus crysaleucas*).

See Table 11-1 for a list of special-status species with the potential to occur in the upper Sacramento River.

Lower Sacramento River and Delta Like the primary study area, habitats in the extended study area also provides vital fish spawning, rearing, and/or migratory habitat for a diverse assemblage of native and nonnative species, many of which are the same as those found in the primary study area (see the *Fisheries and Aquatic Ecosystems Technical Report*), including Chinook salmon, steelhead and sturgeon.

Trinity River The Trinity River provides habitat for Southern Oregon/Northern California Coast coho salmon (*Oncorhynchus kisutch*), Southern Oregon/Northern California Coast Chinook salmon, Klamath Mountains Province steelhead, green sturgeon, white sturgeon, Pacific lamprey, resident rainbow trout, speckled dace, three-spine stickleback, Klamath small scale sucker (*Catostomus rimiculus*), prickly sculpin, and riffle sculpin (*Cottus gulosus*), brook trout (*Salvelinus fontinalis*), brown trout (*Salmo trutta*) American shad, brown bullhead, golden shiner, and green sunfish. Coho salmon and Klamath Mountains Province steelhead are included in this discussion because they are special-status species and CVP and SWP operations in response to changes at Shasta Dam have the potential to affect Trinity River flows.

See Table 11-1 for a list of special-status species with the potential to occur in the Trinity River.

CVP/SWP Service Areas

See Table 11-1 for a list of special-status species with the potential to occur in the CVP/SWP Service Areas.

11.1.3 Aquatic Macroinvertebrates

The constant flow of water in river systems provides an energetically convenient and economical way to disperse to new habitats; this movement downstream is known as drift. Some invertebrates passively enter the drift (e.g., benthic organisms may be entrained in the water column when a large current sweeps through), and others exhibit active drift behavior (individuals actively enter the water column by voluntary actions) (Waters 1965, 1972; Müller 1974; Wiley and Kohler 1984). Macroinvertebrates drift to colonize new habitats (for dispersal of various life stages or to find suitable resources), or leave unsuitable habitats (in response to habitat quality or predation pressure). Drift is one of the most important downstream dispersal mechanisms for macroinvertebrates. Macroinvertebrates drift more commonly in the evening, usually at dusk (Waters 1972, Müller 1974, Wiley and Kohler 1984, Smock 1996).

Drifting invertebrates are the primary source of prey for juvenile fish, including salmonids (Chapman and Bjornn 1969). Juvenile Chinook salmon will often seek refuge in slow-velocity habitats where they can rest and drifting invertebrates will tend to be deposited.

Shasta Lake and Vicinity

Aquatic macroinvertebrates provide an important food base for many fish and wildlife species. In general, published information on the taxonomy, distribution, and abundance of macroinvertebrates in the Sacramento River drainage is limited. A large-scale monitoring effort in 2001 coordinated by DWR from Keswick Dam to Verona on the Sacramento River found that benthic macroinvertebrate diversity and richness decreased as the river moved downstream. The constant flow of water in river systems provides an energetically convenient and economical way to disperse to new habitats; this movement downstream is known as drift. Drift is one of the most important downstream dispersal mechanisms for macroinvertebrates and drifting invertebrates are the primary source of prey for juvenile fish, including salmonids (Chapman and Bjornn 1969).

Invasive Species

New Zealand Mudsnail The New Zealand mudsnail (*Potamopyrgus antipodarum*), known to have been introduced to North America since about 1987 (Bowler 1991), was identified in Shasta Lake at the Bridge Bay Marina on September 10, 2007 (Benson and Kipp 2011). New Zealand mudsnail have also

been found lower in the Central Valley, including Sacramento River near Red Bluff, and the American, Mokelumne and Calaveras rivers (Benson and Kipp 2011). This invasive aquatic mollusk is known from a number of other locations within California and can reach densities of over 500,000 snails per square meter. Densities can fluctuate seasonally, with lowest densities coinciding with the freezing winter months (Proctor et al. 2007). New Zealand mudsnails are highly effective competitors and predators of many native North American benthic macroinvertebrates, including other mollusks, crustaceans, and important aquatic insects. Predators of the New Zealand mudsnail include rainbow trout, brown trout, sculpins, and mountain whitefish (Proctor et al. 2007). Unfortunately, snails are capable of passing through the digestive system of fish alive and intact (Bondesen and Kaiser 1949; Haynes et al.1985).

Possible pathways of introduction into Shasta Lake include contaminated recreational watercraft and trailers and recreational water users (Proctor et al. 2007). Other vectors known to spread the snails, such as contaminated livestock, commercial ships, and dredging/mining equipment, are less likely in the case of Shasta Lake's recent invasion given the lack of commercial activities on the lake. If the particular clone detected in Shasta Lake is tolerant of the local conditions, a rapid colonization of the lake and its tributaries could occur through a variety of vectors.

The potential involvement of recreational watercraft and trailers and recreational water users in the translocation of New Zealand mudsnails between State waters is of immediate concern. Enlargement of Shasta Lake could provide a larger perimeter of shoreline accessibility for the snail, but not necessarily increase preferred lake habitats. In lakes in North America, New Zealand mudsnails do not commonly occupy shoreline habitats. Highest densities of New Zealand mudsnails occur between 20-25 meters (m) in Lake Ontario (Proctor et al. 2007).

Quagga Mussel Quagga mussels (*Dressenia bugensis*), an invasive European aquatic mollusk introduced to North America in ship ballast water and first discovered in Lake Erie in 1989 (Spidle et al. 1994), have not been found in Shasta Lake, to date, but were discovered in California at Lake Havasu in 2007 (Cohen 2007). The DFG has begun monitoring at Lake Shasta for adult mussels and veligers (S. Baumgartner, DFG, pers. comm., 2008). Possible pathways of introduction into Shasta Lake include contaminated recreational watercraft and trailers and recreational water users. The potential involvement of recreational watercraft and trailers and recreational water users in the translocation of quagga mussels between State waters is of immediate concern. Enlargement of Shasta Lake could provide a greater area of deepwater and littoral habitat available for occupation by quagga mussels.

In a 2007 report produced for DFG, Cohen (2007) described the temperature, calcium, pH, DO, and salinity tolerances of quagga mussels in an effort to assess the vulnerability of various California waters to invasion by quagga

mussels and zebra mussels. Cohen identified calcium thresholds as the most important environmental factor influencing distribution of zebra mussels in North America and applied similar thresholds for quagga mussels. In an investigation of the upper Sacramento River region, including Whiskeytown Reservoir and the watersheds above Shasta Dam, Cohen found that the McCloud River above Shasta Reservoir and the Pit River near Canby have the proper range of salinity, DO, temperature and calcium (at less than or equal to 12 milligrams per liter to be of low and moderate suitability to invasion by quagga mussels.

Upper Sacramento River (Shasta Dam to Red Bluff)

A large-scale monitoring effort in 2001 coordinated by DWR from Keswick Dam to Verona on the Sacramento River found that benthic macroinvertebrate diversity and richness decreased as the river moved downstream. Oligochaetes, chironomids, and mollusks became more prominent in this reach than in the reach from Keswick Dam to Red Bluff (Sacramento River Watershed Program 2002). More recently, the diurnal feeding habits of juvenile Chinook salmon in the upper Sacramento River (River Mile 193 to River Mile 275) were examined in relation to drifting invertebrates by Petrusso and Hayes (2001). Chironomids and baetids dominated both the drift and stomach contents. Diets of 153 juvenile salmonids were examined; more than 63 percent of the diet was made up of chironomids of all life stages. Baetids comprised 14 percent of the total diet. It was concluded that based on measurements of mean stomach fullness and availability of drifting organisms, there was reasonable feeding opportunity during the sampling period in spring 1996. Mean drift densities ranged from 211 to 2,100 organisms per 100 cubic meters, with an overall mean of 617 organisms per 100 cubic meter (Petrusso and Hayes 2001). Daily mean drift density appeared to show no spatial patterns across the several sites sampled.

Lower Sacramento River and Delta

Aquatic macroinvertebrates provide an important food base for many fish and wildlife species. In general, published information on the taxonomy, distribution, and abundance of macroinvertebrates in the Sacramento River drainage is limited. Current macroinvertebrate monitoring efforts on the Sacramento River have focused on large-basin scale patterns, and survey sites on the mainstem have been at various locations along the study reach. Under the Sacramento River Watershed program, DFG collected snag samples at two sites, one site near Colusa and one site near Hamilton City. Dominant taxa found in fall 1999 at the Hamilton City site include Orthocladiinae, Naididae, Ephemeroptera (*Baetis* and *Acentrella* sp.) and Trichoptera (*Hydropsyche* sp.) (Sacramento River Watershed Program 2002). Schaffter et al. (1983) found no significant difference in abundance of drifting invertebrates near riprapped and natural habitats on the Sacramento River. More than 50 percent of the drift was composed of chironomids, baetids, and aphids. Analysis of fish diets found the same three families in 72 percent of the guts sampled.

A large-scale monitoring effort in 2001 coordinated by DWR from Keswick Dam to Verona on the Sacramento River found that benthic macroinvertebrate diversity and richness decreased as the river moved downstream. Oligochaetes, chironomids, and mollusks became more prominent in this reach than in the reach from Keswick Dam to Red Bluff (Sacramento River Watershed Program 2002). More recently, the diurnal feeding habits of juvenile Chinook salmon in the upper Sacramento River (River Mile 193 to River Mile 275) were examined in relation to drifting invertebrates by Petrusso and Hayes (2001). Chironomids and baetids dominated both the drift and stomach contents. Diets of 153 juvenile salmonids were examined; more than 63 percent of the diet was made up of chironomids of all life stages. Baetids comprised 14 percent of the total diet. It was concluded that based on measurements of mean stomach fullness and availability of drifting organisms, there was reasonable feeding opportunity during the sampling period in spring 1996. Mean drift densities ranged from 211 to 2,100 organisms per 100 cubic meters, with an overall mean of 617 organisms per 100 cubic meter (Petrusso and Hayes 2001). Daily mean drift density appeared to show no spatial patterns across the several sites sampled.

11.2 Regulatory Framework

Several Federal, State, and local agencies have regulatory authority or responsibility over activities that affect aquatic and fisheries resources. These regulatory authorities are described in the following sections.

11.2.1 Federal

Federal Endangered Species Act

Pursuant to the Federal Endangered Species Act (ESA), USFWS and NMFS have authority over projects that may result in take of a Federally listed species. Under the ESA, the definition of "take" is to "harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct." Under Federal regulation, "take" is further defined to include habitat modification or degradation where it would be expected to result in death or injury to listed wildlife by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering. If the project may affect a Federally listed species, either an incidental take permit, under Section 10(a) of the ESA, or a Federal interagency consultation, under Section 7 of the ESA, is required. USFWS has regulatory jurisdiction over freshwater and estuarine fishes (such as delta smelt), while NMFS has jurisdiction over anadromous and marine species (such as Chinook salmon, steelhead, and green sturgeon).

NMFS Recovery Plan

Under Section 4(f) of the ESA, both NMFS and USFWS are required to publish a recovery plan for each species it lists as threatened or endangered. These plans must have objective and measureable criteria that would help the species

be removed from the ESA list, a description of site-specific management actions necessary for the species recovery, and estimates of time and cost to carry out the recommended recovery measures.

In 2009, NMFS published the *Public Draft Recovery Plan for Evolutionarily Significant Units of Sacramento River Winter-Run Chinook Salmon and Central Valley Spring-Run Chinook Salmon and Distinct Population Segments of Central Valley Steelhead* (NMFS 2009). In this recovery plan, NMFS states that the recovery of winter-run Chinook salmon is affected by the Shasta cold-water pool:

> *Although the status of the Sacramento River winter-run Chinook salmon population numbers has shown improvement over the last six years, there is still only one naturally-spawned component of the ESU, and this single population depends on coldwater releases from Shasta Dam on the Sacramento River. Lindley et al. (2007) considers the Sacramento River winter-run Chinook salmon population at a moderate risk of extinction primarily due to the risks associated with only one existing population. The viability of an ESU that is represented by a single population is vulnerable to changes in the environment through a lack of spatial geographic diversity and genetic diversity that result from having only one population. A single catastrophe with effects persisting for four or more years could extirpate the entire Sacramento River winter-run Chinook salmon ESU (Lindley et al. 2007). Such potential catastrophes include volcanic eruption of Mt. Lassen, prolonged drought which depletes the coldwater pool in Shasta Reservoir or some related failure to manage coldwater storage, a spill of toxic materials with effects that persist for four or more years, or a disease outbreak. Moreover, an ESU that is represented by a single population is vulnerable to the limitation in life history and genetic diversity that would otherwise increase the ability of individuals in the population to withstand environmental variation.*

While the action plans surrounding this issue of cold-water pool are focused primarily on reintroduction into the upper watershed (upstream from Shasta Dam), these actions may not be achievable. Improving the cold-water pool could negate any impacts to the species recovery if the reintroduction process is not successful. Additionally, NMFS includes management actions to improve gravel augmentation programs in the upper Sacramento River.

Sustainable Fisheries Act (Essential Fish Habitat)

In response to growing concern about the status of United States fisheries, Congress passed the Sustainable Fisheries Act of 1996 (Public Law 104-297) to amend the Magnuson-Stevens Fishery Conservation and Management Act

(Public Law 94-265), the primary law governing marine fisheries management in the Federal waters of the United States. Under the Sustainable Fisheries Act, consultation is required by NMFS on any activity that might adversely affect essential fish habitat. Essential fish habitat includes those habitats that fish rely on throughout their life cycles. It encompasses habitats necessary to allow sufficient production of commercially valuable aquatic species to support a long-term sustainable fishery and contribute to a healthy ecosystem.

Fish and Wildlife Coordination Act

The Fish and Wildlife Coordination Act requires Federal agencies to consult with USFWS, NMFS, and State fish and wildlife resource agencies before undertaking or approving projects that control or modify surface water. The recommendations made by these agencies must be fully considered in project plans by Federal agencies.

Clean Water Act, Section 404

Section 404 of the Clean Water Act (CWA) requires project proponents to obtain a permit from the USACE before performing any activity that involves any discharge of dredged or fill material into "waters of the United States," including wetlands. Waters of the United States include navigable waters of the United States, interstate waters, all other waters where the use or degradation or destruction of the waters could affect interstate or foreign commerce, tributaries to any of these waters, and wetlands that meet any of these criteria or that are adjacent to any of these waters or their tributaries. Many surface waters and wetlands in California meet the criteria for waters of the United States.

Clean Water Act, Section 402

CWA Section 402 regulates construction-related stormwater discharges to surface waters through the National Pollutant Discharge Elimination System program, which is administered by the U.S. Environmental Protection Agency. In California, the State Water Resources Control Board (SWRCB) is authorized by the U.S. Environmental Protection Agency to oversee the National Pollutant Discharge Elimination System program through the regional water quality control boards (RWQCB), in this case, the Central Valley RWQCB.

Clean Water Act, Section 401

CWA Section 401(a)(1) specifies that any applicant for a Federal license or permit to conduct any activity that may result in any discharge into navigable waters will provide the Federal licensing or permitting agency with a certification that any such discharge will not violate State water quality standards. The RWQCBs administer the Section 401 program with the intent of prescribing measures for projects that are necessary to avoid, minimize, and mitigate adverse impacts on water quality and ecosystems.

Central Valley Project Improvement Act

Reclamation's evolving mission was written into law on October 30, 1992, with the passage by Congress and signing by President George H.W. Bush, of Public

Law 102-575, the Reclamation Projects Authorization and Adjustment Act of 1992. Included in the law was Title 34, the CVPIA. The CVPIA amended previous authorizations of the CVP to include fish and wildlife protection, restoration, and mitigation as project purposes having equal priority with irrigation and domestic water supply uses, and fish and wildlife enhancement having equal priority with power generation. The following are among the changes mandated by the CVPIA:

- Dedicating 800,000 acre-feet annually to fish, wildlife, and habitat restoration
- Authorizing water transfers outside the CVP service area
- Implementing the Anadromous Fish Restoration Program (AFRP)
- Creating a restoration fund financed by water and power users
- Providing for the Shasta temperature control device
- Implementing fish passage measures at RBDD
- Planning to increase the CVP yield
- Mandating firm water supplies for Central Valley wildlife refuges
- Meeting the Federal trust responsibility to protect fishery resources on the Trinity River

The CVPIA is being implemented on a broad front. The Final Programmatic Environmental Impact Statement for the CVPIA analyzes projected conditions in 2022, 30 years from the CVPIA's adoption in 1992. The Final Programmatic Environmental Impact Statement was released in October 1999, and the CVPIA Record of Decision (ROD) was signed on January 9, 2001.

Operations of the CVP reflect provisions of the CVPIA, particularly Sections 3406(b)(1), (b)(2), and (b)(3). The U.S. Department of the Interior's Decision on Implementation of Section 3406(b)(2) of the CVPIA, October 5, 1999, provides the basis for implementing upstream and Delta actions with CVP delivery capability. The AFRP assumes that Sacramento River water will be acquired under Section 3406(b)(2).

Ecosystem Restoration Program Plan of the CALFED Bay-Delta Program

The mission of the CALFED Bay-Delta Program (CALFED) is to develop a long-term comprehensive plan that will restore ecosystem health and improve water management for beneficial uses of the Bay-Delta system. The program addresses problems in four resource areas: ecosystem quality, water quality, system integrity, and water supply reliability. Programs to address problems in the four resource areas will be designed and integrated to fulfill the CALFED mission.

The goal for ecosystem quality is to improve and increase aquatic and terrestrial habitats and improve ecological functions in the Bay-Delta to support sustainable populations of diverse and valuable plant and animal species. The CALFED Ecosystem Restoration Program Plan (ERPP) addresses this goal. The foundation of the ERPP is restoration of ecological processes that are associated with streamflow, stream channels, watersheds, and floodplains. These processes create and maintain habitats essential to the life history of species dependent on the Delta. In addition, the ERPP aims to reduce the effects of stressors that inhibit ecological processes, habitats, and species.

Key restoration actions for Sacramento River fisheries being proposed by this ERPP include the following:

- Enhancing river flows
- Restoring the natural river meander process
- Enhancing riparian and riverine habitats
- Maintaining suitable river temperatures for salmonids
- Reducing fish losses at points of water diversion
- Improving anadromous fish passage at existing barriers
- Maintaining and improving water quality
- Improving hatchery and stocking programs
- Improving management of inland harvest of salmonids

Such restoration actions, when implemented over the next few decades, are expected to increase Sacramento River fish populations, including salmonid populations, over existing conditions. The ERPP establishes similar restoration goals for other major water courses throughout the Central Valley.

Operating Agreements and Constraints

Coordinated Operations Agreement With the goal of using coordinated management of surplus flows in the Delta to improve Delta export and conveyance capability, the Coordinated Operations Agreement (COA) received Congressional approval in 1986 and became Public Law 99-546. The COA, as modified by interim agreements, coordinates operations between the CVP and SWP and provides for the equitable sharing of surplus water supply. The COA requires that the CVP and SWP operate in conjunction to meet State objectives for water quality in the Bay-Delta estuary, except as specified. Under this agreement the CVP and SWP can each contract for the purchase of surplus water supplies from the other, potentially increasing the efficiency of water operations.

The COA specifies two basic conditions for operational purposes: balanced conditions and excess conditions. Balanced water conditions occur when releases from upstream reservoirs plus unregulated flow equal the water supply needed to meet Sacramento Valley in-basin uses plus exports. During balanced water conditions, storage releases required to meet the Sacramento in-basin uses are made 75 percent from the CVP and 25 percent from the SWP. If unstored water is available during balanced conditions, this water is allocated 55 percent to the CVP and 45 percent to the SWP. Excess water conditions occur when Delta inflows (combined releases from upstream reservoirs and unregulated flow) are greater than needed to meet in-basin uses plus export. Under this condition, flow through the Delta is adequate to meet all needs and no coordinated operation between the CVP and SWP is required.

Since 1986, the COA principles have been modified to reflect changes in regulatory standards, facilities, and operating conditions. At its inception, the COA water quality standards were those of the 1978 Water Quality Control Plan; these were subsequently modified in the 1991 Water Quality Control Plan. The adoption of the 1995 Bay-Delta Plan by the SWRCB superseded those requirements. The Environmental Water Account was established by CALFED in 2000 to protect the fish of the Bay-Delta estuary via changes in the operations of the CVP and SWP, without incurring uncompensated cost to the projects' water users. Evolution of the CWA over time has also impacted the implementation of the COA.

Biological Opinions Biological Opinions (BO) are prepared through formal consultation of Section 7 of the ESA (described above) by either NMFS or USFWS in response to a Federal action affecting a listed species. On February 12, 1993, NMFS issued a long-term BO regarding the operational impacts of the CVP on winter-run Chinook salmon (NMFS 1993). Based on Reclamation's *Long-Term Central Valley Project Operations Criteria and Plan* and biological assessment of impacts, the BO concluded that the proposed long-term operations of the CVP and SWP would likely jeopardize the continued existence of winter-run Chinook salmon, and identified "Reasonable and Prudent Alternatives" (RPA) to avoid jeopardy. The RPAs consisted of 13 separate actions that changed the pattern of storage and withdrawal at Shasta, Trinity, and Whiskeytown Reservoirs for the purpose of improving water temperature control and protecting Sacramento River winter-run Chinook salmon (NMFS 1993). Since that time, many of the original RPA actions have been amended or incorporated into the 1995 Water Quality Control Plan Decision 1641. Therefore, these components of the RPA have become part of the baseline conditions.

Actions that have not changed include:

- Water year forecasting based on a 90 percent probability of exceedence

- Maintaining a minimum 3,250 cfs flow below Keswick Dam from October 1 through March 30
- Implementing ramp-down rates for Shasta Dam releases from July 1 through March 31
- Locating temperature compliance points based on annual plans
- Raising RBDD gates between September 15 and May 15 every year
- Monitoring of winter-run Chinook salmon juveniles in the Delta
- Monitoring entrainment loss of winter-run Chinook salmon juveniles at Rock Slough Pumping Plant
- Monitoring of incidental take at the CVP and SWP Delta pumping facilities

On October 22, 2004, NMFS issued a BO regarding effects of the Long-Term Operations Criteria and Plan (OCAP) for the CVP in coordination with the SWP on Sacramento River winter-run Chinook salmon, Central Valley spring-run Chinook salmon, Central Valley steelhead, Southern Oregon Northern California Coastal Coho salmon, and Central California Coast steelhead and their designated critical habitat. The 2004 BO supersedes the 1993 BO issued by NMFS. It contains reasonable and prudent measures and terms and conditions that specify all of the following:

- Fisheries monitoring actions
- Augmentation of spawning gravel
- Forecasting of deliverable water management of cold-water supply within reservoirs
- Temperature monitoring
- Adaptive management processes to analyze annual cold-water management
- Minimization of flow fluctuations
- Passage at RBDD
- Operation of gates in the Delta
- Fish screening at pumping facilities
- Numerous other effects minimization measures

With the signing of the Principles for Agreement for the Bay-Delta Plan, USFWS agreed to initiate immediate reconsultation on the BO it had issued on February 4, 1994, which addressed the effects of the combined operations of the CVP and SWP on delta smelt for the period of February 15, 1994, through February 15, 1995. In that opinion, USFWS had concluded that the proposed operations of the CVP and SWP would result in jeopardy; therefore, RPAs were included in the BO, which consisted of specific operational criteria that the CVP and SWP would implement (USFWS 1994).

On March 6, 1995, USFWS issued a revised BO for delta smelt. This opinion states that the proposed long-term combined CVP and SWP operations, as modified by the BO for winter-run Chinook salmon, the Principles for Agreement, and the Bay-Delta Plan (draft at the time), are not likely to jeopardize the continued existence of the threatened delta smelt or adversely modify its critical habitat. The BO identifies water quality standards and operational constraints that would provide benefits to delta smelt.

In response to litigation, the 2004 and 2005 BOs were remanded to USFWS and NMFS for revision, but were not vacated. USFWS and NMFS released revised BOs in 2008 and 2009, respectively. Since the revised BOs continue to be locked in controversy and litigation, the 2004 and 2005 BOs are assumed to be govern operations for SLWRI analysis. Further revised BOs are anticipated prior to the release of the final version of this document; final analysis will consider conditions dictated by the BOs in place at that time.

Real-Time Decision-Making to Assist Fishery Management

Reclamation and DWR work closely with USFWS, NMFS, DFG, and other agencies to coordinate the operation of the CVP and SWP with fishery needs. This coordination is facilitated through several forums, as discussed below.

CALFED Water Operations Management Team The Water Operations Management Team (WOMT) was established to facilitate decision making at the appropriate levels and provide timely support of decisions. This team, which first met in 1999, consists of management-level participants from Reclamation, DWR, USFWS, NMFS, and DFG. The WOMT meets frequently to provide oversight and decision making that must routinely occur within the CALFED Ops Group process. The WOMT relies heavily on other teams and work groups for recommendations on fishery actions. It also utilizes the CALFED Ops Group (see below) to communicate with stakeholders about its decisions. Although the goal of the WOMT is to achieve consensus on decisions, the agencies retain their authorized roles and responsibilities.

CALFED Ops Group The CALFED Ops Group consists of participants from Reclamation, DWR, USFWS, NMFS, DFG, SWRCB, and U.S. Environmental Protection Agency. The CALFED Ops Group generally meets 11 times a year in a public setting to discuss CVP and SWP operations, CVPIA implementation, and coordination with efforts to protect endangered species. The CALFED Ops

Group held its first public meeting in January 1995, and during the next 6 years the group developed and refined its process. The CALFED Ops Group is recognized within SWRCB D-1641 and elsewhere as a forum where agencies can consult and achieve consensus on coordinating CVP and SWP operations with endangered species, water quality, and CVPIA requirements. Decisions made by the CALFED Ops Group have been incorporated into the Delta standards to protect beneficial uses of water (e.g., export/inflow ratios and some closures of DCC gates).

Several teams were established as part of the Ops Group. These teams are described below.

Operations and Fishery Forum The stakeholder-driven Operations and Fishery Forum disseminates information about recommendations and decisions regarding CVP and SWP operations. Forum members are considered the contact people for their respective agencies or interest groups when the CALFED Ops Group needs to provide information about take of listed species or address other topics or urgent issues. Alternatively, the CALFED Ops Group may direct the Operations and Fishery Forum to recommend operational responses to issues of concern raised by member agencies.

Data Assessment Team The Data Assessment Team consists of technical staff members from the agencies and stakeholders. The team meets frequently during the fall, winter, and spring to review and interpret data relating to fish movement, location, and behavior. Based on its assessments and information about CVP and SWP operations, the Data Assessment Team recommends potential changes in operations to protect fish.

B2 Interagency Team The B2 Interagency Team was established in 1999 and consists of technical staff members from the agencies. The team meets weekly to discuss implementation of Section 3406(b)(2) of the CVPIA, which defines the dedication of CVP water supply for environmental purposes. It communicates with the WOMT to ensure coordination with the other operational programs or resource-related aspects of project operations.

Fisheries Technical Teams Several fisheries-specific teams have been established to provide guidance on resource management issues. These teams are described below.

The Sacramento River Temperature Task Group The Sacramento River Temperature Task Group (SRTTG) is a multiagency group formed pursuant to SWRCB Water Right Orders 90-5 and 91-1 to help improve and stabilize the Chinook salmon population in the Sacramento River. Reclamation develops temperature operation plans each year for the Shasta and Trinity Divisions of the CVP. These plans consider impacts of CVP operations on winter-run and other races of Chinook salmon. The SRTTG meets in the spring to discuss biological and operational information, objectives, and alternative operations

plans for temperature control, then recommends an operation plan for temperature control. Reclamation then submits a report to SWRCB, generally on or before June 1 each year.

After the operation plan is implemented, the SRTTG may perform additional studies and hold meetings to revise the plan based on updated biological data, reservoir temperature profiles, and operations data. Updated plans may be needed for summer operations to protect winter-run Chinook salmon, or in fall for the fall-run spawning season. If any changes are made to the plan, Reclamation submits a supplemental report to the SWRCB.

Salmon Decision Tree The fishery agencies and project operators use the Chinook Salmon Protection Decision Process to address the often-complex coordination issues surrounding DCC gate operations and the purposes of closures for fishery protection; Delta water quality; and/or export reductions. Inputs such as fish life stage and size development, current hydrologic events, fish indicators (such as the Knight's Landing Catch Index and Sacramento Catch Index), and salvage at the export facilities, as well as current and projected Delta water quality conditions, are used to determine potential DCC closures and/or export reductions. The coordination process has worked well during recent fall and winter DCC operations, and its continued use (in either the present form or a modified version) is expected in the future.

Delta Smelt Working Group The Delta Smelt Working Group was established in 1995 to resolve biological and technical issues regarding delta smelt and to develop recommendations for consideration by USFWS. The working group generally acts when Reclamation and DWR seek consultation with USFWS on delta smelt or when unusual salvage of delta smelt occurs. It also has assisted in developing strategies to improve habitat conditions for delta smelt.

The Delta Smelt Working Group employs a delta smelt decision tree when forming recommendations to send to the WOMT. The working group does not decide what actions will be taken and does not supplant the Data Assessment Team, but merely provides additional advice to the WOMT. The group may propose operations modifications that it believes will protect delta smelt, either by reducing take at the export facilities or by preserving smelt habitat. The decision tree is adapted by the working group as new knowledge becomes available.

American River Operations Work Group In 1996, Reclamation established an operational working group for the lower American River, known as the American River Operations Work Group. Although open to anyone, the working group's meetings generally include representatives from several agencies and organizations with ongoing concerns about management of the lower American River: Reclamation, USFWS, NMFS, DFG, the Sacramento Area Flood Control Agency, the Water Forum, the City of Sacramento, Sacramento County, the Western Area Power Administration, and the Save the

American River Association. The American River Operations Work Group convenes at least monthly to provide fishery updates and reports to enable Reclamation to better manage Folsom Reservoir for fish resources in the lower American River.

San Joaquin River Agreement Technical Committee The San Joaquin River Agreement Technical Committee meets to plan and implement the Vernalis Adaptive Management Plan each year. The committee oversees two subgroups, the Biology subgroup and the Hydrology subgroup, each of which are charged with certain responsibilities. The subgroups must also coordinate their activities within the San Joaquin River Agreement Technical Committee.

DCC Project Work Team The DCC Project Work Team is a multiagency group under CALFED. It determines and evaluates the effects of DCC gate operations on Delta hydrodynamics, water quality, and fish migration. The work team coordinates with the Data Assessment Team and Operations and Fishery Forum to conduct gate experiments; members may be used as a resource to estimate impacts of real-time gate operations.

National Forest Management Act

The National Forest Management Act requires the USFS to prepare the STNF Land and Resources Management Plan (LRMP) that provides the direction to manage the goods and services that are associated with National Forest System lands managed by the STNF. In addition to the requirement for LRMPs, National Forest Management Act also has a specific requirement to "provide for a diversity of plant and animal communities" [16 U.S.C. 1604(g)(3)(B)] as part of their multiple use mandate. The USFS must maintain “viable populations of existing native and desired non-native species in the planning area” (36 CFR. 219.19).

U.S. Forest Service Sensitive Species

The Sensitive Species program is designed to meet the National Forest Management Act requirement to demonstrate the USFS’s commitment to maintaining biodiversity on National Forest System lands. The program is a proactive approach to conserving species to prevent a trend toward listing under the ESA, and to ensure the continued existence of viable, well-distributed populations. A “Sensitive Species” is any species of plant or animal that has been recognized by the Regional Forester to need special management in order to prevent it from becoming threatened or endangered.

Shasta-Trinity National Forest Land and Resource Management Plan

The STNF, LRMP adopted what is commonly referred to as the Northwest Forest Plan, a plan for the management of habitat for late-successional and old-growth forest-related species within the range of the northern spotted owl. The LRMP encompasses all the goals, standards and guidelines established in the 1994 ROD for the Northwest Forest Plan, as a well as establishing Forest goals, standards, and guidelines designed to guide the management of the STNF. As

adopted in 1995, this LRMP incorporates the following goals, standards, and guidelines related to aquatic and fisheries resource issues associated with the project site were excerpted from the STNF LRMP (USFS 2003).

Biological Diversity
Goals (LRMP, p. 4-4)

- Integrate multiple resource management on a landscape level to provide and maintain diversity and quality of habitats that support viable populations of plants, fish, and wildlife.

Threatened, Endangered, and Sensitive Species (Plants and Animals)
Goals (LRMP, p. 4-5)

- Monitor and protect habitat for Federally listed Threatened and Endangered and candidate species. Assist in recovery efforts for Threatened and Endangered species. Cooperate with the State to meet objectives for state listed species.

- Manage habitat for sensitive plants and animals in a manner that will prevent any species from becoming a candidate for Threatened and Endangered status.

Wildlife
Goals (LRMP, p. 4-6)

- Meet habitat or population objectives established for management indicators.

- Cooperate with Federal, State, and local agencies to maintain or improve wildlife habitat.

- Maintain natural wildlife species diversity by continuing to provide special habitat elements within Forest ecosystems.

Standards and Guidelines (LRMP, pp. 4-29 through 4-30)

- Consider transplants, introductions, or reintroductions of wildlife species only after ecosystem analysis and coordination with other agencies and the public.

- Develop interpretation/view sites for wildlife viewing, photography, and study. Provide pamphlets, slide shows, and other educational material that enhance the watchable wildlife and other interpretive programs.

- Maintain and/or enhance habitat for Federally listed threatened and endangered or USFS Sensitive species consistent with individual species recovery plans.

U.S. Forest Service Survey and Manage Species

In 1994, the U.S. Bureau of Land Management and USFS adopted standards and guidelines, The Northwest Forest Plan was designed to address human and environmental needs served by the Federal forests of the western part of the Pacific Northwest and Northern California. The development of the Northwest Forest Plan was triggered in the early 1990s by the listing of the northern spotted owl and marbled murrelet as threatened under the ESA.

To mitigate potential impacts to plant and wildlife species that have the potential to occur within the range of the northern spotted owl, surveys are required for species thought to be rare or whose status is unknown due to a lack of information. These species became known as the Survey and Manage species. The Northwest Forest Plan has gone through several revisions since its implementation in 1994, including the elimination of the Survey and Manage Mitigation Measure Standards and Guidelines in 2004. However, these guidelines were re-instated in January 2006 as the result of a court order.

Management Guide for the Shasta and Trinity Units of the Whiskeytown-Shasta-Trinity National Recreation Area

The Management Guide for the Shasta and Trinity Units of the Whiskeytown-Shasta-Trinity National Recreation Area contains management strategies intended to achieve or maintain a desired condition. These strategies take into account opportunities, management recommendations for specific projects, and mitigation measures needed to achieve specific goals. The following strategies related to biological resource issues associated with the project were excerpted from the Management Guide (USFS 2003).

Wildlife (Management Guide, pp. IV-19 through IV-20)

- Management activities will assure population viability for all native and non-native desirable species. Management to insure viability will occur within occupied habitat for bald eagle, peregrine falcon, northern spotted owl, northern goshawk, willow flycatcher, northwestern pond turtle, Pacific fisher, Shasta salamander, and candidate species in accordance with species and/or territory management plans, Forest Orders, and appropriate laws and policy.

- Surveys will continue within potential suitable habitats to determine occupancy status for Threatened, Endangered, sensitive, and candidate species.

- Cooperation will continue with DFG and the USFWS regarding habitat management of wildlife species inhabiting the National Recreation Area. Consultation with USFWS will continue regarding habitat management for threatened and endangered species.

11.2.2 State

California Endangered Species Act

Pursuant to the California Endangered Species Act (CESA), a permit from DFG is required for projects that could result in take of a State-listed threatened or endangered species. Under CESA, "take" is defined as an activity that would directly or indirectly kill an individual of a species, but the definition does not include "harming" or "harassing," as the ESA does. As a result, the threshold for take under CESA is higher than under the ESA (e.g., habitat modification is not necessarily considered take under CESA). Authorization for take of State-listed species can be obtained through a California Fish and Game Code Section 2080.1 Consistency Determination or Section 2081 Incidental Take Permit.

"Fully Protected" Fish Species

California law (Fish and Game Code, Section 5515) also identifies 10 "fully protected fish" that cannot lawfully be "taken," even with an incidental take permit. None of these species are present in the primary study area.

California Fish and Game Code Section 1602—Streambed Alteration

All diversions, obstructions, or changes to the natural flow or bed, channel, or bank of any river, stream, or lake in California that supports wildlife resources are subject to regulation by DFG under Section 1602 of the California Fish and Game Code. Under Section 1602, it is unlawful for any person, governmental agency, or public utility to do the following without first notifying DFG: substantially divert or obstruct the natural flow of, or substantially change or use any material from the bed, channel, or bank of any river, stream, or lake, or deposit or dispose of debris, waste, or other material containing crumbled, flaked, or ground pavement where it may pass into any river, stream, or lake. A stream is defined as a body of water that flows at least periodically or intermittently through a bed or channel that has banks and supports fish or other aquatic life. This definition includes watercourses with a surface or subsurface flow that supports or has supported riparian vegetation. DFG's jurisdiction within altered or artificial waterways is based on the value of those waterways to fish and wildlife. A DFG streambed alteration agreement must be obtained for any project that would result in an impact on a river, stream, or lake.

California Public Resources Code, Sections 5093.50-5093.70

The California Public Resources Code Sections 5093.50 – 5093.70 were established through 1972 enactment of the Wild and Scenic Rivers Act, which was subsequently amended on several occasions. The essential policy of the State in regard to the matters addressed by the PRC is expressed in Section 5093.50:

> *5093.50 It is the policy of the State of California that certain rivers which possess extraordinary scenic, recreational, fishery, or wildlife values will be preserved in their free-flowing state, together with their immediate environments, for the benefit and*

> *enjoyment of the people of the state. The Legislature declares that such use of these rivers is the highest and most beneficial use and is a reasonable and beneficial use of water within the meaning of Section 2 of Article X of the California Constitution.*

The PRC identifies, classifies, and provides protection for specific rivers or river segments, as approved by the Legislature (much of the text of the PRC is devoted to detailed descriptions of river segment locations). Rivers or river segments that are specifically identified and classified in the PRC comprise the State Wild and Scenic Rivers System. As described in Section 5093.50 of the PRC, rivers or river segments included in the State Wild and Scenic Rivers System must possess "extraordinary scenic, recreational, fishery, or wildlife values"; however, the PRC does not define these "extraordinary values."

Various amendments to the California Wild and Scenic Rivers Act have been passed, modifying the PRC. Rivers or river segments are added to (or, as in a few past cases, removed from) the System by Legislative action. In 1986, Assembly Bill 3101 (Statutes of 1986, Chapter 894) established a study process to help determine eligibility for potential additions to the State Wild and Scenic Rivers System (Section 5093.547 and Section 5093.548). In 1982, the original mandate in the PRC requiring management plans for designated rivers was eliminated; however, the California Resources Agency is required to coordinate activities affecting the State Wild and Scenic Rivers System with other Federal, State, and local agencies (Section 5093.69).

The PRC has also been modified to protect river segments without formally identifying them as part of the State Wild and Scenic Rivers System. Such protective language for the McCloud River was added to the PRC in Section 5093.542, emphasizing protection of the wild trout fishery in the McCloud River.

California Wild Trout Program

The California Wild Trout Program was established by the California Fish and Game Commission in 1971 to protect and enhance high-quality fisheries sustained by wild strains of trout. The primary purpose of the wild trout program is to identify, enhance, and perpetuate natural and attractive trout fisheries where wild strains of trout are given major emphasis, in contrast to the majority of the State's accessible waters that are managed by planting domesticated catchable-sized trout on a "put and take" basis (Rode 1989; Rode and Dean 2004). The Commission adopted a wild trout policy that provides for the designation of "aesthetically pleasing and environmentally productive" streams and lakes to be managed exclusively for wild trout, where the trout populations are managed with appropriate regulations to be "largely unaffected by the angling process."

All designated waters must meet the following policy criteria (Rode 1989, Rode and Dean 2004):

- Be open to public angling
- Be of sufficient size to accommodate a significant number of anglers without overcrowding
- Be able to support, with appropriate angling regulations, wild trout populations of sufficient magnitude to provide satisfactory trout catches in terms of number or size of fish

Designated wild trout waters are required to have a management plan and must be subject to angling restrictions that "emphasize unique values and diversity of opportunity in the geographic area" (Rode 1989, Rode and Dean 2004). Wild trout waters are required to be managed in accordance with the following stipulations:

- Domestic strains of catchable-sized trout will not be planted in designated wild trout waters.
- Hatchery-produced trout of suitable wild and semiwild strains may be planted in designated waters, but only if necessary to supplement natural trout reproduction.
- Habitat protection is of utmost importance for maintenance of wild trout populations. All necessary actions, consistent with State law, will be taken to prevent adverse impacts by land or water development projects affecting designated wild trout waters.

The California Fish and Game Commission in 1976 designated a 10.5-mile river segment immediately below McCloud Dam for special management and habitat protection under the Commission's wild trout program (Rode 1988).

11.2.3 Regional and Local

County and City Policies and Ordinances

Shasta, Tehama, Glenn, Sutter, Sacramento, and Yolo counties and the cities of Redding, Colusa, and Sacramento have established codes and policies that address protection of natural resources, including fisheries, sensitive species, and aquatic resources, and are applicable to the project.

Shasta County's general plan emphasizes that the maintenance and enhancement of quality fish and wildlife habitat is critical to the recreation and tourism industry, and acknowledges that any adverse and prolonged decline of these resources could result in negative impacts on an otherwise vibrant industry. The general plan identifies efforts to protect and restore these habitats to sustain the long-term viability of the tourism and recreation industry (Shasta County 2004).

The City of Redding's general plan strives to strike a balance between development and conservation by implementing several measures such as creek-corridor protection and habitat protection (City of Redding 2000).

Tehama County's general plan update provides an overarching guide to future development and establishes goals, policies, and implementation measures designed to address potential changes in county land use and development.

Glenn County's general plan provides a comprehensive plan for growth and development in Glenn County for the next 20 years (2007 through 2027). This plan recognizes that public lands purchased for wildlife preservation generate economic activity as scientists and members of the public come to view and study remnant ecosystems (Glenn County 1993).

The City of Colusa's general plan seeks to promote its natural resources through increased awareness and improved public access (City of Colusa 2007).

Sutter County's general plan contains policies that generally address preservation of aquatic resources.

Sacramento County's general plan contains policies that promote protection of marsh and riparian areas, including specification of setbacks and "no net loss" of riparian woodland or marsh acreage (Sacramento County 1993).

Yolo County's general plan aims to provide an active and productive buffer of farmland and open space separating the Bay Area from Sacramento, and integrating green spaces into its communities.

11.2.4 Federal, State, and Local Programs and Projects

Watershed Conservancies

Several watershed conservancy groups exist within the study area. These include, but may not be limited to Butte Creek, Mill Creek, Deer Creek and Cottonwood Creek Watershed Conservancies. Watershed conservancies tend to focus on developing and implementing conservation efforts on watershed lands.

California Bay-Delta Authority

The California Bay-Delta Authority was established as a State agency in 2003 to oversee implementation of CALFED for the 25 Federal and State agencies working cooperatively to improve the quality and reliability of California's water supplies while restoring the Bay-Delta ecosystem. CALFED Ecosystem Restoration Program has provided a funding source for projects that include those involving acquisition of lands within the Sacramento River Conservation Area (SRCA), initial baseline monitoring and preliminary restoration planning, and preparation of long-term habitat restoration management and monitoring plans.

Cantara Trustee Council

The Cantara Trustee Council administers a grant program that has provided funding for numerous environmental restoration projects in the primary study area, including programs in the Fall River watershed, Sulphur Creek, the upper Sacramento River, Middle Creek, lower Clear Creek, Battle Creek, Salt Creek, and Olney Creek. The Cantara Trustee Council is a potential local sponsor for future restoration actions in the primary study area. The Cantara Trustee Council includes representatives from DFG, USFWS, the Central Valley RWQCB, California Sportfishing Protection Alliance, and Shasta Cascade Wonderland Association.

Resource Conservation Districts

There are numerous resource conservation districts (RCD) within the study area. Once known as soil conservation districts, RCDs were established under California law with a primary purpose to implement local conservation measures. Although RCDs are locally governed agencies with locally appointed, independent boards of directors, they often have close ties to county agencies and the National Resources Conservation Service. RCDs are empowered to conserve resources within their districts by implementing projects on public and private lands and to educate landowners and the public about resource conservation. They are often involved in the formation and coordination of watershed working groups and other conservation alliances. In the Shasta Lake and upper Sacramento River vicinity, districts include the Western Shasta County RCD and the Tehama County RCD. To the east are the Fall River and Pit River RCDs, and to the west and north are the Trinity County and Shasta Valley RCDs.

Riparian Habitat Joint Venture

The Riparian Habitat Joint Venture (RHJV) was initiated in 1994 and includes signatories from 18 Federal, State, and private agencies. The RHJV promotes conservation and the restoration of riparian habitat to support native bird population through three goals:

- Promote an understanding of the issues affecting riparian habitat through data collection and analysis.
- Double riparian habitat in California by funding and promoting on-the-ground conservation projects.
- Guide land managers and organizations to prioritize conservation actions.

RHJV conservation and action plans are documented in the *Riparian Bird Conservation Plan* (RHJV 2004). The conservation plan targets 14 “indicator” species of riparian-associated birds and provides recommendations for habitat protection, restoration, management, monitoring, and policy. The report notes habitat loss and degradation as one of the most important factors causing the

decline of riparian birds in California. The RHJV has participated in monitoring efforts within the Sacramento National Wildlife Refuge Complex and other conservation areas. The RHJV's conservation plan identifies lower Clear Creek as a prime breeding area for yellow warblers and song sparrows, advocating a continuous riparian corridor along lower Clear Creek. Other recommendations of the conservation plan apply to the North Delta Off stream Storage Investigation study area.

Sacramento River Advisory Council

In 1986, the California Legislature passed Senate Bill 1086, which called for a management plan for the Sacramento River and its tributaries to protect, restore, and enhance fisheries and riparian habitat in an area stretching from the confluence of the Sacramento River with the Feather River and continuing northward to Keswick Dam. The law established an advisory council that included representatives of Federal and State agencies, county supervisors, and representatives of landowners, water contractors, commercial and sport fisheries, and general wildlife and conservation interests. Responsibilities of the advisory council included development of the *Sacramento River Conservation Area Forum Handbook* to guide management of riparian habitat and agricultural uses along the river (Resources Agency 2003). This action also resulted in formation in May 2000 of the SRCA Forum, a nonprofit, public benefit corporation with a board of directors that includes private landowners and public interest representatives from a seven-county area, an appointee of the California Resources Agency, and ex-officio members from six Federal and State resource agencies. The work of the organization is generally focused on planning actions and river management within the SRCA planning area.

Sacramento River Conservation Area Program

Senate Bill 1086 called for a management plan for the Sacramento River and its tributaries to protect, restore, and enhance both fisheries and riparian habitat. The SRCA Program has an overall goal of preserving remaining riparian habitat and reestablishing a continuous riparian ecosystem along the Sacramento River between Redding and Chico, and reestablishing riparian vegetation along the river from Chico to Verona. The program is to be accomplished through an incentive-based, voluntary river management plan. The Upper Sacramento River Fisheries and Riparian Habitat Management Plan (Resources Agency 1989), identifies specific actions to help restore the Sacramento River fishery and riparian habitat between the Feather River and Keswick Dam. The Sacramento River Conservation Area Forum Handbook (Resources Agency 2003) is a guide to implementing the program. The Keswick Dam-to-Red Bluff portion of the conservation area includes areas within the 100-year floodplain, existing riparian bottomlands, and areas of contiguous valley oak woodland, totaling approximately 22,000 acres. The 1989 fisheries restoration plan recommended several actions specific to the study area:

- Fish passage improvements at RBDD (final Environmental Impact Statement/Environmental Impact Report released May 2008)

- Modification of the Spring Creek Tunnel intake for temperature control (completed)
- Spawning gravel replacement program (ongoing)
- Development of side-channel spawning areas, such as those at Turtle Bay in Redding (ongoing)
- Structural modifications to the Anderson-Cottonwood Irrigation District Dam to eliminate short-term flow fluctuations (completed)
- Maintaining instream flows through coordinated operation of water facilities (ongoing)
- Improvements at the Coleman National Fish Hatchery (partially complete)
- Measures to reduce acute toxicity caused by acid mine drainage and heavy metals (ongoing)
- Various fisheries improvements on Clear Creek (partially complete)
- Flow increases, fish screens, and revised gravel removal practices on Battle Creek (beginning summer 2006)
- Control of gravel mining, improvements of spawning areas, improvements of land management practices in the watershed, and protection and restoration of riparian vegetation along Cottonwood Creek

The Nature Conservancy

The Nature Conservancy (TNC) is a private, nonprofit organization involved in environmental restoration and conservation throughout the United States and the world. TNC approaches environmental restoration primarily through strategic land acquisition from willing sellers and obtaining conservation easements. Some of the lands are retained by TNC for active restoration, research, or monitoring activities, while others are turned over to government agencies such as USFWS or DFG for long-term management. Lower in the Sacramento River basin, TNC has been instrumental in acquiring and restoring lands in the Sacramento River National Wildlife Refuge and managing several properties along the Sacramento River. It also has pursued conservation easements on various properties at tributary confluences, including Cottonwood and Battle creeks.

11.3 Environmental Consequences and Mitigation Measures

11.3.1 Methods and Assumptions

The following sections describe the methods, processes, procedures, and/or assumptions used to formulate and conduct the environmental impact analysis.

This analysis of impacts on fisheries and aquatic ecosystems resulting from implementation of the project alternatives under consideration is based on extensive review of existing documentation that addresses aquatic habitats and fishery resources in the primary and extended study areas, and on water resources modeling analysis.

Summary of Water Resources Modeling

Extensive hydrologic, water temperature, and salmon production and mortality modeling was performed to provide a quantitative basis from which to assess potential operation-related effects of the project alternatives on fisheries resources and aquatic habitats within the primary and extended study areas. Model selection and use for each of the variables were as follows:

- **Hydrologic modeling** – CalSim-II (primary and extended study areas)
- **Water temperature modeling** – Sacramento River water temperature model (primary study area)
- **Salmon production and mortality** – SALMOD (primary study area)

Modeling output provided monthly values for each year of the 82-year period of record modeled for river flows, reservoir storage and elevation, and river water temperatures. The period of record is based on records from 1921 through 2003. River flow and water temperature output was put into weekly form and used in SALMOD to characterize flow- and water temperature-induced production and mortality of salmon under each simulated condition.

The models used in the fisheries analyses (i.e., CalSim-II, Sacramento river water temperature model, and SALMOD) are tools that have been developed for comparative planning purposes, rather than for predicting actual river conditions at specific locations and times. The 82-year period of record for CalSim-II and water temperature modeling provides an index of the kinds of changes that would be expected to occur with implementation of a specified set of operational conditions. Reservoir storage, river flows, water temperature, and salmon survival output for the period modeled should not be interpreted or used as definitive absolutes depicting actual river conditions that would occur in the future. Rather, output for the project alternatives was compared to that for the Existing Condition (2005) and No-Action Alternative (future 2030) alternatives simulation to determine the following:

- Whether reservoir storage or river flows and water temperatures would be expected to change with implementation of the SLWRI alternatives.

- Months in which potential reservoir storage and river flow and water temperature changes could occur.

- Relative magnitude of change that could occur during specific months of particular water-year types, and whether the relative magnitude anticipated would be expected to result in effects on fisheries resources and aquatic habitats within the regional area.

The models used, although mathematically precise, should be viewed as having "reasonable detection limits." Establishing reasonable detection limits is useful in interpreting modeling output for impact assessment purposes, and prevents making inferences beyond the capabilities of the models and beyond an ability to actually measure changes.

Simulated water temperature differences of less than 1°F were lower than the reasonable detection limit. In situ temperature loggers used to collect water temperature data used for the model typically have a precision of ±0.36°F, yielding a potential error of 0.72°F (Deas et al. 1997). Therefore, modeled differences in water temperature of 0.36°F or less could not be consistently detected in the river by actual monitoring of water temperatures. In addition, as mentioned above, output from Reclamation's water temperature models provides a "relative index" of water temperatures under the various operational conditions modeled. Output values indicate whether the water temperatures would be expected to increase, remain unchanged, or decrease, and provide insight regarding the relative magnitude of potential changes under one operational condition compared to another.

The Modeling Appendix provides a more detailed discussion of the modeling process and its application to the project analysis, including (1) the primary assumptions and model inputs used to represent hydrologic, regulatory, structural and operational conditions; and (2) the simulations performed from which effects were estimated. SALMOD is discussed in more detail below.

Modeling Uncertainties and Real-Time Decision-Making A process exists for real-time decision-making on CVP and SWP operations to allow fishery management that promotes flexible decision-making able to be adjusted for uncertainties as outcomes of management actions and other events become better understood.

It should be noted that modeling simulations conducted to support the analysis of the project alternatives do not always capture potential operational changes associated with the human element of real-time decision-making. Therefore, although the modeling is based on operational assumptions that are generally accepted, there may be isolated inaccuracies regarding real-time human

decisions on operations to ensure compliance with existing objectives, standards, and/or agreements.

For example, the NMFS BO for the long-term CVP and SWP Operations Criteria and Plan and SWRCB orders require that CVP and SWP operations for the Sacramento River meet specific water temperature criteria. In 1997, construction was completed on the TCD at Shasta Dam. The TCD was designed to selectively withdraw water from elevations within Shasta Lake to better manage water temperatures in the upper river, while allowing power generation. SRTTG is an interagency team that identifies water management alternatives and TCD operations in real time, interprets the availability of cold-water resources in Shasta Lake, and designs an annual/seasonal river temperature compliance strategy, as outlined in SWRCB Water Right Order 90-5 and multiple BOs.

Reservoir Fisheries Analysis

Monthly values for WSEL, surface area, and cold-water storage in Shasta Lake were calculated for 1922 to 2003 using data outputs from CalSim-II. Values were produced for five alternative dam raise scenarios (project alternatives) using a 2005 water supply demand, and a projected 2030 water supply demand for a total of 10 scenarios. Each year of the hydrologic record was categorized as one of five water year categories (wet, above-normal, below-normal, dry, critical) based on the Sacramento River Inflow Index. Model outputs for the last day of each month from February to July (e.g., February 29, March 31) were used for analysis of potential changes in surface area and WSEL. End-of-month values for April, June, August, and October were used to analyze the potential changes in Shasta Lake's cold-water storage. Potential impacts of the enlargement of Shasta Dam and Shasta Lake on the fisheries resources of Shasta Lake were investigated using several habitat-based metrics that are associated with factors known to limit or otherwise regulate warm-water and cold-water reservoir fish populations. The following metrics were computed and used:

- **Surface Area** – Surface area is the metric used to investigate changes in the amount of available littoral (i.e., shoreline) and limnetic (i.e., open water) habitat, which could impact warm-water and cold-water fisheries, under each of the project alternatives. Variations in surface area influence biological productivity (including fish production) because the upper, lighted layer of the pelagic zone is the principal plankton-producing region of the reservoir. Reservoir enlargement may initially produce a "trophic upsurge" phenomenon that occurs in response to terrestrial habitat inundation, nutrient loading, and increases in labile detritus (Kimmel and Groeger 1986). The initial trophic enrichment will decline and stabilize over time as the reservoir ecosystem approaches its natural trophic equilibrium (Kimmel and Groeger 1986). Trophic depression is a response to decreased nutrient loading and decreased labile detritus. Fisheries production experiences a depression in response to the same factors as well as decreases in

available terrestrial organic detritus and loss of cover as inundated vegetation deteriorates (Stables et al. 1990).

- **Cold-Water Storage to Surface Area Ratio** – Cold-water storage to surface area ratio (a dimensionless value) is a useful metric for assessing the potential impact of project alternatives on Shasta Lake's cold-water fishery. Stables et al. (1990) suggest that an increase in pelagic and littoral trout habitat accompanied by lake enlargement should lead to higher total fish yield. While increases in water surface area, such as those that might result from reservoir enlargement, can stimulate primary and secondary productivity (Jones and Stokes Associates 1988), access to cold-water refuge can be a limiting factor for cold-water fish production. Therefore, increases in reservoir surface area without proportional increases in cold-water storage are likely to result in little change in cold-water fish production. Conversely, a proportional increase in the cold-water storage to surface area ratio should result in increased cold-water fish productivity.

- **WSEL** –WSEL is a metric that is useful in analyzing the impact of project alternatives on the Shasta Lake warm-water fishery. The timing and duration of WSEL fluctuation can have a great impact on the reproductive success of nearshore spawning fishes (Ploskey 1986). Stable or increasing WSEL during spring months (March through June) can contribute to increased reproductive success, young-of-the-year production, and juvenile growth rate of several warm-water species, including the black basses (Lee 1999, Ploskey 1986). Inundation of shoreline habitat may also lead to increased structural diversity and availability of spawning substrate or cover for juvenile fishes, depending on vegetation removal activities (Miranda et al. 1984, Ratcliff 2006). Conversely, reduced or variable WSEL due to reservoir drawdown during spring spawning months can cause reduced spawning success for warm-water fishes through nest dewatering, egg desiccation, and physical disruption of spawning or nest guarding activities (Lee 1999, Ploskey 1986).

WSEL values were obtained from CalSim-II outputs, as described above, and were graphed for each comparison set. Monthly change in surface elevation (monthly change in elevation) was calculated by subtracting the previous month's surface elevation from each month. For example, change in elevation for March was calculated by subtracting the February 29 WSEL from the March 31 WSEL. The relative difference in monthly change in elevation from the basis-of-comparison and the relative percent difference in monthly change in elevation were graphed for each comparison set, with the basis-of-comparison as the Existing Condition in sets one and three, and the No-Action Alternative in set two. The relative difference and relative percent difference in monthly change in elevation between CP3 and CP4 were also graphed for comparison sets one and three.

Surface area values obtained from CalSim-II outputs were graphed for each comparison set. Relative differences in monthly surface area values from the basis-of-comparison were graphed for each comparison set, as described for WSEL.

Cold-Water Storage Values obtained from CalSim-II outputs were divided by surface area outputs to generate monthly cold-water storage to surface area ratios. The cold-water storage to surface area ratios were graphed for comparison set two only. The relative difference and relative percent difference in monthly cold-water storage to surface area ratio from the basis-of-comparison were also calculated and graphed for comparison set two only.

For each metric, CalSim-II projections for monthly change under the Existing Condition were graphed against the No-Action Alternative.

Additionally, graphs were prepared depicting the expected ratio of monthly cold-water storage to surface area, monthly surface area, and expected monthly changes in elevation under 2005 and 2030 water demands (separately) for all water-year types for CP1, CP2, CP3, and CP4 for the Shasta Lake and vicinity portion of the primary study area. For example, in the discussion of potential impacts associated with implementation of CP1 is a graph comparing monthly surface area under CP1 with a 2005 water supply demand to monthly surface area under the Existing Condition, and a separate graph making this comparison for CP1 with a 2030 water supply demand versus the No-Action Alternative.

Values for the three habitat metrics were compared in graphical form to address the following issues:

- How reservoir cold-water storage, WSEL, or the cold-water storage to surface area ratio would be expected to change with implementation of the project alternatives

- Months or seasons when potential changes in the habitat metrics could occur

- Relative magnitude of change that could occur during specific months of particular water-year types, and the potential impacts these changes could have on fisheries resources, aquatic resources, and habitats within the reservoir

All analyses were based on CalSim-II model outputs. CalSim-II is California's primary water operations planning model, used by both Reclamation and DWR. While model sensitivity and accuracy calibrations are still being developed for CalSim-II, the model's widespread use for water planning and management operations in Central California makes it useful and its projections easily comparable between projects. However, model outputs should be used as tools

for interpretation of anticipated impacts rather than actual projections (Close et al. 2003).

Tributaries to Shasta Lake

The primary study area is composed of Shasta Dam and Shasta Lake, the lower reaches of the tributaries draining into Shasta Lake, and the Sacramento River downstream to Keswick Dam. Thirteen representative tributary streams to Shasta Reservoir were selected for focused examination as part of this assessment, including the five primary tributaries: Sacramento River, McCloud River, Pit River, Squaw Creek, and Big Backbone Creek.

Considerations for reservoir and tributary fisheries include the following:

- Connectivity to tributary spawning/refuge habitat.
- Potential connectivity to nonfish-bearing streams.
- Potential impacts to special-status species or their habitat from inundation of stream habitat (e.g., through increased turbidity/erosion/sedimentation that may affect connectivity or create a barrier).

Chinook Salmon Between Keswick Dam and Red Bluff Diversion Dam

SALMOD is a computer model that simulates the dynamics of freshwater salmonid populations, but for the SLWRI, SALMOD simulates population dynamics for all four runs of Chinook salmon between Keswick Dam and RBDD. SALMOD was applied to this project because the model had been previously used on the upper Sacramento River (from Keswick Dam to Battle Creek), and has been updated using model parameters and techniques developed for use on the Klamath River and from Sacramento River-specific Chinook salmon information obtained from USFWS and DFG fisheries biologists (Bartholow 2003; Modeling Appendix, Chapter 5). Also, resource agency personnel were presented with the capabilities of the model by John Bartholow (formerly with the U.S. Geological Survey) under contract by Reclamation, and agreed that using SALMOD was the appropriate means of evaluating potential conditions. John Bartholow and John Heasley (contractor to U.S. Geological Survey) were instrumental in extending SALMOD to assess fish production and mortality between Keswick Dam and the RBDD. They also assisted in preparation of the SALMOD description included in the Modeling Appendix, Chapter 5, which contains a detailed discussion of the SALMOD model.

Comprehensive Plans Evaluated SALMOD used weekly streamflow and water temperature to evaluate six different scenarios: the Existing Condition, No-Action Alternative, CP1, CP2, CP3, and CP4. The Existing Condition is based on a 2005 level of development. The No-Action Alternative represents the Future Conditions (2030) without completion of a project to address the objectives of the SLWRI. CP1 is based on a 6.5-foot dam raise; CP2 is based

on a 12.5-foot dam raise; and CP3 is based on an 18-foot dam raise. CP4 was developed based on an 18.5-foot dam raise with operations modified to create a more “fish-friendly” environment, with one-third of the reservoir storage dedicated to fish, to either improve flows or water temperatures.

Additional scenarios were evaluated, but not pursued further, due to inconsistencies or lack of achievement of the primary goals of the project.

In the original presentation (August 16, 2005) of the SALMOD model to resource agency personnel, interest was expressed in setting the number of spawning adults at the AFRP production goal for the Sacramento River upstream from the RBDD. The AFRP defined natural production to be that portion of Chinook salmon not produced in hatcheries, and defined total production to be the sum of harvest and escapement. The production goals include adult fish removed from the system due to both sport and commercial fishing in both freshwater and marine environments. Therefore, SALMOD was run using the appropriate number of spawners (Table 11-3).

SALMOD was also conducted using a spawning population based on the 1999 to 2006 average adult return provided by DFG (2011), which documents spawning escapement estimates for each year in the Central Valley. Using this average was expected to result in a more realistic effect of the project operations on salmon under the Existing Condition, and on the premise that the AFRP goals should take the populations closer to a state of carrying capacity. Thus, if a population is already at or nearing carrying capacity, increases in the populations are unlikely. The starting year for calculating the average number of spawners was in 1999 because the effects of the TCD began in 1999, and ended in 2006, which was the extent of collected and processed data.

Populations of 500 or more salmon are considered necessary for accurate results using SALMOD because it is a deterministic model that relies on the "law of large numbers." When populations are "low" (an arbitrary term), mean responses are quickly affected by environmental stochasticity and individual variability, which are factors SALMOD was not designed to address. Therefore, because the 1999 to 2006 average for spring-run Chinook salmon was 207 adult spawners, the criterion of 500 or more fish was not met. However, because of concerns expressed by DFG and USFWS, the spawning population was left at 207 fish for purposes of the model.

Table 11-3. Number of Spawning Fish Incorporated into SALMOD Model

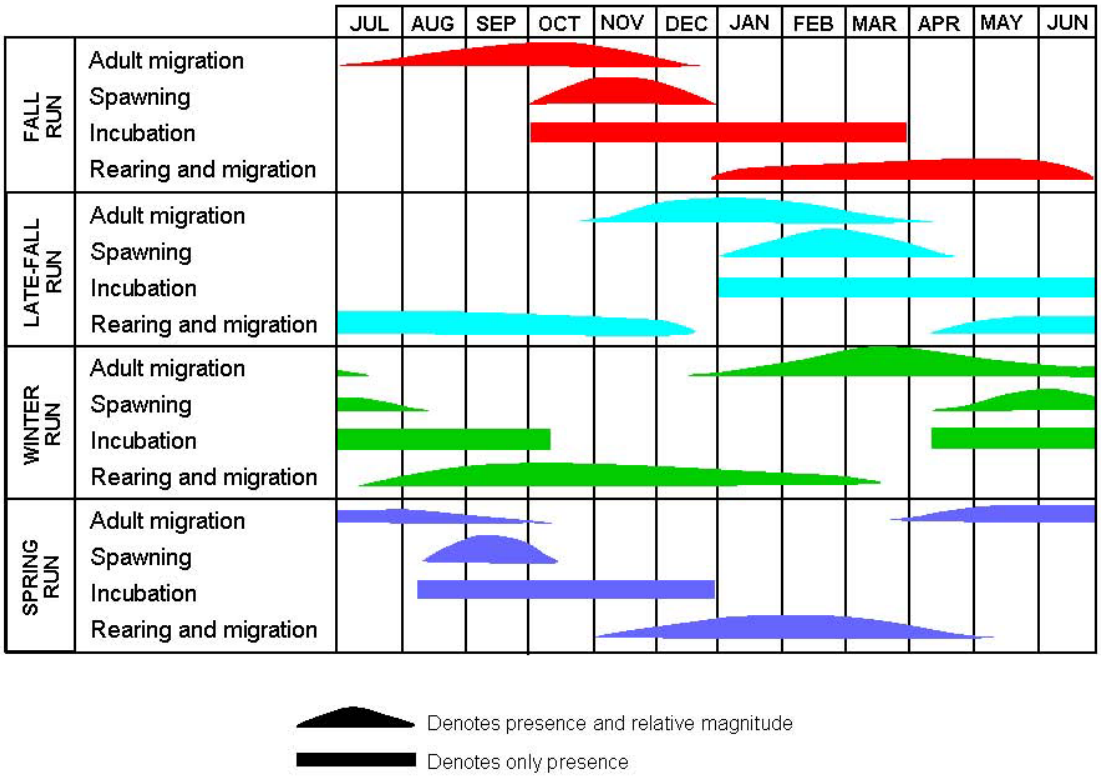
Reach	Fall-Run	Late Fall-Run	Winter-Run	Spring-Run
California Department of Fish and Game (Grand Tab, 1999 through 2006 average)				
Keswick to ACID	6,658	4,725	3,591	9
ACID to Highway 44 Bridge	4,011	2,096	1,761	39
Highway 44 Bridge to Airport Road Bridge	7,175	3,123	3,041	67
Airport Road Bridge to Balls Ferry Bridge	12,405	2,507	163	36
Balls Ferry Bridge to Battle Creek	8,337	767	9	22
Battle Creek to Jellys Ferry Bridge	12,146	282	9	31
Jellys Ferry Bridge to Bend Bridge	8,789	130	17	3
Bend Bridge to RBDD Inundation Zone	5,044	67	0	0
Total Adult Spawners	**64,565**	**13,697**	**8,591**	**207**
Potential Eggs	**154,955,000**	**32,865,000**	**12,369,000**	**495,000**
U.S. Fish and Wildlife Service (AFRP goals)				
Keswick to ACID	10,218	9,761	19,320	1,003
ACID to Highway 44 Bridge	6,174	4,328	9,455	4,235
Highway 44 Bridge to Airport Road Bridge	10,925	6,447	16,358	7,021
Airport Road Bridge to Balls Ferry Bridge	19,022	6,169	886	3,901
Balls Ferry Bridge to Battle Creek	12,731	1,591	66	2,340
Battle Creek to Jellys Ferry Bridge	18,629	597	26	3,343
Jellys Ferry Bridge to Bend Bridge	13,427	278	106	334
Bend Bridge to RBDD Inundation Zone	7,705	146	0	0
Total Adult Spawners	**98,830**	**28,318**	**46,218**	**22,178**
Potential Eggs	**237,200,000**	**67,960,000**	**66,552,000**	**53,220,000**

Note:
Spawners include males and females.
Key:
ACID = Anderson-Cottonwood Irrigation District
AFRP = Anadromous Fish Restoration Program

SALMOD Output SALMOD produces many forms of output files, but two basic output files – production and mortality (both weekly and annual) – were used in this assessment. Two types of mortality were calculated – those caused by the operations (triggered by changes in flow and water temperature) and those that are nonoperations-related (mortalities caused by factors that would still occur without the project in effect, such as disease, predation, and entrainment). Mortality was calculated for each life stage, from migrating/holding adult to the emigrating juvenile.

SALMOD evaluated five separate life stages of Chinook salmon – adult, egg, fry, presmolt, and immature smolt. Figure 11-1 shows the timing for each life stage. Mortality of adults in SALMOD was calculated during the adult migration and spawning time periods. Mortality of eggs (both eggs and in-gravel alevins) was calculated during the adult migration, spawning, and

incubation stages, while fry, presmolts, and immature smolts were calculated during the rearing and migration time period.



Source: Vogel and Marine 1991

Figure 11-1. Approximate Timing of the Four Runs of Chinook Salmon in the Sacramento River

Production SALMOD defines production as follows:

Production = (Potential eggs + entrants) – (prespawn egg mortality + other mortality + residuals)

Where:

- Production is the number of young fish surviving to migrate downstream from the RBDD
- Potential eggs are the number of eggs that could be spawned, providing there is no prespawn mortality of either adult females or eggs *in vivo*
- Entrants are the number of young fish entering the project reach (Keswick Dam to RBDD) from the tributaries
- Mortality is the number of eggs and/or fish that die before leaving the project reach

- Residuals are the number of young fish under 60 mm that, after 52 weeks, have not left the project reach

Mortality The mortality process computed all mortality not explicitly included with one of the other processes. This includes mortality from unsuitable water temperature (Reclamation 1991), population density, superimposition, and eggs while *in vivo* and incubating. In addition, a base mortality for all causes not related to any other process (e.g., entrainment, predation) was also computed.

Categories of mortality calculated in SALMOD include the following and are further described in Chapter 5 of the Modeling Appendix:

- **Nonoperations Related Mortality**
  - **Base (Nonoperational) –** An accounting of mortality of adults, eggs, fry, presmolts, and immature smolts for everything other than what is in the model, or background mortality (mortality that would occur regardless of the project operations) from factors such as predation, disease, etc.
  - **Seasonal (Nonoperational) –** Extra outmigration mortality of presmolts or immature smolts, including diversion-related mortality.
- **Operations-Related Mortality**
  - **Habitat –** Operations-related mortality resulting from forced movement of fry, presmolts, or immature smolts due to habitat constraints.
  - **Temperature –** Operations-related mortality to adults, eggs, fry, presmolts, and/or immature smolts caused by unsuitable water temperatures.
  - **Lost Egg –** Number of eggs lost due to the lack of spawning habitat (a single adult Chinook salmon female cannot spawn because all redds are guarded). It was assumed that these eggs are shed, but as they are alive when leaving the female spawners, they were tallied in the mass balance table. The lack of spawning habitat could be due to lack of spawning gravel, or lower flows precluding access to suitable spawning habitat.
  - ***In Vivo* –** Number of eggs lost because of operations-related water temperature mortality within the female either prior to spawning, or prespawning, thermal mortality in which exposure kills the egg or malformed young fish after spawning.

  - **Incubation –** Number of eggs lost if redds (or portions of redds) are affected by changing egg incubation habitat through the duration of the incubation season due to flushing flows scouring out the redds (occurs at a minimum of 60,000 cfs) or redd dewatering from a drop in streamflows resulting from operations-related actions.

  - **Superimposition –** Number of eggs lost due to new spawning on top of a currently incubating redd resulting from operations-related activities.

- **Analysis –** To evaluate the effects of the project, productions and mortalities were calculated and the differences between the project alternatives and the No-Action Alternative and the Existing Condition were then compared. Most of the years for each run showed minimal differences from the No-Action Alternative, creating an overall average production approaching zero. Each model has its own inherent level of error. In addition, flow data derived from CalSim-II had to be disaggregated from monthly data to weekly, resulting in potential additional error. Because water-year type affects Chinook salmon populations, separate production trends based on water-year type were evaluated for each run.

  Starting populations used in SALMOD were derived from an average population for the years 1999 through 2006, based on the DFG Grandtab table (2011), which lists population estimates on a yearly basis. The AFRP populations were based on the goals identified for the Sacramento River for each run of Chinook salmon.

  Although water year classifications are somewhat arbitrary, and the biological year for each run of Chinook salmon encompasses portions of two separate water years, mortalities caused by operations were separated by water-year types to identify trends, such as changes in mortality in critical water years due to unsuitable water temperatures. Once the years were separated by water-year type, the mortality categories were ranked to determine which mortality category under each alternative was the primary factor affecting production for each run.

  The SLWRI has the greatest variations in project operations from the Existing Condition, No-Action Alternative, and the Comprehensive Plans during critical and dry water years (for further detail, refer to the *Hydrology, Hydraulics and Water Management Technical Report*). Besides providing a more reliable water source for delivery, CP1 through CP5 are able to provide more suitable flows and water temperatures during critical and dry water years. This is shown in increased production and/or decreased operations-related mortalities.

Because CP5 is operated the same as CP3, all results for CP5 are synonymous with CP3 and are not listed in the table of results.

Delta Fisheries

Delta Outflow Water development has changed the volume and timing of freshwater flows through the Bay-Delta. Over the past several decades, the volume of the Bay-Delta's freshwater supply has been reduced by upstream diversions, in-Delta use, and Delta exports. As a result, the proportion of Delta outflow depleted by upstream and Delta diversions has grown substantially. In wet years, diversions reduce outflow by 10 percent to 30 percent. In dry years, diversions may reduce outflow by more than 50 percent.

Water development has also altered the seasonal timing of flows passing into and through the Bay-Delta. Flows have decreased in April, May, and June and have increased slightly during the summer and fall (SFEP 1992). Seasonal flows influence the transport of eggs and young organisms (e.g., zooplankton, fish eggs, larvae) through the Delta and into San Francisco Bay. Flows during the months of April, May, and June play an especially important role in determining the reproductive success and survival of many estuarine species, including salmon, striped bass, American shad, delta smelt, longfin smelt, splittail, and others (Stevens and Miller 1983; Stevens et al. 1985; Herbold 1994; Meng and Moyle 1995).

For purposes of evaluating the potential effect of changes in outflow on fish habitat within the Bay-Delta, and considering the accuracy and inherent noise within the hydrologic model, it was assumed that changes in the average monthly flows that were less than 5 percent (plus or minus) relative to the basis-of-comparison would not be expected to result in a significant (detectable) effect on habitat quality or availability. It would also not be expected to result in a significant effect on the transport mechanisms provided by Delta outflow, on resident or migratory fish or the zooplankton and phytoplankton on which they rely for a food resource.

Delta Inflow Changes in upstream reservoir storage have the potential to affect Delta inflow (water entering the Delta). Delta inflow may affect hydrologic conditions within Delta channels, hydraulic residence times, salinity gradients, and the transport and movement of various life stages of fish, invertebrates, phytoplankton, and nutrients into and through the Delta. Delta inflow serves as a surrogate metric for a variety of habitat conditions within the Delta that directly or indirectly affect fish and other aquatic resources.

The comparison includes the estimated average monthly inflow under the basis-of-comparison conditions (Existing Condition and No-Active Alternative), the average monthly flow under each of project alternatives evaluated, and the percentage change between base flows and operations. For purposes of evaluating the potential effect of changes in Delta inflow on fish habitat within the Bay-Delta, and considering the accuracy and inherent noise within the

hydrologic model, it was assumed that changes in the average monthly flows that were less than 5 percent (plus or minus) relative to the basis-of-comparison would not be expected to result in a significant (detectable) effect on habitat quality or availability, or the transport mechanisms provided by Delta inflow, on resident or migratory fish or the zooplankton and phytoplankton that they rely on for a food resource.

Sacramento River Inflow Flow within the Sacramento River has been identified as an important factor affecting the survival of emigrating juvenile Chinook salmon, important to the downstream transport of planktonic fish eggs and larvae such as delta smelt and longfin smelt, striped bass, and shad, and important for seasonal floodplain inundation that has been identified as important habitat for successful spawning and larval rearing by species such as Sacramento splittail and as seasonal foraging habitat for juvenile Chinook salmon and steelhead. Sacramento River flows are also important in the transport of organic material and nutrients from the upper regions of the watershed downstream into the Delta. A reduction in Sacramento River flow as a result of SLWRI alternative operations, depending on the season and magnitude of change, could adversely affect habitat conditions for both resident and migratory fish species. An increase in river flow is generally considered to be beneficial for aquatic resources within the normal range of typical project operations and flood control. Very large changes in river flow could also affect sediment erosion, scour, deposition, suspended and bedload transport, and other geomorphic processes within the river and watershed.

For purposes of evaluating the potential effect of changes in Sacramento River inflow on fish habitat within the Bay-Delta, and considering the accuracy and inherent noise within the hydrologic model, it was assumed that changes in the average monthly flows less than 5 percent (plus or minus) relative to the basis-of-comparison would not be expected to result in a significant (detectable) effect on habitat quality or availability, or the transport mechanisms provided by Sacramento River inflow, on resident or migratory fish or the zooplankton and phytoplankton that they rely on for a food resource.

San Joaquin River Flow at Vernalis Flow within the San Joaquin River has been identified as an important factor affecting the survival of juvenile Chinook salmon migrating downstream from the tributaries through the mainstem San Joaquin River and Delta, important to the downstream transport of planktonic fish eggs and larvae such as striped bass, and important for seasonal floodplain inundation that is considered to be important habitat for successful spawning and larval rearing by species such as Sacramento splittail and as seasonal foraging habitat for juvenile Chinook salmon. San Joaquin River flows are also important in the transport of organic material and nutrients from the upper regions of the watershed downstream into the Delta. A reduction in San Joaquin River flow as a result of SLWRI alternative operations, depending on the season and magnitude of change, could adversely affect habitat conditions for both resident and migratory fish species. An increase in river flow is

generally considered to be beneficial for aquatic resources within the normal range of typical project operations and flood control. Very large changes in river flow could also affect sediment erosion, scour, deposition, suspended and bedload transport, and other geomorphic processes within the river and watershed.

For purposes of evaluating the potential effect of changes in San Joaquin River flow at Vernalis on fish habitat within the Bay-Delta, and considering the accuracy and inherent noise within the hydrologic model, less than a 5 percent change (plus or minus) relative to the basis-of-comparison, would not be expected to result in a significant (detectable) effect on habitat quality or availability, or the transport mechanisms provided by San Joaquin River flow at Vernalis, on resident or migratory fish or the zooplankton and phytoplankton that they rely on for a food resource.

Entrapment Zone and X2 In many segments of the Bay-Delta, but particularly in Suisun Bay and the Delta, salinity is controlled by the balance of saltwater intrusion from San Francisco Bay and freshwater flow from the tributaries to the Delta. By altering the timing and volume of flows, water development has affected salinity patterns in the Delta and in parts of San Francisco Bay (SFEP 1992). Under natural conditions, the Carquinez Strait/Suisun Bay region marked the approximate boundary between saltwater and freshwater in the Bay-Delta during much of the year. In the late summer and fall of drier years, when Delta outflow was minimal, seawater moved into the Delta from San Francisco Bay. Beginning in the 1920s, following several dry years and because of increased upstream storage and diversions, salinity intrusions became more frequent and extensive.

Since the 1940s, releases of freshwater from upstream storage facilities have increased Delta outflows during summer and fall. These flows have correspondingly limited the extent of salinity intrusion into the Delta. Reservoir releases have helped to ensure that the salinity of water diverted from the Delta is acceptable during the summer and late fall for farming, municipal, and industrial uses (SFEP 1992).

Salinity is an important habitat factor in the Bay-Delta. All estuarine species are assumed to have optimal salinity ranges, and their survival may be affected by the amount of habitat available within the species' optimal salinity range. Because the salinity field in the Bay-Delta is largely controlled by freshwater outflows, the level of outflow may determine the surface area of optimal salinity habitat that is available to the species (Hieb and Baxter 1993, Unger 1994).

The transition area between saline waters within the Bay and freshwater within the rivers, frequently referred to as the low salinity zone, is located within Suisun Bay and the western Delta. The low salinity zone has also been associated with the entrapment zone, a region of the Bay-Delta characterized by higher levels of particulates, higher abundances of several types of organisms,

and a turbidity maximum. It is commonly associated with the position of the 2 parts per thousand salinity isopleth (X2), but actually occurs over a broader range of salinities (Kimmerer 1992). Originally, the primary mechanism responsible for this region was thought to be gravitational circulation, a circulation pattern formed when freshwater flows seaward over a dense, landward-flowing marine tidal current. However, recent studies have shown that gravitational circulation does not occur in the entrapment zone in all years, nor is it always associated with X2 (Burau et al. 1998). Lateral circulation within the Bay-Delta or chemical flocculation may play a role in the formation of turbidity maximum of the entrapment zone.

As a consequence of higher levels of particulates, the entrapment zone may be biologically significant to some species. Mixing and circulation in this zone concentrates plankton and other organic material, thus increasing food biomass and production. Larval fish such as striped bass, delta smelt, and longfin smelt may benefit from enhanced food resources. Since about 1987, however, the introduced Asian overbite clam population has cropped much of the primary production in the Bay-Delta and there has been virtually no enhancement of phytoplankton production or biomass in the entrapment zone (CUWA 1994).

This region continues to have relatively high levels of invertebrates and larval fish, even though the base of the food chain may not have been enhanced in the entrapment zone during the past decade. Vertical migration of these organisms through the water column at different parts of the tidal cycle has been proposed as a possible mechanism to maintain high abundance in this region, but recent evidence suggests that vertical migration does not provide a complete explanation (Kimmerer et al. 2002).

Although evidence indicates that X2 and the entrapment zone are not as closely related as previously believed (Burau et al. 1998), X2 continues to be used as an index of the location of the entrapment zone and area/or of increased biological productivity. Historically, X2 has varied between San Pablo Bay (River Kilometer 50) during high Delta outflow and Rio Vista (River Kilometer 100) during low Delta outflow. In recent years, it has typically been located between approximately Honker Bay and Sherman Island (River Kilometer 70 to 85). X2 is controlled directly by the volume of Delta outflow, although changes in X2 lag behind changes in outflow. Minor modifications in outflow do not greatly alter X2.

Jassby and Powell (1994) showed that when X2 is in the vicinity of Suisun Bay, several estuarine organisms tend to show increased abundance. However, it is by no means certain that X2 has a direct effect on any of the species. The observed correlations may result from a close relationship between X2 and other factors that affect these species.

Operations of upstream storage reservoirs have the potential to affect the location of X2 as a result of changes in freshwater flows from the upstream

tributaries through the Delta. For purposes of evaluating changes in habitat quantity and quality for estuarine species, a significance criterion of an upstream change in X2 location within 1 kilometer (km) of the basis-of-comparison condition was considered to be less than significant. The criterion was applied to a comparison of hydrologic model results for basis-of-comparison conditions and project alternatives, by month and water year, for the months from February through May.

Old and Middle River Reverse Flows Reverse flows occur when Delta exports and agricultural demands exceed San Joaquin River inflow plus Sacramento River inflow through the DCC, Georgiana Slough, and Threemile Slough. The capacities of the DCC, Georgiana Slough, and Threemile Slough are fixed; therefore, if pumping rates exceed that total capacity, plus flows in Old River and Eastside streams, the pumping causes Sacramento River water to flow around the west end of Sherman Island and then eastward up the San Joaquin River. This condition occurs frequently during dry years with low Delta inflows and high levels of export at the CVP and SWP pumps. The reverse flow condition within the lower San Joaquin River is typically referred to as Qwest. As second reverse flow condition occurs within Old and Middle rivers as the rate of water diverted at the CVP and SWP export facilities exceeds tidal and downstream flows within the central region of the Delta.

Reverse flows in Old and Middle rivers, resulting from low San Joaquin River inflows and increased exports to the CVP and SWP, have been identified as a potential cause of increased delta smelt mortality at the CVP and SWP fish facilities within recent years (Simi and Ruhl 2005, Ruhl et al. 2006, Wanger 2007 Case 1:05-cv-01207-OWW-NEW). Results of analyses of the relationship between the magnitude of reverse flows in Old and Middle rivers and salvage of adult delta smelt in the late winter shows a substantial increase in salvage as reverse flows exceed approximately -5,000 cfs. Concerns regarding reverse flows in Old and Middle rivers have also focused on planktonic egg and larval stages of striped bass, splittail, and on Chinook salmon smolts, in addition to delta smelt, and while these species do not spawn to a significant extent in the south Delta, eggs and larvae may be transported into the area by reverse flows in Old and Middle rivers. As discussed previously, these early life stages are generally entrained, since they are too small to be effectively screened from export waters.

Old and Middle river reverse flows have been calculated for project alternatives that equate San Joaquin River flow at Vernalis and exports to Old and Middle river flows. Summaries of Old and Middle river reverse flows are included for Existing Conditions, No-Action and action alternatives, by month and water-year type. The most biologically sensate period when the potential effects of reverse flows could affect delta smelt, Chinook salmon, and many other species extends from the late winter through early summer. For purposes of these analyses, a comparison of reverse flows within Old and Middle rivers under the

basis-of-comparison and proposed alternative project operations was prepared for the seasonal period extending from January through June.

CVP and SWP Export Operations Increased exports could increase the risk of entrainment and salvage of resident and migratory fish present in the south Delta, which may include adult delta smelt, juvenile Chinook salmon, steelhead, striped bass, and other species of fish as well as macroinvertebrates and nutrients. Increased exports during drier water years in the summer could result in an increased risk of entrainment and salvage for juvenile delta smelt and salmon (June) and resident warm-water fish such as striped bass, threadfin shad, catfish, and others during the warmer summer months (July through August). Increased exports could also increase the entrainment and removal of phytoplankton, zooplankton, macroinvertebrates, organic material, and nutrients from the Delta.

Estimated Fish Entrainment/Losses Changes in the volume of water exported at the CVP and SWP facilities is assumed to result in a direct proportional increase or decrease in the risk of fish being entrained and salvaged at the facilities. Using information from the hydrodynamic operations model, in combination with information on the densities of various fish species observed at the salvage facilities, an index in the form of a change in the numbers of a fish species theoretically affected by a change in export operations can be developed. Fish lost to entrainment/salvage at the CVP and SWP were estimated based on monthly estimated combined exports. The project alternatives were modeled in CalSim and assume, for each alternative, that the project would be implemented under the Existing Condition, and under the Future Condition. Both the Existing Condition, or "existing base" conditions, and future base conditions, or "future No-Action Alternative" conditions – which assumes no project was implemented, were assessed.

Data sources used to calculate fish losses at the CVP and SWP consisted of 1995 through 2005 monthly average density data, collected by DWR (2006) at the Skinner Fish Facility and at the Jones Fish Facility located at each export facility, respectively. These density data were calculated for delta smelt, longfin smelt, Chinook salmon, steelhead, striped bass, and splittail. Green sturgeon were considered for this analysis; however, they are seldom collected at the fish facilities, and thus, have not been modeled in the entrainment loss estimates. Fish density data was combined with CalSim results export flows modeled.

From CalSim modeling results, average monthly flows, and average flows per each year from 1922 to 2003 in cfs were converted to acre-feet per each month (January through December), and were then multiplied by monthly average densities (number of fish per acre-foot), for each of the selected fish species. Average monthly fish losses calculated for each year were then averaged by water-year type (e.g., wet, above-normal, normal, below-normal, dry, and critical) for each month, as well as an average across all years (all water-year types), for each month. Fish losses, for each species, were totaled across months

to show the total fish loss for a given species for an average year (all water-year types), wet, above-normal, normal, below-normal, dry, and critical years.

Fish losses resulting from entrainment were calculated two ways, which both produced identical entrainment indices to represent the change in entrainment based on changes in CVP and SWP exports as a result of the SLWRI alternatives:

- Fish losses were estimated by calculating losses under the base conditions, and then by calculating losses under the project alternative, from CalSim modeling. The total number of fish lost under the base case was subtracted from the number lost under the project alternative, indicating whether a net benefit (negative number) or a net loss (positive number) would result from the project alternatives.

- Fish losses were estimated by calculating losses directly from the "Alt minus Base" modeling results in CalSim.

The general calculation of the change in entrainment/salvage risk is shown below:

A = Density of fish per acre-foot for a given fish species (e.g., delta smelt, longfin smelt, salmon, striped bass, steelhead, splittail)

B = Monthly cfs, by year

C = [B x 1.983 x (number of days/month)] = average monthly exports (for CVP+SWP) for a given year, 1922 to 2003, in acre-feet

D = [A] [C] = Average monthly fish loss, per species, in a given year

$D_A = \sum (C_{1922,} C_{1923} \ldots C_{2003})$ = Average monthly fish losses at the CVP + SWP

$D_W = \sum$ (*wet water years*) = Fish losses, by month, at the CVP + SWP, based on wet water years, 1922 to 2003

$D_{AN} = \sum$ (*above-normal water years*) = Fish losses, by month, at the CVP + SWP, based on above-normal water years, 1922 to 2003

$D_N = \sum$ (*normal water years*) = Fish losses, by month, at the CVP + SWP, based on normal water years, 1922 to 2003

$D_{BN} = \sum$ (*below-normal water years*)) = Fish losses, by month, at the CVP + SWP, based on below-normal water years, 1922 to 2003

D_D = $\sum$ (*dry water years*) = Fish losses, by month, at the CVP + SWP, based on dry water years, 1922 to 2003

D_C = $\sum$ (*critical water years*) = Fish losses, by month, at the CVP + SWP, based on critical water years, 1922 to 2003

E_A = ($D_{A\text{-}JANUARY}$ +$D_{A\text{-}FEBRUARY...}$+ $D_{A\text{-}DECEMBER}$) = Total yearly average fish losses, based on monthly average 1922 to 2003 fish losses

E_W = ($D_{W\text{-}JANUARY}$ +$D_{W\text{-}FEBRUARY...}$+ $D_{W\text{-}DECEMBER}$) = Total yearly fish losses in a wet year, based on monthly average 1922 to 2003 fish losses

E_{AN} = ($D_{AN\text{-}JANUARY}$ +$D_{AN\text{-}FEBRUARY...}$+ $D_{AN\text{-}DECEMBER}$) = Total yearly fish losses in a wet year, based on monthly average 1922 to 2003 fish losses

E_N = ($D_{N\text{-}JANUARY}$ +$D_{N\text{-}FEBRUARY...}$+ $D_{N\text{-}DECEMBER}$) = Total yearly fish losses in a wet year, based on monthly average 1922 to 2003 fish losses

E_{BN} = ($D_{BN\text{-}JANUARY}$ +$D_{BN\text{-}FEBRUARY...}$+ $D_{BN\text{-}DECEMBER}$) = Total yearly fish losses in a wet year, based on monthly average 1922 to 2003 fish losses

E_D = ($D_{D\text{-}JANUARY}$ +$D_{D\text{-}FEBRUARY...}$+ $D_{D\text{-}DECEMBER}$) = Total yearly fish losses in a wet year, based on monthly average 1922 to 2003 fish losses

E_C = ($D_{C\text{-}JANUARY}$ +$D_{C\text{-}FEBRUARY...}$+ $D_{C\text{-}DECEMBER}$) = Total yearly fish losses in a wet year, based on monthly average 1922 to 2003 fish losses

Impact Mechanisms

The project could potentially affect fisheries and aquatic ecosystems through the following impact mechanisms:

- Construction-related impacts:
  - Temporary construction-related loss or degradation of aquatic habitat
- Operations-related impacts, including the following:
  - Flow- and/or water temperature-related impacts on species of primary management concern

  - Geomorphic impacts resulting from reduced frequency, duration, and/or magnitude of ecologically important intermediate and peak flows

- Delta flow-related effects, including the following:

  - Delta outflow and inflow related effects on species of primary management concern

  - Effects related to changes in Sacramento River inflow to the Delta

  - San Joaquin River flow-related effects

  - Effects on species of primary management concern resulting from changes in the location of the entrapment zone and X2

  - Effects resulting from reverse flows in Old and Middle rivers

  - Effects of changes in CVP and SWP exports to fish entrainment and salvage

Potential effects resulting from these impact mechanisms were assessed for fish species of primary management concern (i.e., special-status, ecologically important, and recreationally/commercially important fish species) and important aquatic ecological processes that may be affected by construction activities and/or operation located between Shasta Dam and RBDD (i.e., in the primary study area) and within the extended study area.

Fish species of primary management concern for the upper Sacramento River (Shasta Dam to RBDD) portion of the primary study area include the following:

- Four runs of Chinook salmon (winter-, spring-, fall-, and late fall-run)
- Steelhead
- Green sturgeon
- Sacramento splittail
- American shad
- Striped bass

Fish species of primary management concern for the lower Sacramento River to Delta portion of the extended study area include the same fish identified above but also include delta smelt and exclude American shad.

Fish species of primary management concern for the Trinity River portion of the extended study area include the following:

- Chinook salmon
- Steelhead
- Coho salmon
- Green sturgeon
- White sturgeon

The analysis of potential impacts on primary fish species of management concern considered species life history stages (adult migration, spawning, egg incubation, and juvenile rearing and emigration) and biological requirements. For all fish species of primary management concern in the Sacramento River, evaluation of potential impacts on individual life stages was based on life history descriptions provided in the *Fisheries and Aquatic Ecosystems Technical Report*.

Increased water supplies or increased supply reliability also could reduce a limitation on growth or on other activities that could affect aquatic habitats and fishery resources in the primary and extended study areas, resulting in potentially significant impacts. The impacts of this growth would be analyzed in general plan Environmental Impact Report and in project-level CEQA compliance documents for the local jurisdictions in which the growth would occur. Mitigation of these impacts would be the responsibility of these local jurisdictions, and not of Reclamation. The expected increase in water yield relative to the entire CVP and SWP service areas would be small, however, and assuming that this new yield could be provided to any number of geographic areas within the CVP and SWP service areas, the project's impact on growth that could affect aquatic habitats would be minor.

Similarly, projects potentially affecting most aquatic habitats and listed species would require permits from DFG, USACE, USFWS, and NMFS; it is anticipated that effects on aquatic habitats and listed species would be avoided, minimized, and/or mitigated during those agency consultations. Because the extent, location, and timing of induced growth is currently highly uncertain, and in the future the effects of this growth would be analyzed and mitigated during land use planning and environmental review for specific projects, growth-inducing effects on aquatic habitats and fisheries resources are not discussed further in this chapter.

11.3.2 Criteria for Determining Significance of Effects

An environmental document prepared to comply with NEPA must consider the context and intensity of the environmental effects that would be caused by, or result from, the proposed action. Under NEPA, the significance of an effect is used solely to determine whether an Environmental Impact Statement must be prepared. An environmental document prepared to comply with CEQA must identify the potentially significant environmental effects of a proposed project.

A "[s]ignificant effect of the environment" means a substantial, or potentially substantial, adverse change in any of the physical conditions within the area affected by the project (State CEQA Guidelines, Section 15382). CEQA also requires that the environmental document propose feasible measures to avoid or substantially reduce significant environmental effects (State CEQA Guidelines, Section 15126.4(a)).

Significance criteria (sometimes called "thresholds of significance") used in this analysis are based on the checklist presented in Appendix G of the State CEQA Guidelines; factual or scientific information and data; and regulatory standards of Federal, State, and local agencies. These thresholds also encompass the factors taken into account under NEPA to determine the significance of an action in terms of the context and the intensity of its effects.

For the assessment of impacts on fisheries and aquatic ecosystems, habitat indicators for project operations such as water temperature, flows, and important ecological processes have been used to evaluate whether the project alternatives would have an adverse effect on the species and/or species' habitat. For example, exceedence of monthly mean water temperatures identified by NMFS for certain species (e.g., 56ºF at Bend Bridge from April 15 through September 30 for winter-run Chinook salmon) is one such impact on a habitat indicator. Reduction of reservoir WSELs can reduce the availability of nearshore littoral habitat used by warm-water fish for spawning and rearing, thereby reducing spawning and rearing success and subsequent year class strength; therefore, reservoir WSEL is another habitat indicator used. Changes in river flows and water temperatures during certain periods of the year have the potential to affect spawning, fry emergence, and juvenile emigration. Therefore, changes in monthly mean river flows and water temperatures during certain times of the year (during spawning, incubation, and initial rearing) have also been used as habitat impact indicators for species of primary management concern.

The following significance criteria were developed based on guidance provided by the State CEQA Guidelines, and consider the context and intensity of the environmental effects as required under NEPA. Impacts of an alternative on fisheries and aquatic ecosystems would be significant if project implementation would do any of the following:

- Have a substantial adverse effect, either directly or through habitat modifications, on any species identified as a candidate, sensitive, or special-status species in local or regional plans, policies, or regulations or by DFG, USFWS, or NMFS.

- Conflict with the provisions of an adopted habitat conservation plan, natural community conservation plan, or other approved local, regional, or State habitat conservation plan or policies or ordinances protecting biological resources.

- Interfere substantially with the movement of any native resident or migratory fish species or with established habitat, or impede the use of native fish nursery/rearing sites.

- Conflict with a local policy or ordinance that protects aquatic and fishery resources.

- Substantially reduce the habitat of a fish species, cause a fish species to drop below self-sustaining levels, threaten to eliminate a fish or macroinvertebrate community, or substantially reduce the number or restrict the range of an endangered, rare, or threatened fish species.

Significance statements are relative to both the Existing Conditions (2005) and Future Conditions (2030), unless stated otherwise.

11.3.3 Direct and Indirect Effects

This section identifies how aquatic habitats and fish communities could be affected by the project. The project could affect fisheries and aquatic ecosystems through the following:

- Causing construction-related loss or degradation of aquatic habitat in the vicinity of and downstream from Shasta Dam.

- Altering flow regimes and water temperatures downstream from Shasta Dam and downstream from other reservoirs with altered releases.

- Causing a reduction in ecologically important geomorphic processes resulting from reduced frequency and magnitude of intermediate to high flows.

By altering reservoir storage and releases, the project would change flow regimes in downstream waterways. In turn, these alterations to the flow regime could affect fishery resources and important ecological processes on which the fish community depends, particularly their instream and seasonal floodplain habitats along waterways immediately downstream from reservoirs.

No-Action Alternative

Under the No-Action Alternative, the Federal government would take no additional action beyond existing regulatory requirements toward implementing a specific plan to help increase survival of anadromous fish in the Sacramento River, nor would it help address the growing water reliability issues in California. The following discussions highlight the consequences of implementing the No-Action Alternative, as they relate to the objectives of the SLWRI.

Shasta Lake and Vicinity

Impact Aqua-1 (No-Action): Effects on Nearshore, Warm-Water Habitat in Shasta Lake from Project Operations Under the No-Action Alternative, dam enlargement activities would not be implemented. Seasonal fluctuations in the surface area and WSEL of Shasta Lake could be affected, however, by changing water supply demand and regulatory conditions, which could in turn affect the amount of nearshore, warm-water habitat in Shasta Lake. This impact would be potentially significant.

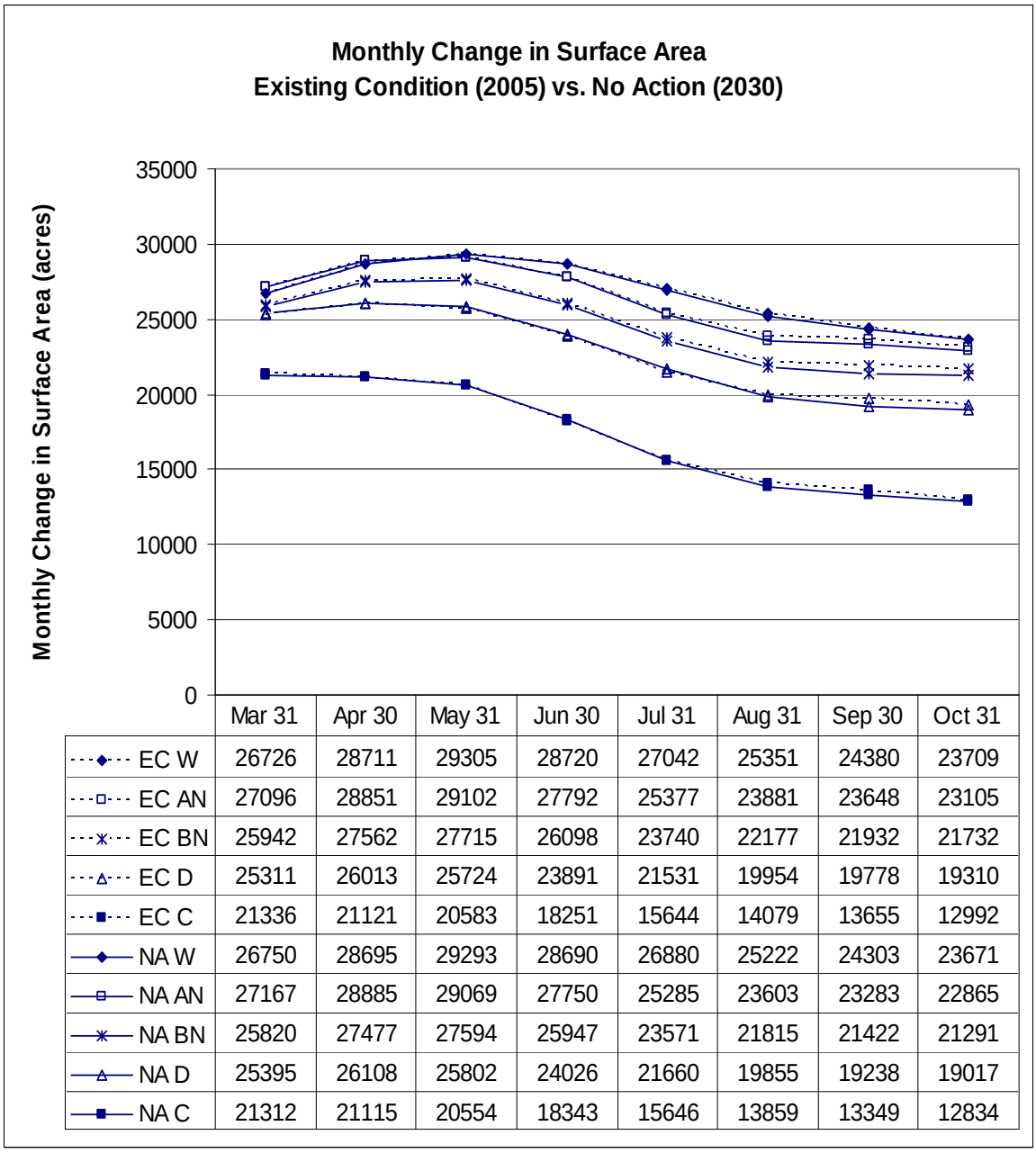
Under the No-Action Alternative with a 2030 water supply demand, the mean surface area of Shasta Lake in all months and all water-year types would be slightly less than under the Existing Condition. The greatest potential decreases would be experienced from September through November in below-normal water years (Figure 11-2). Fluctuations in WSELs are similar for the No-Action Alternative and the Existing Condition for all months except April in a wet water year (Figure 11-3). Overall, the monthly change between March and July trends downward.

Seasonal fluctuations in the surface area and WSEL of Shasta Lake could be affected by changing water supply demand and regulatory conditions. Such fluctuations could have an adverse effect on the quality and quantity of nearshore, warm-warm habitat in the lake. Therefore, this impact would be potentially significant. Mitigation is not required for the No-Action Alternative.

Impact Aqua-2 (No-Action): Effects on Nearshore, Warm-Water Habitat in Shasta Lake from Project Construction Under the No-Action Alternative, dam enlargement activities would not be implemented, and no new facilities would be constructed within the vicinity of Shasta Lake. There would be no impact. Mitigation is not required for the No-Action Alternative.

Impact Aqua-3 (No-Action): Effects on Cold-Water Habitat in Shasta Lake Under the No-Action Alternative, dam enlargement activities would not be implemented. Under this alternative, seasonal fluctuations in the ratio of the volume of cold-water storage in Shasta Lake to the surface area of the lake could be affected by changing water supply demand and regulatory conditions, which could affect the amount of cold-water habitat, including habitat for rainbow trout, a USFS sensitive species. This impact would be potentially significant. Mitigation is not required for the No-Action Alternative.

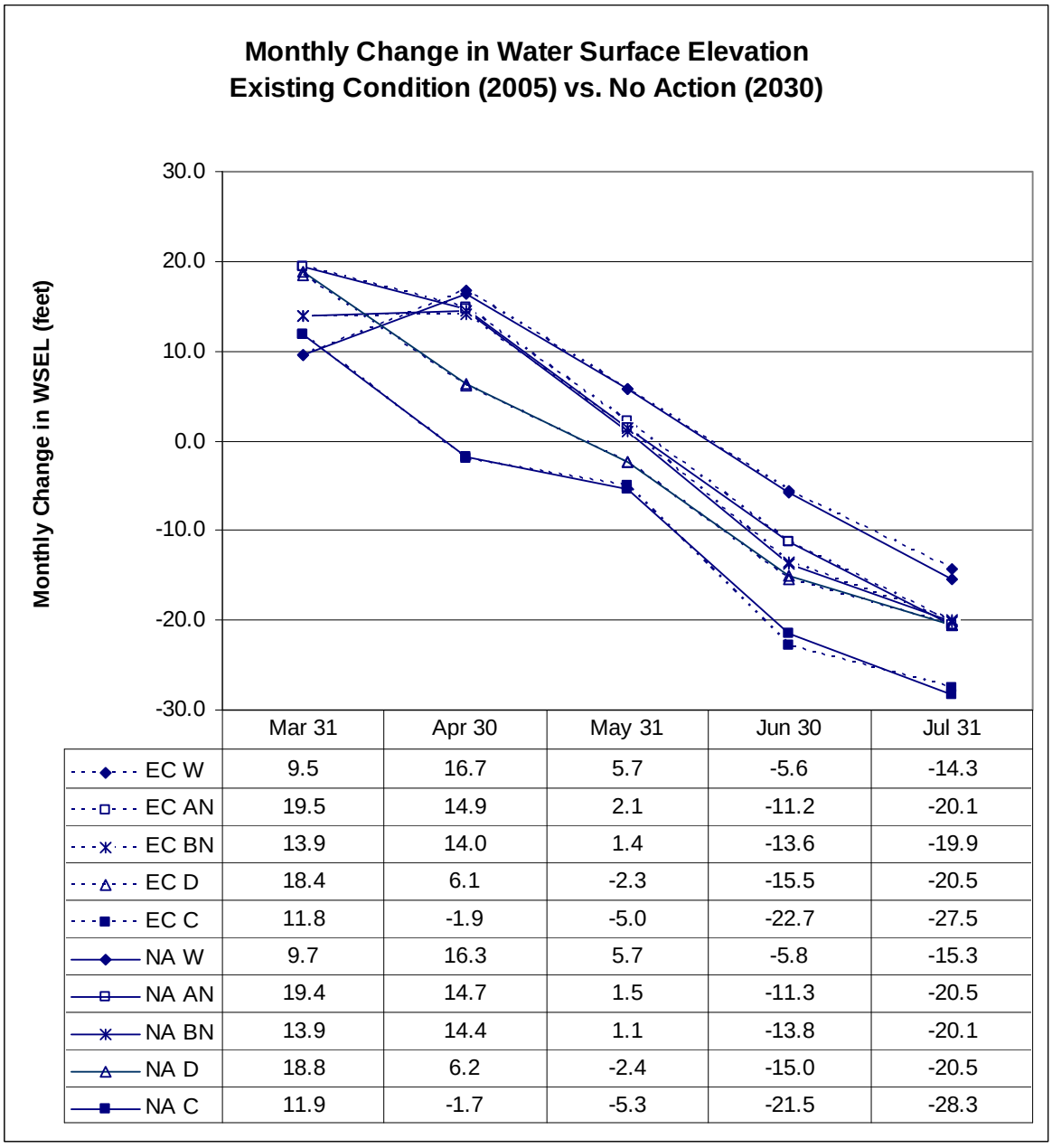
Impact Aqua-4 (No-Action): Effects on Special-Status Aquatic Mollusks Under the No-Action Alternative, dam enlargement activities would not be implemented. Seasonal fluctuations in the surface area and WSEL of Shasta Lake in response to water demand and regulatory conditions could affect special-status aquatic mollusks that may occupy habitat in or near Shasta Lake and its tributaries. These impacts would continue to occur under this alternative. This impact would be less than significant.



	Mar 31	Apr 30	May 31	Jun 30	Jul 31	Aug 31	Sep 30	Oct 31
EC W	26726	28711	29305	28720	27042	25351	24380	23709
EC AN	27096	28851	29102	27792	25377	23881	23648	23105
EC BN	25942	27562	27715	26098	23740	22177	21932	21732
EC D	25311	26013	25724	23891	21531	19954	19778	19310
EC C	21336	21121	20583	18251	15644	14079	13655	12992
NA W	26750	28695	29293	28690	26880	25222	24303	23671
NA AN	27167	28885	29069	27750	25285	23603	23283	22865
NA BN	25820	27477	27594	25947	23571	21815	21422	21291
NA D	25395	26108	25802	24026	21660	19855	19238	19017
NA C	21312	21115	20554	18343	15646	13859	13349	12834

Key:
AN = above-normal water
BN= below-normal water years
C = critical water years
CP = Comprehensive Plan
D = dry water years
EC = Existing conditions
NA = No-Action
W = wet water years

Figure 11-2. Monthly Surface Area (in acres) for Each Water-Year Type Within the Shasta Lake Vicinity of the Primary Study Area, Existing Condition vs. No-Action Alternative



	Mar 31	Apr 30	May 31	Jun 30	Jul 31
EC W	9.5	16.7	5.7	-5.6	-14.3
EC AN	19.5	14.9	2.1	-11.2	-20.1
EC BN	13.9	14.0	1.4	-13.6	-19.9
EC D	18.4	6.1	-2.3	-15.5	-20.5
EC C	11.8	-1.9	-5.0	-22.7	-27.5
NA W	9.7	16.3	5.7	-5.8	-15.3
NA AN	19.4	14.7	1.5	-11.3	-20.5
NA BN	13.9	14.4	1.1	-13.8	-20.1
NA D	18.8	6.2	-2.4	-15.0	-20.5
NA C	11.9	-1.7	-5.3	-21.5	-28.3

Key:
AN = above-normal water
BN= below-normal water years
C = critical water years
CP = Comprehensive Plan
D = dry water years
EC = Existing Condition
NA = No-Action
W = wet water years
WSEL = water surface elevation

Figure 11-3. Monthly Change in WSEL (in feet) for Each Water-Year Type Within the Shasta Lake Vicinity of the Primary Study Area, Existing Condition vs. No-Action Alternative

One special-status mollusk, the California floater, occurs in Shasta Lake, and nine other special-status mollusks could occupy seeps, springs, or tributaries surrounding the reservoir. However, information regarding these species' distributions and abundance is limited, which precludes fully quantifying the impacts of the No-Action Alternative on these organisms and their habitat.

Except for the California floater, it is not known if other special-status mollusks occupy habitat in or near Shasta Lake and its tributaries. The California floater is a bivalve that resides in soft sediment on stream and lake beds and, therefore, could be adversely affected by seasonal fluctuations in the WSEL of the lake that currently exists. This impact would be less than significant. Mitigation is not required for the No-Action Alternative.

Impact Aqua-5 (No-Action): Effects on Special-Status Fish Species Under the No-Action Alternative, dam enlargement activities would not be implemented. However, one fish species occurring within the primary study area and designated as sensitive by USFS could be affected by seasonal fluctuations in the surface area and WSEL of Shasta Lake in response to changing water demand and regulatory conditions; however, this impact would be less than significant.

The hardhead minnow is designated as sensitive by USFS and is known to occur in Shasta Lake. Two other USFS sensitive species, rough sculpin (in the Pit River) and redband trout (in the upper McCloud River), are known to occur upstream from Shasta Lake, but their presence have not been documented in Shasta Lake or in their respective tributaries within the primary study area. The analysis of the No-Action Alternative therefore excludes consideration of these two special-status species.

Fluctuations in the surface area and WSEL of Shasta Lake under the No-Action Alternative could interfere with the connectivity to riverine habitat preferred by hardhead in tributaries that drain into Shasta Lake. However, access to riverine habitat among all the main tributaries to the reservoir would not likely become any more limiting than under current conditions. Therefore, this impact would be less than significant. Mitigation is not required for the No-Action Alternative.

Impact Aqua-6 (No-Action): Creation or Removal of Barriers to Fish Between Tributaries and Shasta Lake Under the No-Action Alternative, dam enlargement activities would not be implemented, and tributaries to Shasta Lake would continue to respond to fluctuations in reservoir levels. New barriers would not be created or removed that could impede or facilitate the movement of native and nonnative fish species between Shasta Lake and its tributaries. There would be no impact. Mitigation is not required for the No-Action Alternative.

Impact Aqua-7 (No-Action): Effects on Spawning and Rearing Habitat of Adfluvial Salmonids in Low-Gradient Tributaries to Shasta Lake Under the No-Action Alternative, dam enlargement activities would not be implemented, and there would be no change to spawning and rearing habitat for adfluvial salmonids in low-gradient tributaries to Shasta Lake. There would be no impact. Mitigation is not required for the No-Action Alternative.

Impact Aqua-8 (No-Action): Effects on Aquatic Connectivity in Non-Fish-Bearing Tributaries to Shasta Lake Under the No-Action Alternative, dam enlargement activities would not be implemented. Therefore, aquatic connectivity in non-fish-bearing streams would not be affected. There would be no impact. Mitigation is not required for the No-Action Alternative.

Impact Aqua-9 (No-Action): Effects on Water Quality at Livingston Stone Hatchery Under the No-Action Alternative, dam enlargement activities would not be implemented. Therefore, there would be no changes to the water system that supplies high-quality water to the Livingston Stone Hatchery. There would be no impact. Mitigation is not required for the No-Action Alternative.

Upper Sacramento River (Shasta Dam to RBDD)

Impact Aqua-10 (No-Action): Loss or Degradation of Aquatic Habitat in the Upper Sacramento River During Construction Activities Under the No-Action Alternative, there would be no construction-related loss or degradation of aquatic habitat and no variation in CVP and SWP reservoir storage levels in the upper Sacramento River or tributaries associated with project alternatives. It is anticipated that, if the project alternatives were not implemented, actions to protect the fisheries and aquatic resources would continue under existing regulatory requirements, including other CALFED actions intended to protect and enhance fisheries resources. Therefore, there would be no construction-related impacts on fisheries and aquatic ecosystems associated with the No-Action Alternative. Mitigation is not required for the No-Action Alternative.

Impact Aqua-11 (No-Action): Release and Exposure of Contaminants in the Upper Sacramento River During Construction Activities Under the No-Action Alternative, there would be no construction-related contaminant exposure in the upper Sacramento River or tributaries associated with project alternatives. It is anticipated that, if the project alternatives were not implemented, actions to protect the fisheries and aquatic resources would continue under existing regulatory requirements, including other CALFED actions intended to protect and enhance fisheries resources. Therefore, there would be no construction-related impacts on fisheries and aquatic ecosystems associated with the No-Action Alternative. Mitigation is not required for the No-Action Alternative.

Impact Aqua-12 (No-Action): Changes in Flow and Water Temperature in the Upper Sacramento River Resulting from Project Operation – Chinook Salmon Flow releases would continue to be operated in compliance with existing BOs, which represent the regulatory baseline. However, it is anticipated that climate

change would result in an increase in water temperatures in the upper Sacramento River (NMFS 2009), which could make it much more difficult, especially in critical water years, to meet the water temperature requirements needs for all runs of Chinook salmon, particularly winter-run Chinook salmon. As a result, Chinook salmon in the upper Sacramento River could experience potentially significant impacts. Mitigation is not required for the No-Action Alternative.

Impact Aqua-13 (No-Action): Changes in Flow and Water Temperature in the Upper Sacramento River Resulting from Project Operation – Steelhead, Green Sturgeon, Sacramento Splittail, American Shad, and Striped Bass Flow releases would continue to be operated in compliance with existing BOs, which represent the regulatory baseline. However, it is anticipated that climate change would result in an increase in water temperatures (NMFS 2009). This could make it much more difficult, especially in critical water years, to meet the water temperature requirements needs for steelhead, green sturgeon, Sacramento splittail, American shad, and striped bass. As a result, fishes in the upper Sacramento River could experience potentially significant impacts. Mitigation is not required for the No-Action Alternative.

Impact Aqua-14 (No-Action): Reduction in Ecologically Important Geomorphic Processes in the Upper Sacramento River Resulting from Reduced Frequency and Magnitude of Intermediate to High Flows Under the No-Action Alternative, there would be no change to the geomorphic processes in the upper Sacramento River. Mitigation is not required for the No-Action Alternative.

Lower Sacramento River, Tributaries, Delta and Trinity River Under the No-Action Alternative, there would be no project-related alteration of CVP and SWP reservoir storage levels, river flows, or water temperatures in the lower Sacramento River or Delta. It is anticipated that if the project alternatives were not implemented, actions to protect fisheries and benefit aquatic environments would continue under existing regulatory requirements, including other CALFED actions intended to protect and enhance fisheries resources. Compliance with existing BOs would result in continued pumping curtailments, particularly in dry years. Reclamation and the DWR would continue to attempt to reoperate the CVP and SWP, respectively, to avoid decreased deliveries to export users. Therefore, there would be no project-related impacts changes on fisheries and aquatic ecosystems associated with the No-Action Alternative.

Under the No-Action Alternative, there would be no project-related alteration of CVP and SWP reservoir storage levels, river flows, or water temperatures in the Trinity River. Therefore there would be no impacts associated with the No-Action Alternative to the aquatic resources in the Trinity River.

CVP/SWP Service Areas Under the No-Action Alternative, there would be no project-related change in CVP and SWP operations or deliveries to the CVP and SWP service areas. It is anticipated that if the project alternatives were not

implemented, actions to protect fisheries and benefit aquatic environments would continue under existing regulatory requirements, including other CALFED actions and existing BOs intended to protect and enhance fisheries resources.

CP1 – 6.5-Foot Dam Raise, Anadromous Fish Survival and Water Supply Reliability

CP1 focuses on increasing water supply reliability while contributing to increased survival of anadromous fish, actions that are consistent with the 2000 CALFED ROD. CP1 consists primarily of raising Shasta Dam by 6.5 feet, an elevation change that would increase the reservoir's full pool elevation by 8.5 feet and would enlarge the total storage space in the reservoir by 256,000 acre-feet. Under CP1, Shasta Dam operational guidelines would continue unchanged, with the additional storage retained for water supply reliability. CP1 would help to reduce future water shortages by increasing the reliability of the water supply in drought and average water years. The increased pool depth and volume would also contribute to maintaining lower seasonal water temperatures and more reliable flows on the upper Sacramento River for anadromous fish.

Shasta Lake and Vicinity

Impact Aqua-1 (CP1): Effects on Nearshore, Warm-Water Habitat in Shasta Lake from Project Operations Under CP1, project operations would contribute to an increase in the surface area and WSEL of Shasta Lake, which would in turn increase the area and productivity of nearshore, warm-water habitat. Project operations would also result in reduced monthly fluctuations in the WSEL, which would contribute to increased reproductive success, young-of-the-year production, and the juvenile growth rate of warm-water fish species. The increase in the WSEL will influence riparian vegetation, including willow species planted to enhance lacustrine habitat, likely resulting in some amount of willow mortality. The increase in the WSEL will also influence the effectiveness of the brush structures that have been introduced by the STNF at various locations within the current drawdown zone of Shasta Lake. While the value of these structural improvements will be influenced by an overall increase in the maximum WSEL, these structures will continue to function to varying degrees under the operational conditions established for CP1. These impacts to structural habitat improvements are expected to be localized and will vary as the brush structures age and riparian vegetation readjusts to a new baseline condition. The retention of vegetation along more than 40 percent of the increased shoreline area that would be subject to inundation as a result of CP1 is expected to offset reductions in effective structural habitat improvements for a period of time. The benefits of inundated vegetation will decrease over time (e.g., 10-20 years) as the vegetation decays and the shoreline erosion processes expand into the new drawdown zone. . This impact would be less than significant..

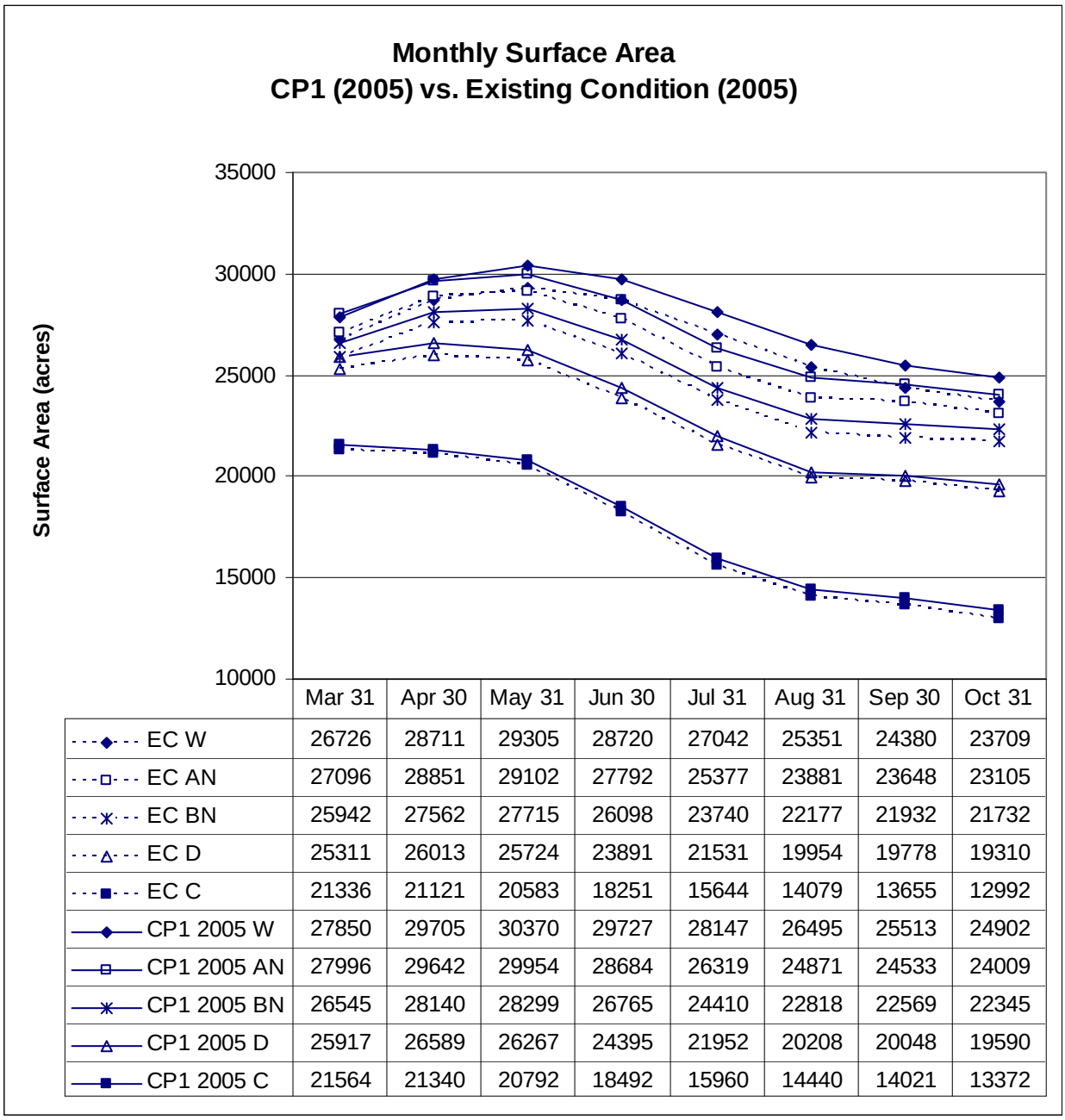
Biological productivity is greatest in the upper, lighted layer of the reservoir, where most plankton production occurs. An increase in the surface area of the

reservoir could affect warm-water habitat by increasing the area of littoral (nearshore) habitat, which could result in increased biological productivity. Increased inundation of terrestrial habitat, leading to increased nutrient loading from vegetative debris along the shore for some period of time, could increase plankton production, causing an upsurge in nutritional sources for warm-water species (Kimmel and Groeger 1986).

CalSim-II modeling indicated that the surface area of Shasta Lake would be larger under CP1 with a 2005 water supply demand than under the Existing Condition or under the No-Action Alternative for all five water-year types. The Shasta Lake surface area would be larger under CP1 with a 2030 water supply demand than under the Existing Condition or under the No-Action Alternative in wet, above-normal, and below-normal water years. In dry water years, the surface area under CP1 would be larger than under the No-Action Alternative in all months modeled, and would be larger than the Existing Condition in all months except September, when it would be only 8 acres less; given the size of Shasta Lake, a decrease of 8 acres would be essentially equivalent to the Existing Condition. In critical water years from March through May, which is the beginning of the spawning period for warm-water fishes, the surface area under CP1 with a 2030 water supply demand would be smaller than both the Existing Condition and the No-Action Alternative by an average of 23 acres and 42 acres, respectively, but would be larger at the end of the spawning period (June and July) than both the Existing Condition and the No-Action Alternative. From August until sometime in October in critical water years, the surface area under CP1 with a 2030 water supply demand would continue to be larger than the surface area under the No-Action Alternative, but would be less than the Existing Condition by an average of 160 acres (Figures 11-4 and 11-5).

An increase in the WSEL could benefit fish by increasing the amount and quality of available warm-water habitat in Shasta Lake. According to Ozen and Noble (2002), inundation of a reservoir creates an area that is sparsely populated by fish (i.e., decreases fish density per unit of habitat); the low population numbers stimulate the natural reproductive and growth processes of the fish. The newly inundated vegetation creates temporary cover for shoreline-dwelling fishes. As the vegetation decomposes, it releases nutrients for phytoplankton and periphyton, which are in turn consumed by the fish.

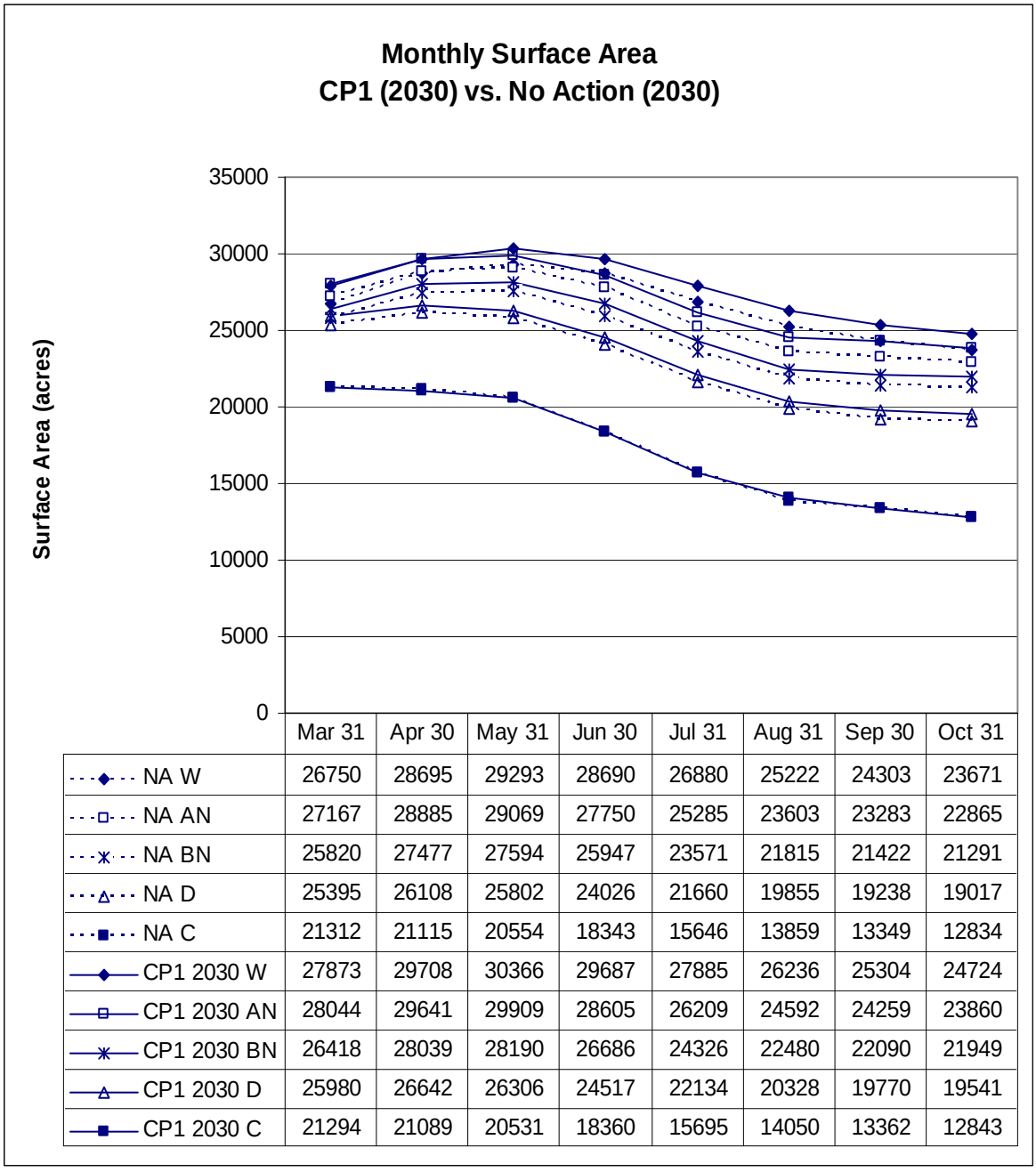
According to CalSim-II modeling, the Shasta Lake WSEL would be higher under CP1 with a 2005 water supply demand than under the Existing Condition or the No-Action Alternative for all five water-year types. The Shasta Lake WSEL would be higher under CP1 with a 2030 water supply demand than under the Existing Condition or under the No-Action Alternative in all but critical water years. In critical water years, the WSEL under CP1 with a 2030 water supply demand would be similar to the No-Action Alternative.



	Mar 31	Apr 30	May 31	Jun 30	Jul 31	Aug 31	Sep 30	Oct 31
EC W	26726	28711	29305	28720	27042	25351	24380	23709
EC AN	27096	28851	29102	27792	25377	23881	23648	23105
EC BN	25942	27562	27715	26098	23740	22177	21932	21732
EC D	25311	26013	25724	23891	21531	19954	19778	19310
EC C	21336	21121	20583	18251	15644	14079	13655	12992
CP1 2005 W	27850	29705	30370	29727	28147	26495	25513	24902
CP1 2005 AN	27996	29642	29954	28684	26319	24871	24533	24009
CP1 2005 BN	26545	28140	28299	26765	24410	22818	22569	22345
CP1 2005 D	25917	26589	26267	24395	21952	20208	20048	19590
CP1 2005 C	21564	21340	20792	18492	15960	14440	14021	13372

Key:
AN = above-normal water
BN= below-normal water years
C = critical water years
CP = Comprehensive Plan
D = dry water years
EC = Existing Conditions
W = wet water years

Figure 11-4. Monthly Surface Area for Each Water-Year Type Within the Shasta Lake Vicinity of the Primary Study Area, CP1 vs. Existing Condition



	Mar 31	Apr 30	May 31	Jun 30	Jul 31	Aug 31	Sep 30	Oct 31
NA W	26750	28695	29293	28690	26880	25222	24303	23671
NA AN	27167	28885	29069	27750	25285	23603	23283	22865
NA BN	25820	27477	27594	25947	23571	21815	21422	21291
NA D	25395	26108	25802	24026	21660	19855	19238	19017
NA C	21312	21115	20554	18343	15646	13859	13349	12834
CP1 2030 W	27873	29708	30366	29687	27885	26236	25304	24724
CP1 2030 AN	28044	29641	29909	28605	26209	24592	24259	23860
CP1 2030 BN	26418	28039	28190	26686	24326	22480	22090	21949
CP1 2030 D	25980	26642	26306	24517	22134	20328	19770	19541
CP1 2030 C	21294	21089	20531	18360	15695	14050	13362	12843

Key:
AN = above-normal water
BN= below-normal water years
C = critical water years
CP = Comprehensive Plan
D = dry water years
NA = No-Action
W = wet water years

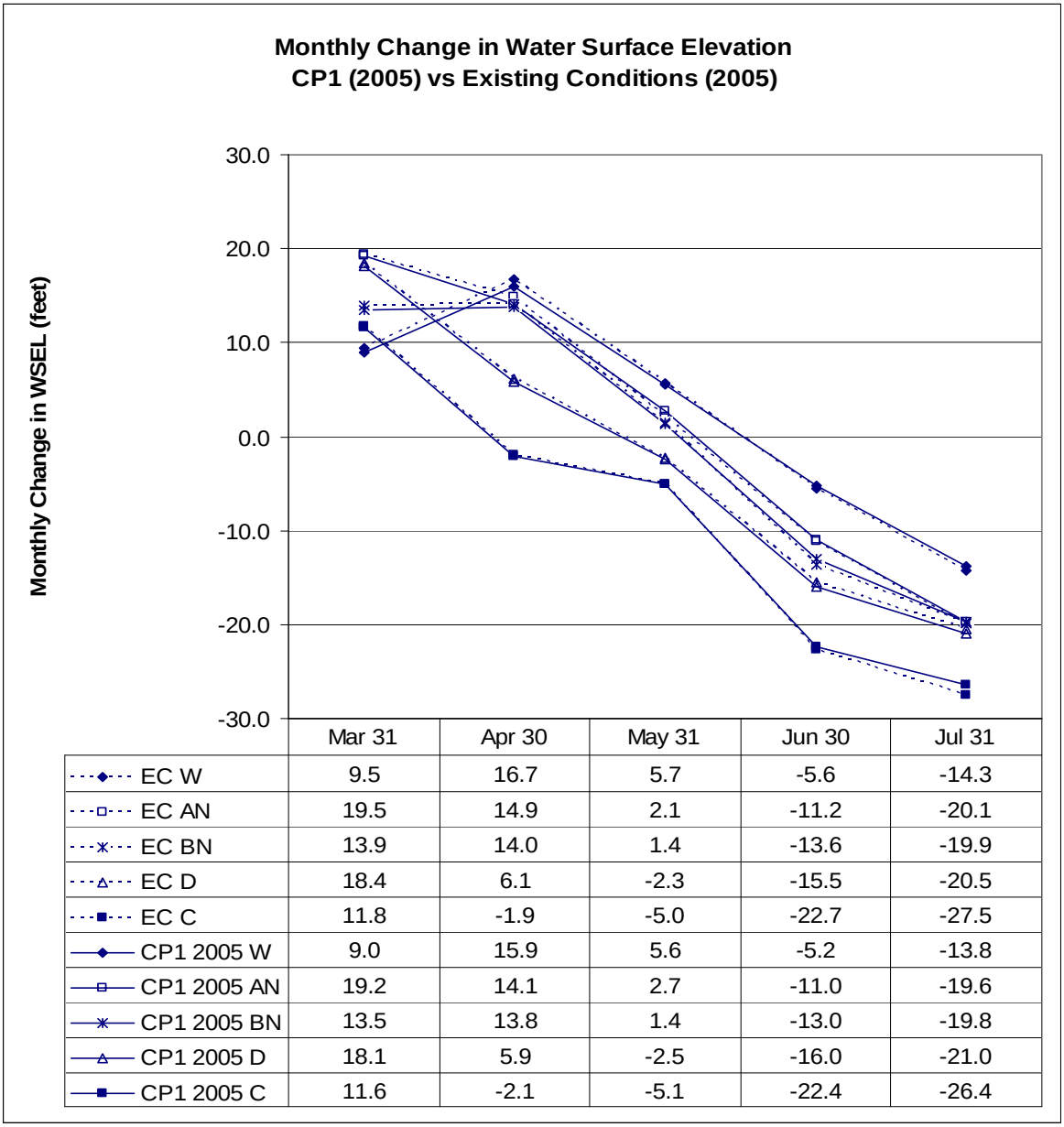
Figure 11-5. Monthly Change in Surface Area for Each Water-Year Type Within the Shasta Lake Vicinity of the Primary Study Area, CP1 (2030) vs. No-Action Alternative

Rapid rates of increase in WSEL during the critical spring nesting period can lead to such adverse effects as decreased spawning success through nest abandonment or decreased egg survival (Mitchell 1982). Jones and Stokes (1998) reported that mortality approaches 10 percent for eggs in nests submerged under more than 15 feet of water during periods of rapid increase in reservoir elevations.

Rapidly decreasing WSELs can also have an adverse effect on aquatic organisms. According to Lee (1999), the maximum rate of drawdown that would allow a nesting success rate of 10 percent varied between species, with receding water level rates of less than 0.07, less than 0.03, and less than 0.02 feet per day for largemouth, smallmouth, and spotted bass nests, respectively. Lee found that daily drawdown rates of 0.36, 0.36, and 0.72 feet per day for largemouth, smallmouth, and spotted bass, respectively, resulted in 20 percent nest survival. Under CP1, none of the changes in monthly WSEL fluctuation were substantially different from the Existing Condition.

Monthly WSEL fluctuations were compared with projections for water supply demand. For CP1 with a 2005 water supply demand, 20 percent of monthly changes in projected WSELs (i.e., 5 of the 25 total projections made for the 5 months from March through July for all five water-year types) showed increased monthly WSEL fluctuations relative to the Existing Condition and 80 percent showed reduced monthly WSEL fluctuations (Figure 11-6). For CP1 with a projected 2030 water supply demand, 36 percent of monthly changes in projected WSELs showed increased WSEL fluctuations relative to the No-Action Alternative and 64 percent showed reduced monthly WSEL fluctuations (Figure 11-7).

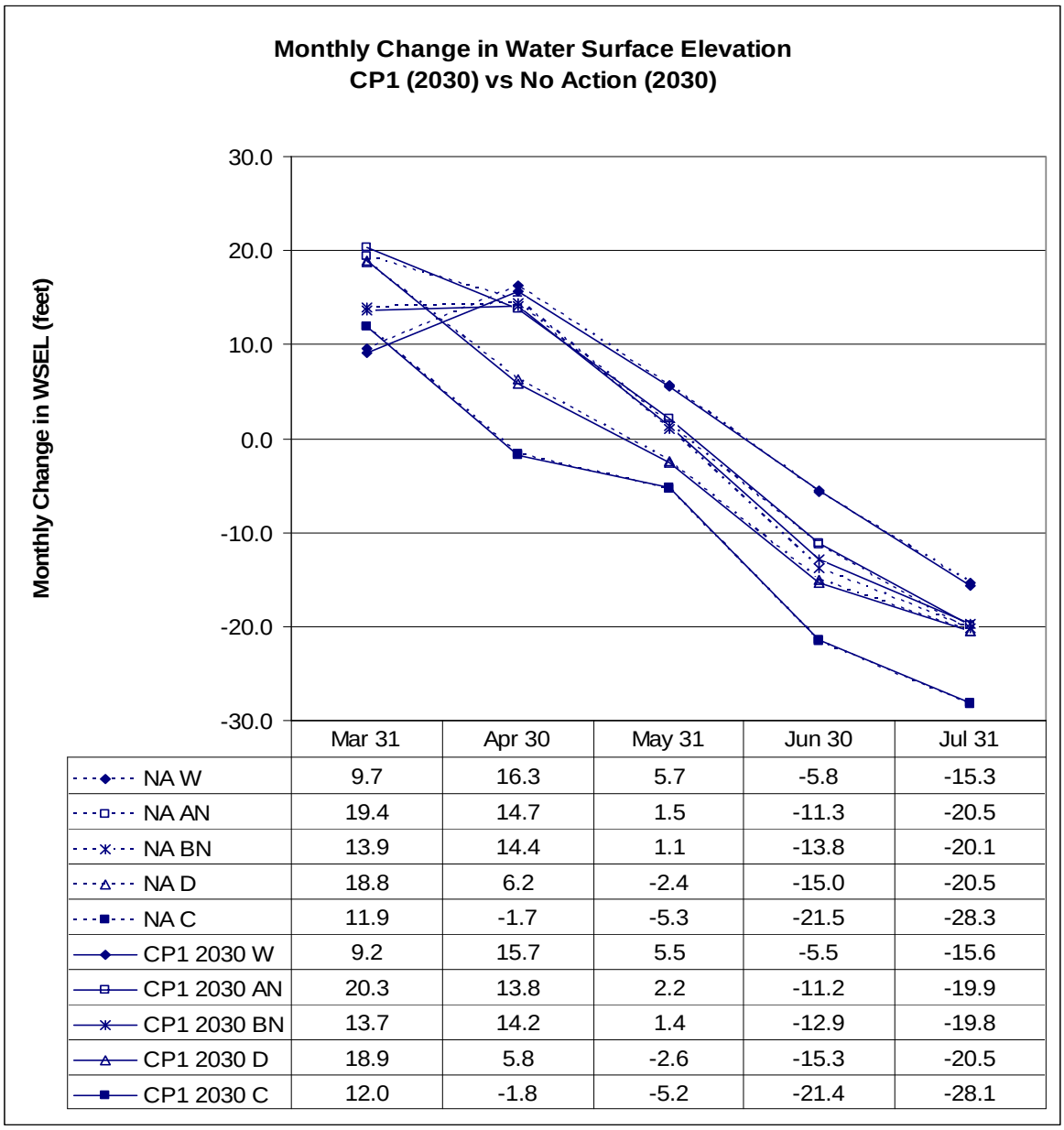
Increases in the overall surface area and WSEL under CP1 would increase the area of available warm-water habitat and stimulate biological productivity, including fish production, of the entire lake, although the value of structural and vegetative improvements that currently provide effective structural habitat at specific locations will be decreased to some extent. Overall, CP1 would result in reductions in the magnitude of monthly WSEL fluctuations and would contribute to increased reproductive success, young-of-the-year production, and juvenile growth rate of warm-water species, and provide for an increase in structural habitat (inundated vegetation) for some period of time. Therefore, this impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.



	Mar 31	Apr 30	May 31	Jun 30	Jul 31
EC W	9.5	16.7	5.7	-5.6	-14.3
EC AN	19.5	14.9	2.1	-11.2	-20.1
EC BN	13.9	14.0	1.4	-13.6	-19.9
EC D	18.4	6.1	-2.3	-15.5	-20.5
EC C	11.8	-1.9	-5.0	-22.7	-27.5
CP1 2005 W	9.0	15.9	5.6	-5.2	-13.8
CP1 2005 AN	19.2	14.1	2.7	-11.0	-19.6
CP1 2005 BN	13.5	13.8	1.4	-13.0	-19.8
CP1 2005 D	18.1	5.9	-2.5	-16.0	-21.0
CP1 2005 C	11.6	-2.1	-5.1	-22.4	-26.4

Key:
AN = above-normal water
BN = below-normal water years
C = critical water years
CP = Comprehensive Plan
D = dry water years
EC = Existing Conditions
W = wet water years
WSEL = water surface elevation

Figure 11-6. Monthly Change in WSEL for Each Water-Year Type Within the Shasta Lake Vicinity of the Primary Study Area, CP1 vs. Existing Condition



	Mar 31	Apr 30	May 31	Jun 30	Jul 31
NA W	9.7	16.3	5.7	-5.8	-15.3
NA AN	19.4	14.7	1.5	-11.3	-20.5
NA BN	13.9	14.4	1.1	-13.8	-20.1
NA D	18.8	6.2	-2.4	-15.0	-20.5
NA C	11.9	-1.7	-5.3	-21.5	-28.3
CP1 2030 W	9.2	15.7	5.5	-5.5	-15.6
CP1 2030 AN	20.3	13.8	2.2	-11.2	-19.9
CP1 2030 BN	13.7	14.2	1.4	-12.9	-19.8
CP1 2030 D	18.9	5.8	-2.6	-15.3	-20.5
CP1 2030 C	12.0	-1.8	-5.2	-21.4	-28.1

Key:
AN = above-normal water
BN= below-normal water years
C = critical water years
CP = Comprehensive Plan
D = dry water years
NA = No-Action
W = wet water years
WSEL water surface elevation

Figure 11-7. Monthly Change in WSEL for Each Water-Year Type Within the Shasta Lake Vicinity of the Primary Study Area, CP1 vs. No-Action Alternative

Impact Aqua-2 (CP1): Effects on Nearshore, Warm-Water Habitat in Shasta Lake from Project Construction Localized increases in soil erosion and resulting runoff sedimentation, and turbidity resulting from project construction in the vicinity of Shasta Dam and at utility, road, and other facility relocation areas could affect nearshore warm-water habitat. However, the environmental commitments for all action alternatives include the development and implementation of a Construction Management Plan, Erosion and Sediment Control Plan, Stormwater Pollution Prevention Plan, and Revegetation Plan as well as water quality and fisheries conservation measures and compliance with all required permit terms and conditions. These environmental commitments would result in less than significant impacts. Mitigation for this impact is not needed, and thus not proposed.

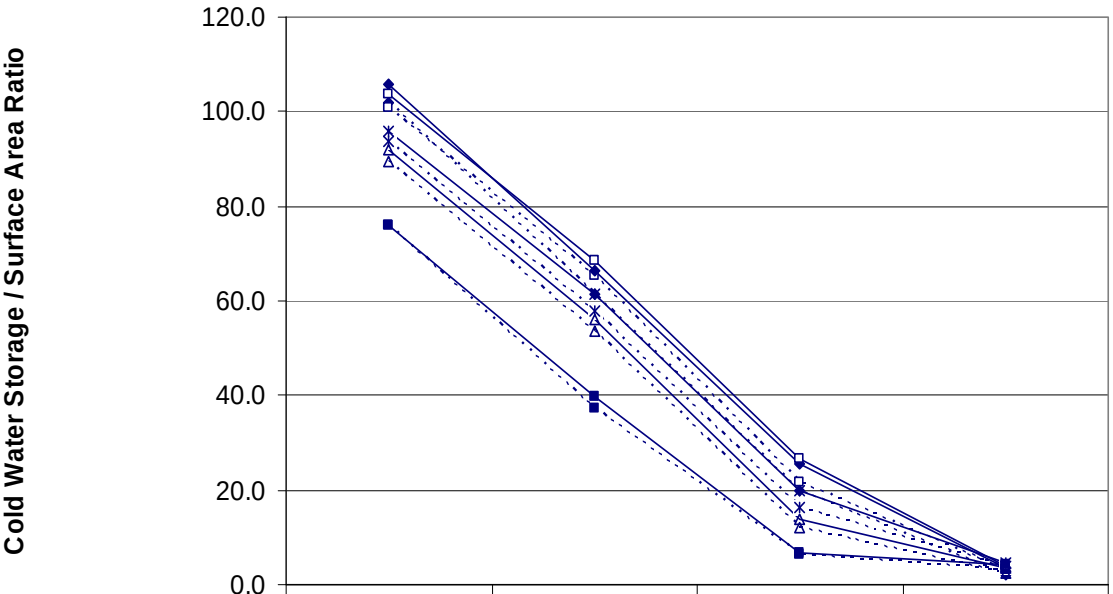
Impact Aqua-3 (CP1): Effects on Cold-Water Habitat in Shasta Lake Under CP1, operations-related changes in the ratio of the volume of cold-water storage to surface area would increase the availability of suitable habitat for cold-water fish in Shasta Lake, including rainbow trout. This impact would be beneficial.

Access to cold-water refuge can be a limiting factor for the production of cold-water fish, even when the benefits of increased surface area are present. Increases in the surface area of a reservoir without proportional increases in the volume of cold-water storage result in little change to cold-water fisheries production (Jones and Stokes Associates 1988).

CalSim-II modeling showed that under CP1 with a 2030 water supply demand, the ratio of the volume of cold-water storage to surface area was slightly higher than under the No-Action Alternative in all water years and during all months modeled. The greatest projected increases over the No-Action Alternative occurred between June 30 and August 31, which is the critical holding and rearing period for cold-water fishes in reservoirs; the increases were highest in wet water years (Figure 11-8).

CP1 would increase the availability of suitable habitat for cold-water fish in Shasta Lake. Therefore, this impact would be beneficial. Mitigation for this impact is not needed, and thus not proposed.

Impact Aqua-4 (CP1): Effects on Special-Status Aquatic Mollusks Under CP1, habitat for special-status mollusks may become inundated. Seasonal fluctuations in the surface area and WSEL of Shasta Lake could also adversely affect special-status aquatic mollusks that may occupy habitat in or near Shasta Lake and its tributaries. This impact would be potentially significant.



	Apr 30	Jun 30	Aug 31	Oct 31
NA W	102.1	61.5	19.8	2.2
NA AN	100.9	65.2	21.8	3.1
NA BN	93.9	57.9	16.3	3.8
NA D	89.6	53.5	12.0	2.5
NA C	75.8	37.4	6.5	3.2
CP1 2030 W	105.7	66.2	25.6	3.4
CP1 2030 AN	103.7	68.4	26.6	4.0
CP1 2030 BN	95.9	61.5	20.0	4.5
CP1 2030 D	91.8	56.1	14.0	3.4
CP1 2030 C	75.9	39.9	6.9	4.3

Key:
AN = above-normal water
BN= below-normal water years
C = critical water years
CP = Comprehensive Plan
D = dry water years
NA = No-Action
W = wet water years

Figure 11-8. Monthly Cold-water Storage to Surface Area Ratio for Each Water-Year Type Within the Shasta Lake Vicinity of the Primary Study Area, CP1 vs. No-Action Alternative

One special-status mollusk, the California floater, occurs in Shasta Lake, and nine other special-status mollusks could occupy affected seeps, springs, or tributaries. However, information regarding these species' distributions and abundance is limited, which precludes fully quantifying the impacts of CP1 on these organisms and their habitat. Tributary investigations are ongoing and will provide additional information for inclusion in the Final Environmental Impact Statement (FEIS). Except for the California floater, it is not known if other special-status mollusks occupy habitat in or near Shasta Lake and its tributaries. If they do occur in these habitats, they could be adversely affected by increased WSEL and seasonal fluctuations in the surface area under CP1. Therefore, this impact would be potentially significant. Mitigation for this impact is proposed in Section 11.3.4.

Impact Aqua-5 (CP1): Effects on Special-Status Fish Species The expansion of the surface area of Shasta Lake and the inundation of additional tributary habitat under CP1 could affect one species designated as sensitive by USFS, the hardhead. This impact would be less than significant.

The hardhead minnow is designated as sensitive by USFS and is known to occur in Shasta Lake. Two other USFS sensitive species, rough sculpin (in the Pit River) and redband trout (in the upper McCloud River), are known to occur upstream from Shasta Lake, but their presence have not been documented in Shasta Lake or in their respective tributaries within the primary study area. The analysis of the CP1 therefore excludes consideration of these special-status species.

Expansion of the surface area of Shasta Lake could be modestly beneficial to hardhead because it could expand the amount of habitat available to this species in the lake. Hardhead prefer low gradient stream habitat, which can be created by the backwater effect of the reservoir within the transition reaches of the main tributaries at their confluence; however, this would not be expected to be much greater than under existing conditions, since reservoir enlargement would simply move the transition reaches farther upstream in the tributaries. Tributary investigations, including an analysis of barriers are ongoing and will provide additional information for inclusion in the FEIS. Although there is some evidence that a physical barrier at the upper end of the Squaw Creek Arm may be modified by an increase in WSEL (J. Zustak, USFWS, pers. comm., 2009), there is no evidence that other barriers exist in a form that would impact this species or its habitat. Pending new information, this impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact Aqua-6 (CP1): Creation or Removal of Barriers to Fish Between Tributaries and Shasta Lake Under CP1, project implementation would result in the periodic inundation of steep and low-gradient tributaries to Shasta Lake up to the 1,080-foot contour, the maximum inundation level under this alternative. Tributary investigations are ongoing and will provide additional information for inclusion in the FEIS. However, based on digital topographic

data and stream channel data generated from limited field inventories, no substantial barriers appear to exist between the 1,070-foot and 1,080-foot contours that would be inundated under this alternative. This impact would be less than significant.

Most of the tributaries are too steep (i.e., greater than 7 percent) up to the 1,080-foot contour to be passable by fish; the tributaries that are low-gradient up to the 1,080-foot contour and thus allow fish passage remain low-gradient well upstream from the 1,080-foot contour. Therefore, this impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact Aqua-7 (CP1): Effects on Spawning and Rearing Habitat of Adfluvial Salmonids in Low-Gradient Tributaries to Shasta Lake CP1 would result in additional periodic inundation of riverine habitat potentially suitable for spawning and rearing habitat for adfluvial salmonids (trout and land-locked salmon that spawn in streams and rear in lakes) in tributaries to Shasta Lake. In addition to modification of the flow regimes of these affected reaches, changes in the WSEL as a result of CP1 will affect the character and location of substrate (e.g., spawning gravel) at some locations, thereby influencing the suitability and availability of spawning and rearing habitat for adfluvial salmonids. Tributary investigations are ongoing and will provide additional information for inclusion in the FEIS. Only 5.4 miles of low-gradient reaches that could potentially provide some spawning and rearing habitat for adfluvial salmonids would be affected by CP1, which is only about 1.4 percent of the low-gradient habitat upstream from Shasta Lake. This impact would be less than significant.

CP1 would inundate perennial stream reaches with gradients of less than 7 percent that could provide suitable spawning and rearing habitat for adfluvial salmonids. Chapter 4, “Geology, Geomorphology, Minerals, and Soils,” discusses the periodic inundation of low-gradient stream reaches. The lengths of low-gradient tributaries to each arm of Shasta Lake that would be periodically affected are as follows:

- Sacramento River Arm 2.2 miles
- McCloud River Arm 1.1 miles
- Pit River Arm 1.0 mile
- Big Backbone Creek Arm 0.5 miles
- Squaw Creek Arm 0.6 miles

Only about 1.4 percent of the low-gradient habitat upstream from Shasta Lake would be periodically inundated. Therefore, this impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact Aqua-8 (CP1): Effects on Aquatic Connectivity in Non-Fish-Bearing Tributaries to Shasta Lake CP1 would result in periodic inundation of varying amounts of non-fish-bearing tributaries to Shasta Lake. Only 12.6 miles of non-fish-bearing tributary habitat would be affected by CP1, which is a length of only about 0.4 percent of non-fish-bearing tributary upstream from Shasta Lake. This impact would be less than significant.

As described in Chapter 4, "Geology, Geomorphology, Minerals, and Soils," CP1 would inundate tributary segments with channel slopes in excess of 7 percent. Although these segments do not typically support salmonid populations, they do provide riparian and aquatic habitat for a variety of organisms and serve as corridors that connect habitat types. The lengths of non-fish-bearing tributaries for each arm of Shasta Lake that would be periodically inundated are as follows:

- Sacramento River Arm 2.9 miles
- McCloud River Arm 2.1 miles
- Pit River Arm 1.8 miles
- Big Backbone Creek Arm 1.3 miles
- Squaw Creek Arm 0.9 miles
- Main Body 3.6 miles

Only 12.6 miles of non-fish-bearing tributary habitat would be periodically inundated under CP1, which is only about 0.4 percent of the habitat upstream from Shasta Lake. Therefore, this impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact Aqua-9 (CP1): Effects on Water Quality at Livingston Stone Hatchery Reclamation provides the water supply to the Livingston Stone Hatchery from a pipeline emanating from Shasta Dam. This supply would not be interrupted by any activity associated with CP1. There would be no impact. Mitigation for this impact is not needed, and thus not proposed.

Upper Sacramento River (Shasta Dam to RBDD)

Impact Aqua-10 (CP1): Loss or Degradation of Aquatic Habitat in the Upper Sacramento River During Construction Activities Construction-related activities could temporarily increase sedimentation and turbidity, which would adversely affect aquatic habitats and fish populations within the upper Sacramento River immediately downstream from project construction activities. However, environmental commitments would be in place to reduce these levels. This impact would be less than significant.

Construction activities could disturb sediments and soils within and adjacent to waterways. These activities include increasing the height of the dam, constructing haul roads, using staging areas, and placing of removed material.

Any resulting erosion or disturbance of sediments and soils would temporarily increase turbidity and sedimentation downstream from the construction sites throughout the primary study area if soils are transported in river flows, stormwater runoff, or reservoir water. Construction-related sedimentation and increased turbidity, or other contamination, would be most pronounced in the segment of river from Shasta Dam to Keswick Dam due to the backwater effect that Keswick Reservoir has on flow conditions in the Sacramento River. It is also important to note that Keswick Dam acts as a barrier to upstream migration; therefore, all anadromous fish species are downstream from this facility. (See Chapter 7, "Water Quality," for additional discussion of this issue.)

Fish population abundance, distribution, and survival have been linked to levels of turbidity and silt deposition. Prolonged exposure to high levels of suspended sediment would create a loss of visual capability in fish in aquatic habitats within the study area, leading to reduced feeding and growth rates; a thickening of the gills, potentially causing the loss of respiratory function; clogging and abrasion of gills; and increases in stress levels, reducing the tolerance of fish to disease and toxicants (Waters 1995). Turbidity also could result in increased water temperature, especially in willow quiet pools, and in turn affect DO levels, both effects thereby stressing respiration.

Also, high levels of suspended sediments would cause the movement and redistribution of fish populations, and could diminish the character and quality of the physical habitat important to fish survival. Once suspended sediment is deposited, it would reduce water depths in stream pools, decreasing the water's physical carrying capacity for juvenile and adult fish (Waters 1995). Increased sediment loading would degrade food-producing habitat downstream from construction areas. Sediment loading would interfere with photosynthesis of aquatic flora and displace aquatic fauna. Many fish, including salmonids, are sight feeders, and turbid waters reduce the ability of these fish to locate and feed on prey. Some fish, particularly juveniles, likely would become disoriented and leave areas where their main food sources are located, ultimately reducing their growth rates. Prey (e.g., macroinvertebrates) of fish populations would be adversely affected by decline in habitat quality (i.e., water quality and substrate conditions) as a result of increased turbidity, decreased DO content, increased level of pollutants (Coull and Chandler 1992), or (although unlikely) an extreme change in pH or water temperatures (Rundle and Hildrew 1990). Decreases in the diversity and abundance of smaller organisms living on or in the sediments have been associated with smaller sediment grain sizes (Coull 1988) and the associated DO decreases in those sediments (Boulton et al. 1991).

Avoidance of adverse habitat conditions by fish is the most common result of increases in turbidity and sedimentation. Fish will not occupy areas unsuitable for survival unless they have no other option. Some fish, such as bluegill and bass species, will not spawn in excessively turbid water (Bell 1990) and salmonids require gravels that are relatively clean and free of excess amounts of

fine sediments. Therefore, if high turbidity results from construction activities, fish species may be precluded from occupying habitat required for specific life stages. In some locations, few opportunities for escape from turbid waters may be available, particularly during lower flow conditions.

Construction-related sedimentation and increased turbidity or other contamination could temporarily degrade water quality and reduce or adversely affect fish habitat and fish populations in localized areas. However, the environmental commitments for all action alternatives include the development and implementation of a Construction Management Plan, Erosion and Sediment Control Plan, Stormwater Pollution Prevention Plan, and Revegetation Plan as well as water quality and fisheries conservation measures and compliance with all required permit terms and conditions. These environmental commitments would result in less than significant impacts. Mitigation for this impact is not needed, and thus not proposed.

Impact Aqua-11 (CP1): Release and Exposure of Contaminants in the Upper Sacramento River During Construction Activities Construction-related activities could result in the release and exposure of contaminants resulting in adverse effects on aquatic habitats, the aquatic food web, and fish populations, including special-status species, within the primary study area downstream from project construction activities. However, environmental commitments would be in place to reduce the impacts to less than significant.

Potential exists for contaminants such as fuels, oils, other petroleum products, cement, and various chemicals used in construction activities to be introduced accidentally in spills into the water system directly or incrementally through surface runoff from haul routes and construction sites. Contaminants in sufficient concentrations would be toxic to fish and prey organisms (e.g., benthic macroinvertebrates) occupying habitats in the study area or may alter oxygen diffusion rates and cause acute and chronic toxicity to aquatic organisms, thereby reducing growth and survival and/or leading to mortality.

The potential release of hazardous materials into Shasta Lake or the Sacramento River could result in the reduction of aquatic habitats and fish populations if proper procedures are not implemented to contain the discharge. However, the environmental commitments for all action alternatives include the development and implementation of a Construction Management Plan, Erosion and Sediment Control Plan, Stormwater Pollution Prevention Plan, and Revegetation Plan as well as water quality and fisheries conservation measures and compliance with all required permit terms and conditions. These environmental commitments would result in less than significant impacts. Mitigation for this impact is not needed, and thus not proposed.

Impact Aqua-12 (CP1): Changes in Flow and Water Temperature in the Upper Sacramento River Resulting from Project Operation – Chinook Salmon Project operation would result in improved flow and water temperature conditions in

the upper Sacramento River for fish species of management concern relative to both the No-Action Alternative and the Existing Condition. This impact would be beneficial.

Winter-Run Chinook Salmon

Production

Based on the 1999 through 2006 population average, CP1 had a slight overall average increase in winter-run Chinook salmon production relative to the No-Action Alternative. The maximum increase in production relative to the No-Action Alternative was 43 percent for CP1. The largest decrease in production relative to the No-Action Alternative was 39 percent for CP1 (Attachment 1A of the *Fisheries and Aquatic Ecosystems Technical Report*). Separating production by water-year type to focus on critical water years (when water storage is more reliable) showed a 4 percent increase over the No-Action Alternative. With one exception (1977 at 39 percent decrease), years with the lowest production over the simulation period showed the largest increase in production under CP1 conditions.

Under CP1, critical water years 1924, 1931, 1933, 1934, and 1992 resulted in an increase in winter-run production relative to the No-Action Alternative, ranging from 7 percent to 43 percent. Above-normal water years, 1928, 1954 and 1993, resulted in an increase in production of 3 to 5 percent relative to the No-Action Alternative. Critical water years, 1976 and 1977, resulted in a decrease (4 to 39 percent) in production relative to the No-Action Alternative. One dry water year (1932) showed a decrease in production of 7 percent.

CP1 production was relatively similar to the Existing Condition. The maximum increase in production relative to the Existing Condition was 23 percent for CP1. The largest decrease in production relative to the Existing Condition was 5 percent for CP1 (Attachment 2A of the *Fisheries and Aquatic Ecosystems Technical Report*).

Under CP1, critical water years 1931, 1933, 1934, and 1977 resulted in an increase in winter-run production relative to the Existing Condition ranging from 5 percent to 23 percent. Production in dry water year 1985 and wet water year 1974 decreased by 5 percent.

Based on AFRP population goals, the overall average winter-run Chinook salmon production was similar for CP1 relative to the No-Action Alternative (Attachment 3A of the *Fisheries and Aquatic Ecosystems Technical Report*). The maximum increase in production relative to the No-Action Alternative was 28 percent for CP1. The largest decrease in production relative to the No-Action Alternative was 33 percent for CP1. Years with the lowest production under the No-Action Alternative typically had the greatest percent increase in production under CP1, with one exception – 1977 (34-percent decrease).

Mortality

Based on the 1999 through 2006 population average, the greatest mortality to winter-run under CP1 occurred to the egg incubation life stage, followed by presmolts, then fry, and lastly to immature smolts. Nonoperational conditions were the primary causes of mortality for all life stages under CP1. Table 11-4 displays the overall mortalities for each Comprehensive Plan that were caused by nonoperational factors versus those caused by operations (i.e., water temperature and flow) (Attachments 1B and 2B of the *Fisheries and Aquatic Ecosystems Technical Report* contain further detail). Mortalities caused by the project decrease as the proposed dam height increases from 6.5 to 18.5 feet.

Table 11-4. Percent Mortality to Winter-Run Chinook Salmon Caused by Nonoperations-Related Effects and Operations-Related Effects Under Each Comprehensive Plan When the Starting Population is Based on the 1999 Through 2006 Average

Plan	% Nonoperations-Related Mortality	% of the Total Mortality	% Operations-Related Mortality	% of the Total Mortality
Future Condition (2030)				
No-Action Alternative	59.8	86.0	9.7	14.0
CP1	60.1	86.6	9.3	13.4
CP2	60.1	86.6	9.3	13.3
CP3, CP5	60.4	87.2	8.9	12.8
CP4	61.1	89.2	7.4	10.8
Existing Condition (2005)				
Existing Condition	59.9	86.6	9.3	13.4
CP1	60.2	87.0	9.0	13.0
CP2	60.2	87.0	9.0	13.0
CP3, CP5	60.3	87.0	9.0	13.0
CP4	61.1	89.3	7.3	10.7

Note:
Results derived from SALMOD.
Key:
CP = Comprehensive Plan

Mortality was separated by operations-related mortality versus nonoperations-related mortality to assess the level of impacts on the four runs of Chinook salmon caused by the actions of the project. Nonoperations-related mortality are the base and seasonal mortality that would occur even without the effects of Shasta operations (changes in flow and/or water temperature). Operations-related mortality is that caused by altering flow and water temperatures.

When removing nonoperations-related mortality, allowing the comparison of mortality for operations-related activities only, fry were the primary life stage affected, but operations-related activities had a greater effect on eggs than on presmolts, and no effect on immature smolts, with both water temperature and flow causing the mortality (Table 11-5).

Table 11-5. Average Annual Mortality Under Each Comprehensive Plan Caused by Project Activities to Winter-Run Chinook Salmon When the Starting Population is Based on the 1999 Through 2006 Average

Plan	Mortality Factor						Total
	Incubation	Eggs – Temperature	Fry Temperature	Fry Habitat	Presmolt Temperature	Presmolt	
Future Condition (2030)							
No-Action Alternative	239,655	286,866	30,102	619,541	17,202	3,737	1,197,103
CP1	248,054	221,542	23,998	631,476	17,488	3,678	1,146,236
CP2	245,208	231,177	27,637	628,045	18,318	3,590	1,153,975
CP3, CP5	251,561	197,624	23,824	609,465	16,196	3,510	1,102,180
CP4	262,729	23,985	3,231	614,146	1,991	3,722	909,804
Existing Condition (2005)							
Existing Condition	292,017	222,215	26,778	580,616	19,566	3,735	1,144,927
CP1	288,104	196,861	24,811	575,402	17,986	3,511	1,106,675
CP2	287,761	208,257	26,780	568,211	19,664	3,601	1,114,274
CP3, CP5	288,275	199,852	26,248	574,694	19,861	3,358	1,112,288
CP4	302,726	26,214	5,064	562,473	4,195	3,545	904,217

Note:
Results derived from SALMOD.
Key:
CP = Comprehensive Plan

In critical water years, mortality to eggs due to unsuitable water temperatures was the primary cause of operations-related mortalities for CP1, followed by mortality to fry (more by flow and density than water temperature), then to eggs from redd dewatering, followed by presmolts (affected first by water temperature then flow) and, finally, immature smolts (affected by flow). Attachments 1C and 2C of the *Fisheries and Aquatic Ecosystems Technical Report* contain tables of mortality to winter-run Chinook salmon sorted by water-year type, and Table 11-6 outlines the ranks classified under each Comprehensive Plan for each water-year type.

In dry water years, mortality to fry when moving to new habitats was the primary cause of operations-related mortalities for all Comprehensive Plans, followed by mortality to eggs due to redd dewatering. Third was the mortality to eggs due to unsuitable water temperatures.

Below-normal, above-normal, and wet water years also had the greatest number of winter-run Chinook salmon perish as fry caused by forced movement to habitat downstream, followed by mortality to eggs due to redd dewatering or scouring, then the loss of eggs from unsuitable water temperatures, and forced movement of presmolts to downstream habitats.

Table 11-6. Mortality Parameters Ranked by Importance for Winter-Run Chinook Salmon by No-Action and Comprehensive Plans by Water-Year Type When the Starting Population Is Based on the 1999 Through 2006 Average

Alternative/Plan Water Year-Type	Mortality Factor							
	Incubation	Super-imposition	Egg – Temperature	Fry – Temperature	Fry – Habitat	Presmolt – Temperature	Presmolt – Habitat	Immature Smolt Habitat
No-Action Alternative								
Critical	3	- / 7	1	4	2	5	6	7 / 8
Dry	2	7 / 6	3	6 / 5	1	5 / 4	4 / 7	8
Below-normal	2		3		1		4	- / 5
Above-normal	2		4		1		3	
Wet	2		4		1		3	
CP1								
Critical	3	- / 6	1	4	2	5	6 / 7	7 / 8
Dry	2	7 / 4	3	5 / 6	1	6 / 5	4 / 7	8
Below-normal	2		4 / 3		1		3 / 4	5 / -
Above-normal	2		4		1		3	
Wet	2	5 / -	4		1		3	
CP2								
Critical	3	8 / 6	1	4	2	5	6	7
Dry	2	6 / 4	3	5 / 6	1	4	7	8
Below-normal	2		3		1		4	5
Above-normal	2		4		1		3	
Wet	2	5 / -	4		1		3	
CP3, CP5								
Critical	3	6	1	4	2	5	7	8
Dry	2	6 / 4	3	5 / 6	1	4	7	8
Below-normal	2		3		1		4	5
Above-normal	2		4		1		3	
Wet	2		4		1		3	
CP4								
Critical	2	- / 6	3	5 / 4	1	4 / 5	6 / 7	7 / 8
Dry	2	4 / 3	3 / 4		1		5	6
Below-normal	2		4		1		3	
Above-normal	2		4		1		3	
Wet	2	5 / -	4		1		3	

Notes:
Blanks and "-" indicate negligible or no mortality occurred as a result of that factor.
In most cases, the NEPA No-Action Alternative is identical to the CEQA Existing Condition. However, when ranking between the two differs, the differences are presented as "Future Condition Rank" / "Existing Condition Rank"
Rank values: 1 = most significant; 5 = least significant
Results derived from SALMOD.
Key:
CP = Comprehensive Plan

Years with the highest operations-related mortality were the same for the No-Action Alternative, Existing Condition, and CP1 (1924, 1931, 1933, 1934, 1977, and 1992). Each of these years was a critical water year, and was preceded by either a critical (1933, 1976, 1991), dry (1930, 1932) or below-

normal (1923) water-year type. Years in which the project had the greatest impact on winter-run were also the years in which the lowest production occurs (Attachments 1C and 2C of the *Fisheries and Aquatic Ecosystems Technical Report*).

Based on AFRP population goals, winter-run Chinook salmon mortality caused by operations-related activities decreased under CP1 compared to the No-Action Alternative conditions (Attachment 3B). Under CP1, mortality caused by operations-related activities would decrease from non-operations related mortality by over 10 percent. Under CP1, the greatest mortality to winter-run occurred to the egg incubation life stage, followed by presmolts, then fry, and lastly to immature smolts. Nonoperational conditions were the primary causes of mortality for all life stages under all alternatives.

Because winter-run Chinook salmon have, overall, a reduced mortality, particularly in critical water years, winter-run Chinook salmon would benefit from actions taken in CP1. Mitigation for this impact is not needed, and thus not proposed.

Spring-Run Chinook Salmon

Production

Based on the 1999 through 2006 population average, the overall average spring-run Chinook salmon production for the 82-year period remained relatively similar to the No-Action Alternative and the Existing Condition (Attachments 4A and 5A of the *Fisheries and Aquatic Ecosystems Technical Report*). The maximum increase in production relative to the No-Action Alternative was 109 percent for CP1, while the largest decrease in production relative to the No-Action Alternative was 39 percent for CP1 (Attachment 4A). The maximum increase in production relative to the Existing Condition was 125 percent for CP1, while the largest decrease in production relative to the Existing Condition was 50 percent for CP1 (Attachment 5A of the *Fisheries and Aquatic Ecosystems Technical Report*).

Years in which production was the lowest under the No-Action Alternative typically had the largest increase under CP1 conditions, except for 1934, which had a 15-percent reduction, and 1992, which decreased by 39 percent.

Under CP1, critical water years 1924, 1931, 1933 and 1977 resulted in an increased production relative to the No-Action Alternative ranging from 13 percent to 109 percent. Dry water years, 1925, 1926, and 1932 resulted in increased production (4 percent to 22 percent) relative to the No-Action Alternative. Critical water years 1934, 1992, 1994 and 2001 resulted in a decrease in production relative to the No-Action Alternative (4 percent to 40 percent).

Under CP1, critical water years 1931, 1933, 1934, 1988, 1994, and 2001 resulted in an increased production relative to the Existing Condition ranging

from 5 percent to 83 percent. Dry water year 1932 resulted in a substantial increase in production (125 percent) relative to the Existing Condition. Critical water years 1977 and 1992 resulted in a decrease in production relative to the Existing Condition (7 percent to 50 percent).

When using AFRP goals as the spawning population, overall average spring-run Chinook salmon production was similar for CP1 relative to the No-Action Alternative (Attachment 6A of the *Fisheries and Aquatic Ecosystems Technical Report*). The maximum increase in production relative to the No-Action Alternative was 99 percent for CP1. The largest decrease in production relative to the No-Action Alternative was 47 percent for CP1. Years with the lowest production under the No-Action Alternative typically had the largest increase under CP1 conditions, except for 1934, which had a 13-percent reduction, and 1992, which decreased by 47 percent.

Mortality

Based on the 1999 through 2006 population average, the greatest mortality to spring-run occurred to eggs, followed by presmolts, then fry. Nonoperational conditions were the primary causes of mortality for all life stages under all Comprehensive Plans. Table 11-7 displays overall mortalities for each Comprehensive Plan that are caused by nonoperational factors versus those caused by operations (i.e., water temperature, flow) (Attachments 4B and 5B of the *Fisheries and Aquatic Ecosystems Technical Report*). Mortalities caused by the project decreased as the proposed dam height increases from 6.5 to 18.5 feet (Tables 11-7 and 11-8).

Table 11-7. Percent Mortality to Spring-Run Chinook Salmon Caused by Nonoperations-Related and Operations-Related Effects Under the No-Action Alternative and Comprehensive Plans When Starting Population Is Based on the 1999 Through 2006 Average

Alternative/ Plan	% Nonoperations-Related Mortality	% of the Total Mortality	% Operations-Related Mortality	% of the Total Mortality
Future Condition (2030)				
No-Action Alternative	54.8	82.4	11.7	17.6
CP1	55.2	85.3	9.5	14.7
CP2	55.5	86.2	8.9	13.8
CP3, CP5	56.0	86.3	8.9	13.7
CP4	59.0	90.8	6.0	9.2
Existing Condition (2005)				
Existing Condition	54.8	82.4	11.7	17.6
CP1	55.4	85.6	9.3	14.4
CP2	55.4	85.5	8.4	14.5
CP3, CP5	55.8	86.4	8.8	13.6
CP4	58.9	90.6	6.1	9.4

Note: Results derived from SALMOD.
Key: CP = Comprehensive Plan

Table 11-8. Average Annual Mortality Under the No-Action Alternative and Each Comprehensive Plan Caused by Project Activities to Spring-Run Chinook Salmon When Starting Population is Based on 1999 Through 2006 Average

Alternative /Plan	Mortality Factor				
	Prespawn	Incubation	Eggs – Temperature	Fry – Habitat	Total
Future Condition (2030)					
No-Action Alternative	11,899	2,498	43,469	51	57,917
CP1	9,483	2,403	44,440	49	56,375
CP2	10,266	2,419	41,694	49	54,428
CP3, CP5	8,297	2,662	41,289	45	52,293
CP4	425	3,433	26,430	43	30,331
Existing Condition (2005)					
Existing Condition	9,955	2,570	45,554	53	58,132
CP1	8,768	2,567	43,176	56	54,567
CP2	9,683	2,549	43,867	43	56,142
CP3, CP5	10,204	2,661	40,847	42	53,754
CP4	341	3,549	26,649	43	30,582

Note:
Results derived from SALMOD.
Key:
CP = Comprehensive Plan

Only eggs and fry were affected by operation (Table 11-8). Critical water years showed mortality to eggs due to unsuitable water temperatures as the primary cause of operations-related mortalities, followed by mortality to eggs prespawned and during incubation caused by dewatering the redds, then to fry from forced movement to downstream habitats. Attachments 4C and 5C contain tables of mortality to spring-run sorted by water-year type, and Table 11-9 outlines the ranks classified under each Comprehensive Plan for each water-year type.

In dry, below-normal and above-normal water years, all Comprehensive Plans were dominated by egg temperature mortality, followed by mortality resulting from redd dewatering. Mortality to prespawned eggs occurred in only two dry years, not in any below-normal water years. Mortality to fry from forced movement was relatively low and occurred in only a few more years (Table 11-9).

In wet water years, spring-run eggs under conditions created by CP1 were more affected by redd dewatering than by unsuitable water temperatures (Table 11-9).

Table 11-9. Mortality Parameters Ranked by Importance for Spring-Run Chinook Salmon by Comprehensive Plan and Water-Year Type When Starting Population Is Based on 1999 Through 2006 Average

Alternative/Plan Water-Year Type	Mortality Factor			
	Prespawn	Incubation	Egg – Temperature	Fry – Habitat
No-Action Alternative				
Critical	2	3	1	4
Dry	3	2	1	4
Below-normal		2	1	3
Above-normal	4	2	1	3
Wet		2	1	3
CP1				
Critical	2	3	1	
Dry	3	2	1	4
Below-normal		2	1	3
Above-normal	4	2	1	3
Wet		2	1	3
CP2				
Critical	2	3	1	4
Dry	3	2	1	4
Below-normal		2	1	3
Above-normal	4	2	1	3
Wet		1	2	3
CP3, CP5				
Critical	2	3	1	4
Dry	3	2	1	4
Below-normal		2	1	3
Above-normal	4	2	1	3
Wet		1	2	3
CP4				
Critical	3	2	1	4
Dry		2	1	3
Below-normal		2	1	3
Above-normal	4	2	1	3
Wet		1	2	3

Notes:

Blanks indicate no mortality occurred as a result of that factor.

In most cases, the No-Action Alternative is identical to the Existing Condition. However, when ranking between the two differs, the differences are presented as Future Condition Rank / Existing Condition Rank.

Rank values

1 = most significant

5 = last significant

Results derived from SALMOD

Key:

CP = Comprehensive Plan

Years with the highest operations-related mortality were the same for all the Comprehensive Plans: 1924, 1931, 1932, 1933, 1934, 1977, and 1992. Except in 1932 (a dry water year), each of these years was a critical water-year type and was preceded by either a below, dry, or (predominantly) a critical water year. However, years with the lowest mortality varied between all water-year types. Project operations were responsible for years where spring-run Chinook salmon had the lowest mortality, with nearly all the mortality occurring in the egg incubation life stage (Attachments 4C and 5C).

Based on AFRP population goals, spring-run Chinook salmon mortality caused by operations-related activities decreased under CP1 compared to No-Action Alternative conditions (Attachment 6B). Under CP1, the greatest mortality to spring-run occurred to the egg incubation life stage, followed by presmolts, then fry, and lastly to immature smolts. Nonoperational conditions were the primary causes of mortality for all life stages under all alternatives.

Because spring-run Chinook salmon have, overall, a reduced mortality, particularly in critical water years, spring-run Chinook salmon would benefit from actions taken in CP1. Mitigation for this impact is not needed, and thus not proposed.

Fall-Run Chinook Salmon

Production

Based on the 1999 through 2006 population average, the overall average fall-run Chinook salmon production for the 82-year period was similar for CP1 relative to the No-Action Alternative and the Existing Condition (Attachments 7A and 8A). The maximum increase in production relative to the No-Action Alternative was 112 percent for CP1. The largest decrease in production relative to the No-Action Alternative was 7 percent for CP1 (Attachment 7A). In critical, dry, and below-normal water years, years with the lowest production typically had the greatest increase in production resulting from operations-related activities. The maximum increase in production relative to the Existing Condition was 43 percent for CP1. The largest decrease in production relative to the Existing Condition was 38 percent for CP1 (Attachment 8A).

In critical, dry, and below-normal water years, when production was lowest over the simulation period, the increase in production resulting from operations-related activities was greatest. In above-normal and wet water years, however, the lowest production years typically had a slight decrease in production under CP1 conditions relative to the No-Action Alternative.

Under CP1, critical water years 1931, 1933, 1934, and 1977 and dry water year 1932 resulted in increases in production relative to the No-Action Alternative ranging from 6 percent to 113 percent. Below-normal water years, 1937 and 1945, resulted in an increase in production ranging from 13 percent to 18 percent relative to the No-Action Alternative. Only critical water year 1992 and

wet water year 1999 resulted in a decrease of 7 percent in production relative to the No-Action.

Under CP1, critical water years 1931 and 1934 resulted in increases in production relative to the Existing Condition ranging from 14 to 43 percent. Dry water years 1926, 1932, 1955, 1964, and 1985 showed an increase production of between 5 and 7 percent relative to the Existing Condition. Below-normal water years 1937 and 1945 resulted in an increase in production (6 to 11 percent) relative to the Existing Condition. Critical water years 1977 and 1992 and wet water years 1969 and 1999 resulted in decreases in production relative to the Existing Condition ranging from 6 percent to 47 percent.

When evaluating the project under AFRP spawning population goals, the overall average fall-run Chinook salmon production was similar for CP1 relative to the No-Action Alternative (Attachment 9A). The maximum increase in production relative to the No-Action Alternative was 94 percent for CP1. The largest decrease in production relative to the No-Action Alternative was 10 percent for CP1. In critical, dry, and below-normal water years, years with the lowest production under the No-Action Alternative typically had the greatest percent increase in production under CP1. In above-normal and wet water years, however, the lowest production years typically remained similar or had a slight decrease in production under CP1 conditions relative to the No-Action Alternative.

Mortality

Based on the 1999 through 2006 population average, the greatest mortality to fall-run Chinook salmon under CP1 occurred to the egg incubation life stage, followed by presmolts, then fry, and lastly to immature smolts. Nonoperational conditions were the primary causes of mortality for all life stages under all Comprehensive Plans. Table 11-8 displays the overall mortalities for each alternative that were caused by nonoperational factors versus those caused by operations (i.e., water temperature and flow) (Attachments 7B and 8B). Mortalities caused by the operations-related activities were less under CP1 than under the No-Action Alternative and Existing Condition (Tables 11-10 and 11-11).

When removing nonoperations-related mortality, allowing comparison of mortality for operations-related activities only, egg incubation was still the primary life stage affected, but operations-related activities had a greater effect on fry than on presmolts and an even lesser effect on immature smolts. Flow effects triggered a higher percentage of the operations-related mortality (Table 11-11).

In all water-year types, the greatest portion of mortality under CP1 occurred to fry caused by forced movement to downstream habitats. Prespawn, incubation,

and superimposition mortality were greater than mortality to eggs caused by unsuitable water temperatures and presmolt habitat movement.

Table 11-10. Percent Mortality to Fall-Run Chinook Salmon Caused by Nonoperations-Related Effects and Operations-Related Effects Under the Comprehensive Plans When Starting Population Is Based on the 1999 Through 2006 Average

Alternative /Plan	% Nonoperations-Related Mortality	% of the Total Mortality	% Operations-Related Mortality	% of the Total Mortality
Future Condition (2030)				
No-Action Alternative	54.4	63.6	31.2	36.4
CP1	54.0	67.0	26.6	33.0
CP2	54.2	67.3	26.3	32.7
CP3, CP5	54.8	67.7	26.2	32.3
CP4	56.0	66.9	27.7	33.1
Existing Condition (2005)				
Existing Condition	54.3	63.5	31.2	36.5
CP1	54.3	63.7	30.9	36.3
CP2	54.8	64.1	30.7	35.9
CP3, CP5	54.8	64.1	30.7	35.9
CP4	56.8	66.8	28.2	33.2

Note:
Results derived from SALMOD.
Key:
CP = Comprehensive Plan

Table 11-11. Average Annual Mortality Under Each Comprehensive Plan Caused by Project Activities to Fall-Run Chinook Salmon When the Starting Population Is Based on 1999 Through 2006 Average

Alternative/ Plan	Mortality Factor									Total
	Prespawn	Incubation	Super-imposition	Eggs – Temperature	Fry Habitat	Presmolt Temperature	Presmolt Habitat	Immature Smolt Temperature	Immature Smolt Habitat	
Future Condition (2030)										
No-Action	6,933,038	8,637,460	11,297,314	751,707	20,454,063	2,616	185,161	1,828	7,986	48,271,173
CP1	5,953,724	8,598,648	10,782,834	842,722	20,842,014	3,478	203,758	2,176	9,423	47,238,777
CP2	6,323,278	8,540,437	10,124,156	757,096	21,173,718	3,207	207,219	2,280	9,320	47,140,711
CP3, CP5	5,247,046	8,176,898	9,816,774	780,596	21,620,408	2,805	197,386	1,779	8,770	45,852,462
CP4	615,999	8,752,615	10,788,926	457,114	22,733,903	3,197	215,680	1,104	12,719	43,581,257
Existing Condition (2005)										
Existing Condition	6,412,279	8,627,932	11,633,303	836,483	20,574,388	3,476	201,791	1,868	9,779	48,301,299
CP1	6,575,997	8,629,625	10,869,399	711,591	20,799,632	3,552	204,478	1,811	9,078	47,805,163
CP2	6,648,591	8,392,873	10,487,388	809,925	21,000,903	3,740	210,743	2,048	8,162	47,564,373
CP3, CP5	7,018,928	8,151,667	10,172,594	731,280	21,302,504	2,528	200,284	1,441	8,505	47,589,731
CP4	739,579	8,813,580	10,872,888	449,679	22,650,162	1,835	232,417	727	13,256	43,774,123

Note:
Results derived from SALMOD.
Key:
CP = Comprehensive Plan

In critical water years, mortality to prespawning females was the primary cause of operations-related mortalities for CP1, followed by mortality to fry due to forced movement, and then to eggs from redd dewatering or scouring and superimposition. Least affected were presmolts and then immature smolts by both water temperatures and forced movement. Attachments 7C and 8C contains tables of mortality to fall-run sorted by water-year type, and Table 11-12 outlines the ranks classified under each Comprehensive Plan for each water-year type.

As with critical water years, dry water years were dominated by mortality to fry due to forced movement downstream, followed by redd dewatering or scouring and redd superimposition. Additional mortality occurred to fall-run Chinook salmon presmolts and immature smolts from both forced movement and unsuitable water temperatures (Table 11-12).

Below-normal and above-normal water years were relatively similar for all Comprehensive Plans. Mortality factors were dominated by mortality to fry due to forced movement downstream, followed by redd superimposition, dewatering, or scouring. Mortality to presmolts caused by forced downstream movement was a greater factor affecting fall-run populations than was egg mortality caused by unsuitable water temperatures, or to immature smolts and fry due to unsuitable water temperatures (Table 11-12).

As with the water-year types discussed above, under wet water year conditions, the majority of mortality also occurred to fry due to forced downstream movement, followed by redd superimposition, and redd dewatering or scouring. Mortality to presmolts and immature smolts from downstream movement were the lowest rates resulting from operations-related activities. Least affected were eggs due to unsuitable water temperatures, both pre- and post-spawn.

Years with the highest mortality were the same for the No-Action Alternative and CP1: 1934, 1935, 1970, 1978, and 1993. With the exception of 1970, each of these years was preceded by a critical water year. Overall, years with the lowest mortality tended to be dry or critical water years (Attachment 7C).

Years with the highest mortality were the same for the Existing Condition and CP1: 1957, 1982, 1985, 1994, and 1997. Overall, years with the lowest mortality tended to be dry or critical water years (Attachment 8C).

Table 11-12. Mortality Parameters Ranked by Importance for Fall-Run Chinook Salmon by the No-Action Alternative or Comprehensive Plan and Water-Year Type When the Starting Population Is Based on the 1999 Through 2006 Average

Alternative/ Plan Water-Year Type	Mortality Factor									
	Prespawn	Incubation	Superimposition	Eggs – Temperature	Fry – Temperature	Fry – Habitat	Presmolt – Temperature	Presmolt – Habitat	Immature Smolt – Temperature	Immature Smolt – Habitat
No-Action Alternative										
Critical	1	3	5	4		2	8	6	9	7
Dry	4	2	3	5	10	1	8	6	9	7
Below-normal	6	3	2	5	10 / 9	1	8	4	9/10	7
Above-normal	4 / 5	2	3	7	10 / -	1	9 / -	5 / 4	8	6
Wet	6	3	2	5		1	8	4	- / 9	7
CP1										
Critical	1	3	5	4		2	8	6	9	7
Dry	4	2	3	5	10	1	8	6	9	7
Below-normal	6 / 7	3	2	5	9	1	8	4	10	7 / 6
Above-normal	5	3	2	7		1		4	8 / -	6
Wet	6 / 7	2 / 3	3 / 2	5		1		4	- / 9	7 / 6
CP2										
Critical	1	3	5	4		2	8	6	9	7 / 8
Dry	4	3 / 2	2 / 3	5	- / 10	1	8	6	9	7
Below-normal	7 / 6	3	2	5	9	1	8	4	10	6 / 7
Above-normal	6 / 5	3	2	7		1		4		5 / 6
Wet	7 / 6	3	2	6 / 5		1	- / 8	4		5 / 7
CP3, CP5										
Critical	1	3	5	4	10 / -	2	8 / 7	6	9	7
Dry	5 / 4	3	2	4 / 5	- / 10	1	9	6	8 / 9	7
Below-normal	7 / 6	3	2	5	- / 9	1	8	4	10	6 / 7
Above-normal	5	3	2	7		1		4		6
Wet	6 / 7	3	2	5		1	- / 8	4		7 / 6
CP4										
Critical	3	2	5	4	10 / -	1	8	6	9	7
Dry	- / 8	2	3	5	9 / 10	1	7	4	8 / 9	6
Below-normal	8 / -	3	2	5 / 6	9 / 8	1	7	4	10/9	6 / 5
Above-normal	5	3	2	7		1		4		6
Wet	7	3	2	6		1	- / 8	4		5

Notes:

Blanks and "-" indicate no mortality occurred as a result of that factor.

In most cases, the No-Action Alternative is identical to the Existing Condition. However, when ranking the ranks between the two differs, the differences are presented as Future Conditions Rank/Existing Condition Rank.

Rank values

1 = most significant

5 = last significant

Results derived from SALMOD.

Key:

CP = Comprehensive Plan

When using AFRP population goals as the spawning population, fall-run Chinook salmon mortality caused by operations-related activities decreased under CP1 compared to No-Action Alternative conditions. Under CP1, mortality caused by operations-related activities would decrease from nonoperations related mortality by more than 13 percent. Under CP2, the greatest mortality to fall-run occurred to the egg incubation life stage, followed by fry, then presmolts, and lastly to immature smolts. Nonoperational conditions were the primary causes of mortality for all life stages under all alternatives (Attachment 9B).

Because fall-run Chinook salmon have, overall, a reduced mortality, fall-run Chinook salmon would benefit from actions taken in CP1. Mitigation for this impact is not needed, and thus not proposed.

Late Fall-Run Chinook Salmon

Production

Based on the 1999 through 2006 population average, overall average late fall-run Chinook salmon production for the 82-year period was similar for CP1 relative to the No-Action Alternative and the Existing Condition. The maximum increase in production relative to the No-Action Alternative was 6 percent for CP1, while the largest decrease in production relative to the No-Action Alternative was 3 percent for CP1 (Attachment 10A). Production remained relatively similar regardless of water-year type.

Overall average late fall-run Chinook salmon production for the 82-year period was similar for CP1 relative to the Existing Condition. The maximum increase in production relative to the Existing Condition was 13 percent for CP1 (1985), while the largest decrease in production relative to the Existing Condition was -5 percent for CP1 (1934) (Attachment 11A).

Under CP1, no critical water years resulted in an increase in production relative to the Existing Condition ranging greater than 5 percent when model noise was removed. Four dry water years (1926, 1961, 1930, and 1985) resulted in a 5 to 13-percent increase in production relative to the Existing Condition. No below-normal, above-normal, or wet water years resulted in a greater than 5-percent difference from the Existing Condition.

When the starting population was the AFRP goal, overall average late fall-run Chinook salmon production was similar for CP1 relative to the No-Action Alternative (Attachment 12A). The maximum increase in production relative to the No-Action Alternative was 8 percent for CP1. The largest decrease in production relative to the No-Action Alternative was 4 percent for CP1. Production remained relatively similar regardless of water-year type.

Mortality

Based on the 1999 through 2006 population average, the greatest mortality to late fall-run Chinook salmon under CP1 occurred to the egg incubation life

stage, followed by fry, then presmolts and lastly to immature smolts. Nonoperational conditions were primary causes of mortality for all life stage. Table 11-13 displays the overall mortalities for each Comprehensive Plan that are caused by nonoperational factors versus those caused by operations (i.e., water temperature and flow) (Attachments 10B and 11B). Mortalities caused by the project decreased for all Comprehensive Plans relative to the No-Action Alternative.

When removing nonoperations-related mortality, allowing comparison of mortality for operations-related activities only, fry became the primary life stage affected, and operations-related activities had a greater effect on eggs than on presmolts and an even lesser effect on immature smolts. Most of the mortality occurred as a result of flow conditions rather than water temperature (Table 11-14).

Table 11-13. Percent Mortality to Late Fall-Run Chinook Salmon Caused by Nonoperations-Related and Operations-Related Effects Under the No-Action Alternative and Comprehensive Plans When Starting Population is Based on 1999 Through 2006 Average

Plan	% Nonoperations-Related Mortality	% of the Total Mortality	% Operations-Related Mortality	% of the Total Mortality
Future Condition (2030)				
No-Action Alternative	60.6	78.1	17.0	11.9
CP1	60.6	78.3	16.8	11.7
CP2	60.6	78.3	16.8	11.7
CP3, CP5	60.7	78.4	16.7	11.6
CP4	60.5	78.6	16.5	11.4
Existing Condition (2005)				
Existing Condition	60.5	78.1	17.0	21.9
CP1	60.6	78.2	16.9	21.8
CP2	60.6	78.2	16.9	21.8
CP3, CP5	60.6	78.3	16.8	21.7
CP4	60.5	78.3	16.6	21.7

Note:
Results derived from SALMOD.
Key:
CP = Comprehensive Plan

Table 11-14. Average Annual Mortality Under Each Comprehensive Plan Caused by Project Activities to Late Fall-Run Chinook Salmon When Starting Population Is Based on 1999 Through 2006 Average

Alternative/ Plan	Mortality Factor									Total
	Incubation	Super-imposition	Eggs – Temperature	Fry – Temperature	Fry – Habitat	Presmolt – Temperature	Presmolt – Habitat	Immature Smolt – Temperature	Immature Smolt – Habitat	
Future Condition (2030)										
No-Action Alternative	885,900	1,129,675	18,538	2,873	3,396,805	86,590	16,940	33,034	1,514	5,571,869
CP1	877,958	1,060,236	24,035	1,519	3,438,193	67,196	17,459	33,021	1,717	5,521,334
CP2	864,780	1,027,257	23,665	1,869	3,484,534	73,169	16,561	34,001	1,774	5,527,610
CP3, CP5	851,079	1,033,193	23,418	1,441	3,475,832	60,496	19.058	29,915	1,716	5,477,109
CP4	875,916	1,060,236	25,236	77	3,438,827	6,484	20,580	8,318	2,071	5,437,745
Existing Condition (2005)										
No-Action Alternative	942,064	1,101,169	23,763	2,223	3,409,077	70,182	16,292	35,069	1,678	5,601,517
CP1	906,913	1,050,151	23,965	1,431	3,453,329	62,887	15,249	34,088	1,684	5,549,697
CP2	888,150	1,040,323	24,034	2,169	3,468,156	68,815	16,556	35,221	1,728	5,545,152
CP3, CP5	873,920	1,040,676	24,172	2,104	3,445,358	69,686	18,314	35,778	1,664	5,511,672
CP4	904,730	1,050,151	25,078	24	3,425,210	8,475	20,082	8,746	2,020	5,444,516

Note:
Results derived from SALMOD.
Key:
CP = Comprehensive Plan

Under CP1, mortality to fry resulting from unsuitable water temperatures only occurred at low levels to late fall-run Chinook salmon during critical, dry, and below-normal water years only. In all water-year types, mortality to fry during forced movement to downstream habitats was the primary cause of operations-related mortality.

In critical, dry, and below-normal water years, the causes of operations-related mortality follow similar trends for all alternatives with a few exceptions. In general, the effects of flow (and density) had the greatest effect on mortality. Forced movement of fry resulted in the greatest mortality, followed by flow effects on eggs via scouring, dewatering, or superimposition. Next affected were presmolts and immature smolts by unsuitable water temperatures, and lastly temperature effects on eggs and flow effects on presmolts and immature smolts and fry (Table 11-15).

Wet and above-normal water years were overall similar to critical, dry, and below-normal water years except that mortality to fry due to unsuitable water temperatures disappears.

Years with the highest mortality under CP1 were 1937, 1957, 1982, 1985, 1994 and 1997. Three years were preceded by a wet water year, one was preceded by an above-normal water year, and at least one was preceded by a below-normal water year (Attachments 10C and 11C).

When starting with a spawning population equal to the AFRP goal, late fall-run Chinook salmon mortality caused by the operations-related activities was slightly less under CP1 than under No-Action Alternative conditions (Attachment 12B). Under CP1, mortality caused by operations-related activities would decrease from non-operations related mortality by more than 28 percent. Under CP1, the greatest mortality to late fall-run Chinook salmon occurred to the egg incubation life stage, followed by presmolts, then fry, and lastly to immature smolts. Nonoperational conditions were the primary causes of mortality for all life stages under all alternatives.

Because late fall-run Chinook salmon have, overall, a reduced mortality, late fall-run Chinook salmon would benefit from actions taken in CP1. Mitigation for this impact is not needed, and thus not proposed.

Impact Aqua-13 (CP1): Changes in Flow and Water Temperatures in the Upper Sacramento River Resulting from Project Operations—Steelhead, Green Sturgeon, Sacramento Splittail, American Shad, and Striped Bass Project operation would result in slightly improved flow and water temperature conditions in the upper Sacramento River for steelhead, green sturgeon, Sacramento splittail, American shad, and striped bass. This impact would be less than significant.

Table 11-15. Mortality Parameters Ranked by Importance for Late Fall-Run Chinook Salmon by Comprehensive Plan and Water-Year Type When Starting Population Is Based on 1999 Through 2006 Average

Alternative/ Plan Water-Year Type	Mortality Factor								
	Incubation	Superimposition	Eggs – Temperature	Fry – Temperature	Fry – Habitat	Presmolt – Temperature	Presmolt – Habitat	Immature Smolt – Temperature	Immature Smolt – Habitat
No-Action Alternative									
Critical	2	4 / 3	6	8	1	3 / 4	7	5	9
Dry	3	2	5 / 6	9	1	4	6	7 / 5	8
Below-normal	3	2	4 / 6	9	1	5	7	6 / 4	8
Above-normal	2	3	5 / 4	9 / -	1	6	4	7	8
Wet	3	2	5		1	7	4	8 / 6	6 / 8
CP1									
Critical	2	3	6	9 / 8	1	4	7	5	8 / 9
Dry	3	2	5	9	1	4	6	7 / 6	8
Below-normal	3	2	4 / 6	- / 9	1	6 / 5	7	5 / 4	8
Above-normal	2	3	5 / 4		1	6 / 5	4	7 / 6	8 / 7
Wet	3	2	5		1	7 / 8	4	6	8 / 7
CP2									
Critical	2	3	6	8	1	4	7	5	9
Dry	3	2	6 / 5	9	1	4	7	5 / 6	8
Below-normal	3	2	4 / 6		1	6 / 5	7	5 / 4	8
Above-normal	2	3	5 / 4		1	7 / 6	4	6 / 7	8
Wet	3	2	5		1	7 / 8	4	6	8 / 7
CP3, CP5									
Critical	2	3	6	8	1	4	7	5	9
Dry	3	2	6 / 5	9	1	4	7	5 / 6	8
Below-normal	3	2	4 / 6	- / 9	1	7 / 5	5	6 / 4	8
Above-normal	2	3	5		1	7 / 6	4	6 / 7	8
Wet	3	2	5		1	7 / 8	4	6	8 / 7
CP4									
Critical	2	3	4	9 / -	1	6 / 5	7	5 / 6	8
Dry	3	2	4	9 / -	1	7 / -	5	6 / -	8 / 6
Below-normal	3	2	4		1	8 / 7	5	7 / 6	6 / 8
Above-normal	2	3	5		1	7 / 8	4	6	8 / 7
Wet	3	2	5		1	8	4	6	7

Notes:

Blanks and "-" indicates no mortality occurred as a result of that factor.

In most cases, the NEPA Future Condition is identical to the CEQA Existing Condition. However, when ranking between the two differs, the differences are presented as Future Condition Rank/ Existing Condition Rank.

Rank values

1 = most significant

5 = last significant

Results derived from SALMOD.

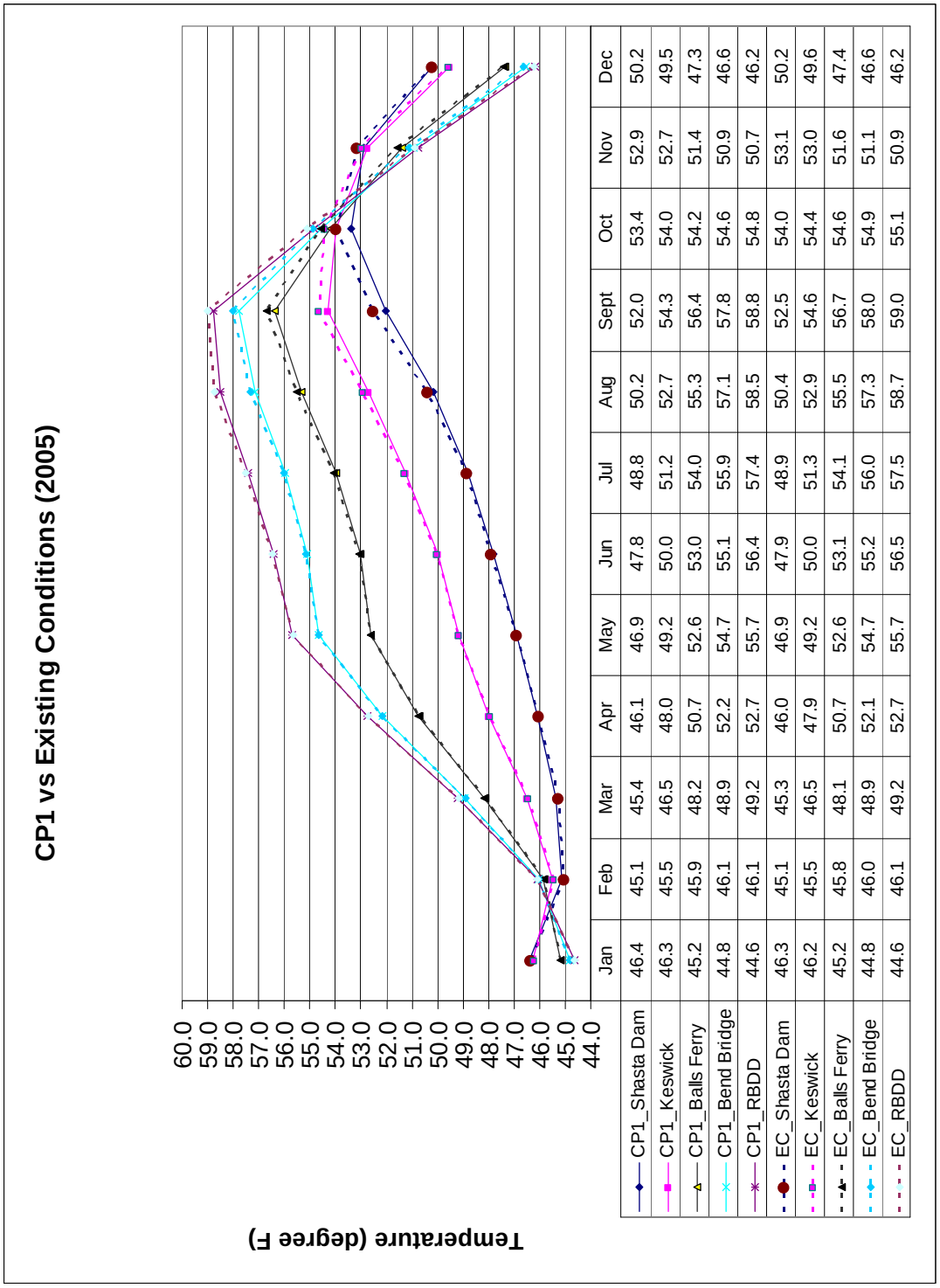
Key:

CP = Comprehensive Plan

Flow-Related Effects Monthly mean flows at all model locations (i.e., below Shasta Dam, below Keswick Dam, above Bend Bridge, and above RBDD) within the upper Sacramento River under CP1 would be essentially equivalent (less than 2-percent difference) to flows under the Existing Condition and No-Action Alternative simulated for all months (see the *Hydrology, Hydraulics and Water Management Technical Report*). Potential flow-related effects on fish species of management concern in the upper Sacramento River from this alternative would be minimal. During most years, releases from Shasta Lake would be unchanged. In average and wet years, river flows would decrease slightly in some years during the December-through-February period because of the use of increased capacity within Shasta Lake, usually following an extended dry period. Also, flows (and stages) would increase slightly during the June-through-August period of most years. Although small, this increase would be most pronounced during dry periods, as more water is released from Shasta Dam for water supply reliability purposes. However, also during dry periods, few to no changes would occur in water flows or changes during winter and spring. The average changes in mean monthly flow would be reductions or increases of several percent, although the changes in mean monthly flow would be greater in some years. Nonetheless, differences generally would be small (less than 2 percent). All potential changes in flows and stages would diminish downstream from RBDD because of the increasing effect of inflows from tributaries and of diversions and flood bypasses.

There would be no discernable flow-related effects on steelhead, green sturgeon, Sacramento splittail, American shad, or striped bass in the upper Sacramento River related to changes in monthly mean flows under CP1, relative to the Existing Condition and No-Action Alternative. Functional flows for migration, attraction, spawning, egg incubation, and rearing/emigration for all these fish species would be unchanged. Therefore, flow-related effects on these fish species would be less than significant.

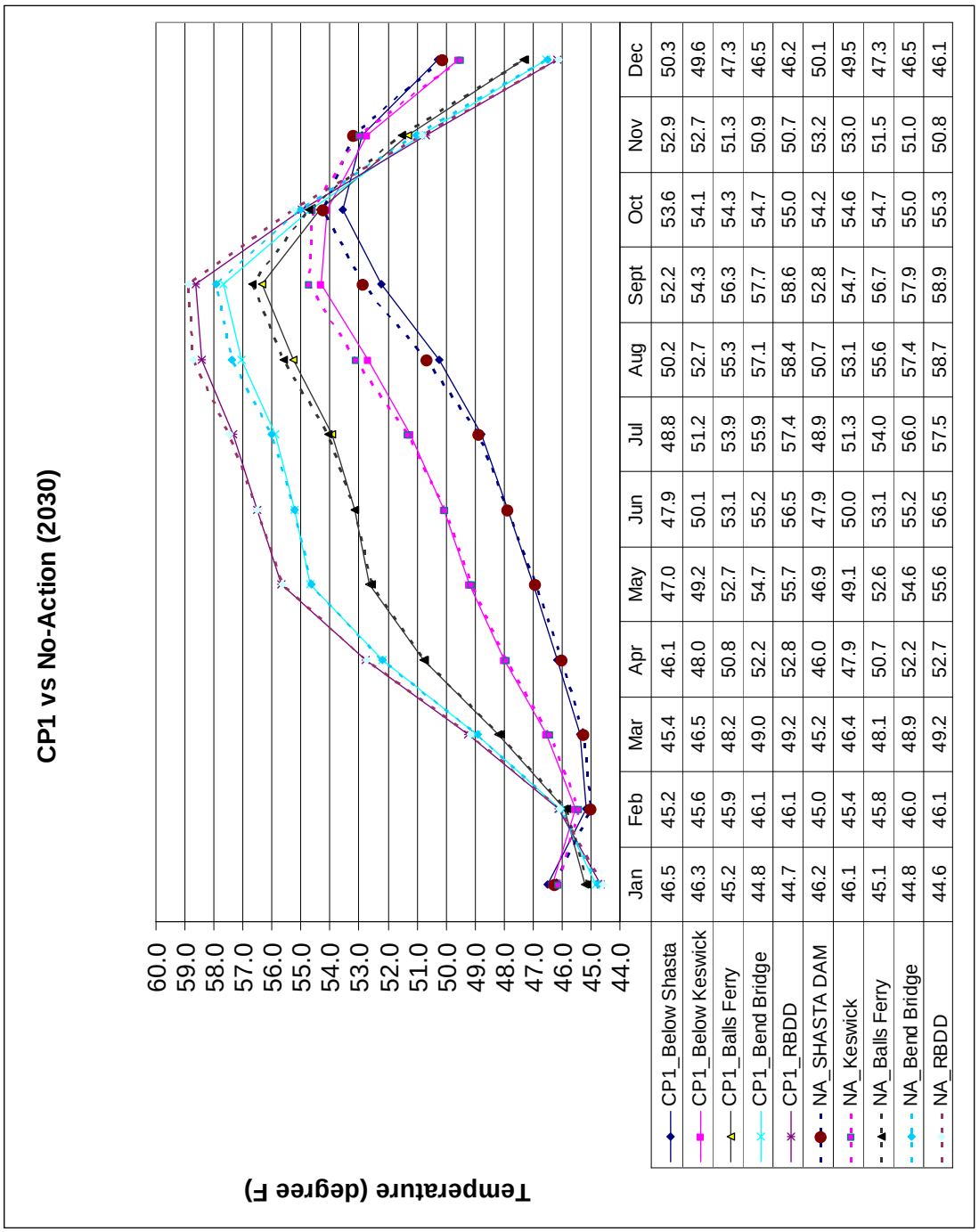
Water Temperature-Related Effects Monthly mean water temperatures at all model locations (i.e., below Shasta Dam, below Keswick Dam, above Bend Bridge, and above RBDD) within the upper Sacramento River under CP1 would be the same, or fractionally less, than those under the Existing Condition and No-Action Alternative conditions simulated for all months (Figures 11-9 and 11-10) (see also the *Hydrology, Hydraulics, and Water Management Technical Report* for complete modeling results). As discussed above, the modeling simulations may not fully account for real-time management of the cold-water pool and TCD (through the SRTTG) to achieve maximum cold-water benefits. Therefore, the modeled changes in water temperature (i.e., small benefits) are likely conservative and understated to some degree. Nevertheless, potential water temperature–related effects on fish species of management concern in the upper Sacramento River from this alternative would be minimal. During most years, annual releases from Shasta Lake would be unchanged.



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
CP1_Shasta Dam	46.4	45.1	45.4	46.1	46.9	47.8	48.8	50.2	52.0	53.4	52.9	50.2
CP1_Keswick	46.3	45.5	46.5	48.0	49.2	50.0	51.2	52.7	54.3	54.0	52.7	49.5
CP1_Balls Ferry	45.2	45.9	48.2	50.7	52.6	53.0	54.0	55.3	56.4	54.2	51.4	47.3
CP1_Bend Bridge	44.8	46.1	48.9	52.2	54.7	55.1	55.9	57.1	57.8	54.6	50.9	46.6
CP1_RBDD	44.6	46.1	49.2	52.7	55.7	56.4	57.4	58.5	58.8	54.8	50.7	46.2
EC_Shasta Dam	46.3	45.1	45.3	46.0	46.9	47.9	48.9	50.4	52.5	54.0	53.1	50.2
EC_Keswick	46.2	45.5	46.5	47.9	49.2	50.0	51.3	52.9	54.6	54.4	53.0	49.6
EC_Balls Ferry	45.2	45.8	48.1	50.7	52.6	53.1	54.1	55.5	56.7	54.6	51.6	47.4
EC_Bend Bridge	44.8	46.0	48.9	52.1	54.7	55.2	56.0	57.3	58.0	54.9	51.1	46.6
EC_RBDD	44.6	46.1	49.2	52.7	55.7	56.5	57.5	58.7	59.0	55.1	50.9	46.2

Key:
CP = Comprehensive Plan
EC = Existing Condition
RBDD = Red Bluff Diversion Dam

Figure 11-9. Changes in Mean Monthly Water Temperature at Modeled Locations in the Sacramento River Within the Primary Study Area (Existing Condition)



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
CP1_Below Shasta	46.5	45.2	45.4	46.1	47.0	47.9	48.8	50.2	52.2	53.6	52.9	50.3
CP1_Below Keswick	46.3	45.6	46.5	48.0	49.2	50.1	51.2	52.7	54.3	54.1	52.7	49.6
CP1_Balls Ferry	45.2	45.9	48.2	50.8	52.7	53.1	53.9	55.3	56.3	54.3	51.3	47.3
CP1_Bend Bridge	44.8	46.1	49.0	52.2	54.7	55.2	55.9	57.1	57.7	54.7	50.9	46.5
CP1_RBDD	44.7	46.1	49.2	52.8	55.7	56.5	57.4	58.4	58.6	55.0	50.7	46.2
NA_SHASTA DAM	46.2	45.0	45.2	46.0	46.9	47.9	48.9	50.7	52.8	54.2	53.2	50.1
NA_Keswick	46.1	45.4	46.4	47.9	49.1	50.0	51.3	53.1	54.7	54.6	53.0	49.5
NA_Balls Ferry	45.1	45.8	48.1	50.7	52.6	53.1	54.0	55.6	56.7	54.7	51.5	47.3
NA_Bend Bridge	44.8	46.0	48.9	52.2	54.6	55.2	56.0	57.4	57.9	55.0	51.0	46.5
NA_RBDD	44.6	46.1	49.2	52.7	55.6	56.5	57.5	58.7	58.9	55.3	50.8	46.1

Key:
EC = Existing Condition
CP = Comprehensive Plan
RBDD = Red Bluff Diversion Dam

Figure 11-10. Changes in Mean Monthly Water Temperature at Modeled Locations in the Sacramento River Within the Primary Study Area (No-Action Alternative)

Overall, the greatest cooling effect (less than 1°F) would occur during critical years and during the late summer (i.e., July through September), because of the increased cold-water pool volume within Shasta Lake, even following an extended dry period. This would benefit incubating eggs. All potential changes in flows and stages would diminish downstream from RBDD because of the increasing effect of inflows from tributaries, and of diversions and flood bypasses.

There would be very small water temperature-related effects on steelhead, green sturgeon, Sacramento splittail, American shad, and striped bass in the upper Sacramento River related to slightly cooler monthly mean water temperatures under CP1, relative to the Existing Condition and the No-Action Alternative. Mean monthly water temperatures would not rise above important thermal tolerances for the species life stages relevant to the upper Sacramento River. Therefore, water temperature-related effects on these fish species would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact Aqua-14 (CP1): Reduction in Ecologically Important Geomorphic Processes in the Upper Sacramento River Resulting from Reduced Frequency and Magnitude of Intermediate to High Flows Project operations could result in the reduction of the magnitude, duration, or frequency of intermediate to large flows that are necessary for channel formation and maintenance, meander migration, and the creation of seasonally inundated floodplains, all of which are processes necessary for the maintenance of important aquatic habitat functions and values for the fish and macroinvertebrate communities. A reduction in these ecologically important geomorphic processes and related aquatic habitat functions and values in the Sacramento River and lowermost (confluence) areas of tributaries would be a potentially significant impact.

Sediment transport, deposition, and scour regulate the formation of key habitat features such as point bars, gravel deposits, and shaded riverine aquatic (SRA) habitat. These processes are regulated by the magnitude, duration, and frequency of flows, with relatively large floods providing the energy required to mobilize sediment from the bed, produce meander migration, and create seasonally inundated floodplains. Project operations could result in reduced intermediate to large flows that are necessary for channel formation and maintenance, meander migration, and the creation of seasonally inundated floodplains.

Channel Forming and Maintenance In undisturbed alluvial rivers, channels and bedforms develop in response to flow and sediment loading conditions that may vary by orders of magnitude within a few hours. In many cases, the frequency distribution of flow and sediment supply are such that rivers convey the greatest fraction of their sediment load at an intermediate "dominant" discharge, which is often close to the bankfull flow (Leopold et al. 1964). Although the recurrence interval of bankfull flow varies from river to river, it is often close to 1.5 to 2 years (Leopold et al. 1964). This provides a

rational basis for assuming that coarse sediment is routed as bedload during the 1.5-year (Q) flood. Flow regulation of the Sacramento River has reduced its Q1.5 by 30 percent from 86,000 cfs to 61,000 cfs (Kondolf et al. 2000).

Whereas bankfull flow may provide a good first approximation for assessing the threshold for bed mobilization, it is not necessarily indicative of flows that are required to maintain the health of habitats in the alluvial system. For example, it has been estimated that the naturally occurring 5- to 10-year recurrence interval flood may often be required for maintenance of a mobile alternating bar-pool sequence (Trush et al. 2000) – an ecologically desired condition. In the regulated flow regime of the Sacramento River, the 10-year flood has been reduced by 38 percent from 218,000 cfs to 134,000 cfs (Kondolf et al. 2000).

At many locations between Keswick Dam and RBDD, the channel is characterized by bedrock control of its base level and its banks. This implies that, compared to alluvial reaches downstream, the channel in this area has been limited in its ability to adjust hydraulic geometry (i.e., channel width and depth) in response to dam-related changes in flow. Thus, it is possible that the channel is not in balance with the current flow regime, such that typical recurrence intervals of mobilization and bedform alteration are much longer than they were before the dams reduced the magnitude of Q1.5 and Q10. This implies that the bed and point bars may have become static in the postdam era, such that only remnants of gravel of once abundant spawning habitat in this reach remain.

The flow required for mobilization and scour of a channel bed depends in part on the grain-size distribution of the bed sediment. On the Sacramento River, the grain-size distributions of deposits between Keswick Dam and Cottonwood Creek may have increased since construction of Shasta Dam because of winnowing associated with dam-related reductions in sediment supply (Stillwater Sciences 2006). This would tend to increase the threshold for mobilization and scour of the channel bed, even as the frequency of high flows was reduced by operations of Shasta Dam. The hypothesized coarsening of the bed would thus tend to make mobilization of sediment and bedforms even less likely under the regulated flow regime in the upper Sacramento River.

Changes (reductions) in intermediate to large flows in the Sacramento River also has the potential to affect the lower reaches (confluence areas) of tributaries by reducing the backwater effect that the mainstem river has on the lower reaches of the tributaries. A decrease in the frequency, duration, and intensity of intermediate to large flows on the Sacramento River, and associated decrease in the stage elevation of the river surface, could result in increased downcutting in the lower reaches of the tributaries. Downcutting of the lower tributaries could result in bank erosion, channel widening, and the channel becoming disconnected from its floodplain, which in turn could affect riparian recruitment and succession processes.

Meander Migration Suitable spawning habitat on the mainstem currently extends from Keswick Dam to Princeton. Since 1945, Shasta (and later Keswick) Dam has altered mainstem flow and sediment supply, and has thus affected the quantity and grain-size distributions of gravel in the channel bed. This in turn has affected the extent and quality of salmonid spawning habitat. The expected evolution of spawning gravel in the Sacramento River can be summarized in the following three working hypotheses (Stillwater Sciences 2006):

1. Bed coarsening in the upper Sacramento River has occurred and is continuing such that spawning habitat has been progressively reduced in the reach between Keswick Dam and Anderson Bridge, despite the effects of recent gravel augmentation.

2. Bed coarsening has progressed downstream since 1980 and has now reduced spawning habitat area between Anderson Bridge and Cottonwood Creek.

3. Although the concentration of fine sediment in the subsurface has appeared to remain suitably low between Keswick Dam and Cottonwood Creek, it may have become higher in downstream reaches, because of dam-related reductions in large flows coupled with high sediment supply from Cottonwood Creek and local hydraulic conditions (i.e., a break in slope) that promote local deposition, such that successful spawning of fall-run Chinook salmon in reaches below Cottonwood Creek may have been compromised.

Whereas the success of anadromous salmonids depends strongly on gravel dynamics in the mainstem, other fish species of primary management concern rely much more heavily on the dynamics of meander migration, which affects the quality and availability of near- and off-channel habitat such as SRA.

SRA habitat is composed of vegetation and instream tree and shrub debris that provides important fish habitat. SRA habitat is defined as the nearshore aquatic habitat occurring at the interface between a river and adjacent woody riparian habitat. The principal attributes of this cover type are (1) an adjacent bank composed of natural, eroding substrates supporting riparian vegetation that either overhang or protrude into the water, and (2) water that contains variable amounts of woody debris, such as leaves, logs, branches, and roots and has variable depths, velocities, and currents. Riparian habitat provides structure (through SRA habitat) and food for fish species. Shade decreases water temperatures, while low overhanging branches can provide sources of food by attracting terrestrial insects. As riparian areas mature and banks erode, the vegetation sloughs off into the rivers, creating structurally complex habitat consisting of instream woody material that furnishes refugia from predators, creates higher water velocities, and provides habitat for aquatic invertebrates. For these reasons, many fish species are attracted to SRA habitat.

On the upper Sacramento River, actively migrating reaches alternate with stable reaches, which migrate slowly or not at all because they are confined by erosion-resistant geologic deposits or revetment placed to protect adjacent uses. Meander migration and bank erosion occur by progressive channel migration and episodic meander-bend cutoff. Over decadal timescales, cutoffs generally affect less than 10 percent of the actively migrating length of the Sacramento River. Even so, cutoffs can account for well over 20 percent of the integrated lateral channel change, because they affect relatively large areas when they do occur (Stillwater Sciences 2006).

Chute cutoff and progressive migration interact to produce a characteristic pattern of planform development over time. Individual bends evolve greater sinuosity and curvature via progressive channel migration. Cutoffs reduce sinuosity when it exceeds a local threshold for the initiation of cutoff processes. This should produce measurable changes in local geomorphology over time. Averaged over larger timescales, however, changes in morphology in one reach should be balanced by changes in morphology in others, such that the overall pattern of planform geometry for migrating portions of rivers should approach a state of dynamic equilibrium in the absence of human modifications. Recent studies indicate that the sinuosity of cutoff bends is decreasing over time on the Sacramento River (Stillwater Sciences 2006). This suggests that the Sacramento River is not in a state of dynamic equilibrium. The fact that cutoff migration has increased in frequency and is increasingly dominated by partial cutoffs (which affect smaller areas than complete cutoffs) provides further evidence that nonequilibrium conditions may prevail.

Process-based interpretations suggest that potential project alternative-related changes in flow (i.e., reductions in peak flow and overbank discharge) could tend to reduce the frequency of these important geomorphic processes. This would generally be accompanied by a reduction in average sinuosity; however, observations from the Sacramento River indicate that the overall number of channel cutoffs has nevertheless increased in recent times. This supports the hypothesis that the erodibility of banks and floodplains has increased (and thus enhanced the likelihood of cutoff) because of the effects of agricultural clearing of riparian forests on floodplains (Micheli et al. 2004).

Floodplain Inundation Inundation of floodplains reduces floodflow magnitude (i.e., peak volume of flood flows) and promotes exchange of nutrients, organisms, sediment, and energy between the terrestrial and aquatic systems. Flood pulses contribute to high rates of primary productivity in functioning floodplain systems (Junk et al. 1989). On the Sacramento River, floodplains provide important winter and spring spawning and rearing habitats for native fish, such as Sacramento splittail and Chinook salmon (Moyle et al. 2004, Sommer et al. 2001).

Typically, the floodplain immediately adjacent to the river is maintained at an elevation equal to the bankfull stage of the channel, such that discharge

magnitudes greater than the bankfull flow inundate the adjacent floodplains (Leopold et al. 1964). As bankfull flow typically has a recurrence interval of Q1.5-2 on alluvial rivers, flow magnitudes greater than the Q1.5 flow event are often assumed to initiate floodplain inundation.

These effects would likely occur along the upper Sacramento River, downstream from Shasta Dam, throughout the primary study area. Reductions in the magnitude of high flows would likely be sufficient to reduce ecologically important processes along the upper Sacramento River, downstream from Shasta Dam, throughout the primary study area. Therefore, these impacts would be potentially significant. Mitigation for this impact is proposed in Section 11.3.4.

Lower Sacramento River and Tributaries, Delta, and Trinity River
Impact Aqua-15 (CP1): Changes in Flow and Water Temperatures in the Lower Sacramento River and Tributaries and Trinity River Resulting from Project Operation – Fish Species of Primary Management Concern Project operation would result in no discernable change in mean monthly flow or water temperature conditions in the lower Sacramento River; however, predicted changes in flow in the Feather River, American River, and Trinity River could result in an adverse effect on Chinook salmon, steelhead, coho salmon, green sturgeon, Sacramento splittail, American shad, and striped bass, if they were to occur. This impact would be potentially significant.

Monthly mean flows at model locations (i.e., Verona, Freeport) within the lower Sacramento River under CP1 would be comparable to flows under Existing Condition and No-Action Alternative conditions simulated for all months (see the *Hydrology, Hydraulics, and Water Management Technical Report* for complete CalSim-II modeling results). All potential changes in flows diminish rapidly downstream from RBDD because of increasing effect of inflows from tributaries and of diversions and flood bypasses. Potential flow-related effects on fish species of management concern in the lower Sacramento River from this alternative would be minimal. Differences in mean monthly flow are generally small (less than 2 percent) and within the existing range of variability.

Monthly mean flows at all model locations within the lower Feather River (i.e., below Thermalito Afterbay) and the American River (i.e., near the H Street Bridge in Sacramento) under CP1 would be essentially equivalent (less than 2-percent difference) to flows under the Existing Condition and No-Action Alternative conditions simulated for all months (see the *Hydrology, Hydraulics, and Water Management Technical Report* for complete CalSim-II modeling results). All potential changes in flows are diminished in these areas because of operation of upstream CVP and SWP reservoirs (i.e., Lake Oroville and Folsom Lake) and increasing effects of inflows from tributaries and of diversions and flood bypasses. Potential flow-related effects on fish species of management concern in the Feather River and American River from this alternative would be minimal and within the existing range of variability. All potential changes in

water temperatures in the lower Sacramento River due to small changes in releases would diminish rapidly downstream because of increasing effect of inflows, atmospheric influences, and groundwater. Therefore, flow- and water temperature-related impacts on fish species in the lower Sacramento River would be less than significant.

Effects of altered flow regimes resulting from implementation of CP1 are unlikely to extend into the lower Sacramento River (i.e., downstream from Verona) and Delta because the Central Valley's reservoirs and diversions are managed as a single integrated system (consisting of the CVP and SWP). The guidelines for this management, which are described in the CVP/SWP OCAP, have been designed to maintain standards for flow to the lower Sacramento River and Delta. CVP and SWP operations must be consistent with the OCAP to allow ESA coverage by the OCAP permits and BOs. Thus, under CP1, this project is not anticipated to cause an alteration in flow to the Delta nor cause an alteration to water temperatures in the lower Sacramento River and primary tributaries within the extended study area sufficient to cause effects on Chinook salmon, steelhead, green sturgeon, Sacramento splittail, American shad, or striped bass in the lower Sacramento River or tributaries relative to the Existing Condition and No-Action Alternative. Functional flows for fish migration, attraction, spawning, egg incubation, and rearing/emigration for all these fish species would be unchanged. Therefore, flow- and water temperature-related effects on these fish species would be less than significant.

Monthly mean flows at model locations within the lower Feather River (i.e., below Thermalito Afterbay) and the American River (i.e., near the H Street Bridge in Sacramento) under CP1 would be essentially equivalent (less than 2 percent difference) to flows under the Existing Condition and No-Action Alternative conditions simulated for most months; however, several months within the modeling record show substantial changes (based on model simulations) to flows in tributaries (see the *Hydrology, Hydraulics, and Water Management Technical Report* for complete CalSim-II modeling results). All potential changes in flows could be reduced in these areas because of real-time operations to meet existing operational rules and operation of upstream CVP and SWP reservoirs (i.e., Lake Oroville and Folsom Lake). Nevertheless, based on predicted changes in flow and associated flow-habitat relationships (including water temperature) for fish, potential flow-related impacts on species of management concern in the American and Feather rivers would be a potentially significant impact.

Similar to the lower Feather River and lower American River, monthly mean flows at all model locations within the Trinity River under CP1 would be essentially equivalent (less than 2 percent difference) to flows under the Existing Condition and No-Action Alternative simulated for most months; however, several months within the modeling record show substantial changes (based on model simulations) to flows in tributaries (see the *Hydrology, Hydraulics, and Water Management Technical Report* for complete CalSim-II

modeling results). Based on predicted changes in flow and associated flow-habitat relationships for fish, potential flow-related impacts on species of management concern in the Trinity River would be a potentially significant impact. Mitigation for this impact is proposed in Section 11.3.4.

Impact Aqua-16 (CP1): Reduction in Ecologically Important Geomorphic Processes in the Lower Sacramento River Resulting from Reduced Frequency and Magnitude of Intermediate to High Flows Project operation could result in reduced intermediate to large flows that are necessary for channel forming and maintenance, meander migration, and the creation of seasonally inundated floodplains, all of which are processes necessary for the maintenance of important aquatic habitat functions and values for the fish and macroinvertebrate community. A reduction in these ecologically important geomorphic processes and related aquatic habitat functions and values in the lower Sacramento River and lowermost (confluence) areas of tributaries would be a potentially significant impact.

As discussed under Impact Aqua-14 (CP1), sediment transport, deposition, and scour regulate the formation of key habitat features such as point bars, gravel deposits, and SRA habitat. These processes are regulated by the magnitude, duration, and frequency of flow, with relatively large flows providing the energy required to mobilize sediment from the bed, produce meander migration, and create seasonally inundated floodplains. Project operation could result in reduced intermediate to large flows that are necessary for channel forming and maintenance, meander migration, and the creation of seasonally inundated floodplains (including floodplain bypasses) in the lower Sacramento River.

Relative to the upper Sacramento River, there is significantly less bedrock control between RBDD and Colusa. Consequently, sediment transports and meander migration processes are more pronounced in this more alluvial reach. This is supported by widespread evidence of frequent lateral migration in the upper reaches of the lower Sacramento River (between RBDD and Colusa) (e.g., Micheli et al. 2004). This implies that these reaches of the Sacramento River experience much more frequent bed and bar mobilization than the upper Sacramento River.

As discussed under Impact Aqua-14 (CP1), changes (reductions) in intermediate to large flows in the Sacramento River has the potential to affect the lower reaches (confluence areas) of tributaries by reducing the backwater effect that the mainstem river has on the lower reaches of the tributaries. Decreases in the frequency, duration, and intensity of intermediate to large flows on the Sacramento River, and associated decrease in the stage elevation of the river surface, could result in increased downcutting in the lower reaches of the tributaries. Downcutting of the lower tributaries could result in bank erosion, channel widening, and the channel becoming disconnected from its floodplain, which in turn could affect riparian recruitment and succession processes.

Reaches of the Sacramento River differ in the extent of floodplain inundation. Most of the upper Sacramento River between Keswick Dam and RBDD is also bounded by high banks and terraces, such that there is limited opportunity for floodplain inundation in this reach. Also along the upper reaches of the lower Sacramento River, between Chico Landing and Colusa, the river is bounded by levees that provide flood protection for cities and agricultural areas. However, the levees of this reach of the Sacramento River are for the most part set back from the mainstem channel such that flooding can be significant within the river corridor. In the lower Sacramento River between RBDD and Chico Landing, the mainstem channel is flanked by broad floodplains. Evidence of ongoing sediment deposition of these areas testifies to continued inundation in floodplains in this reach (Buer 1994).

An important attribute of the middle and lower reaches of the Sacramento River is the presence of floodplain bypasses (e.g., Butte Basin, Sutter Bypass, and Yolo Bypass). In winter and spring, agricultural fields and wetland habitats throughout the floodplain bypasses often flood during high flows and are used by Sacramento splittail for spawning and rearing, and by Chinook salmon and steelhead for rearing (Sommer et al. 2001, 2003). For this reason, a key restoration goal of CALFED is to improve the connectivity between rivers and floodplain habitats, including floodplain bypasses, as well as increase the amount of willow-water habitat in the Central Valley (CALFED 2001). Numerous studies have shown that willow water and dense vegetation in these areas provide highly productive rearing areas for numerous species, including Chinook salmon and splittail. Seasonally flooded habitat provides rearing habitat for Chinook salmon and spawning, rearing, and foraging habitat for splittail (Sommer et al. 1997, 2001, 2002; Baxter et al. 1996; USACE 1999). Floodplain habitat offers protection from large piscivorous fish such as striped bass. The temporary nature of the flooded habitat and the protection offered by relatively willow water and dense vegetative cover serve to exclude predatory fish. The productivity of floodplains is generally related to the frequency, timing, water depths, velocities, vegetation, water quality, and duration of inundation relative to the life history and habitat requirements of fish species. Physical conditions (e.g., type and extent of vegetation, soil conditions, and drainage patterns) may also contribute to habitat quality.

Flooded vegetation provides an abundant source of food, including detrital material, insect larvae, crustaceans, and other invertebrates. Juvenile Chinook salmon and splittail apparently forage among a variety of vegetation types, including trees, brush, and herbaceous vegetation, but their relative importance, alone or in combination, is unknown. Juvenile Chinook salmon that rear in seasonally flooded habitat have higher survival and growth rates than juveniles that remain in the main river channel to rear (USACE 1999, Sommer et al. 2001). The increased growth rate may be related to the higher water temperatures in the willow water in this habitat, and the higher associated rate of production of invertebrates, which are a substantial source of food for rearing juveniles, and of the grasses that support the invertebrates. Increases in the area

available to juveniles could also reduce competition for food and space, and could reduce the likelihood of encounters with predators (Sommer et al. 2001). In addition, juvenile Chinook salmon that grow faster are likely to migrate downstream sooner, which helps to reduce the risks of predation and competition in freshwater systems.

In summary, CP1 would lead to a further reduction in the magnitude, duration, and frequency of intermediate to large flows, relative to the Existing Condition and No-Action Alternative. Overall, the project would increase the existing, ongoing impacts on geomorphic processes resulting from operation of Shasta Dam that are necessary for channel forming and maintenance, meander migration, the creation of seasonally inundated floodplains, and the inundation of floodplain bypasses. These impacts would likely occur along the upper reaches of the lower Sacramento River. Reductions in the magnitude of high flows would likely be sufficient to reduce ecologically important processes along the upper Sacramento River and its floodplain bypasses. These impacts would be potentially significant. Mitigation for this impact is proposed in Section 11.3.4.

Impact Aqua-17 (CP1): Effects to Delta Fishery Habitat Resulting from Changes to Delta Outflow Based on the results of hydrologic modeling comparing Delta outflow under basis-of-comparison conditions, and under CP1 under the Existing Condition and No-Action Alternative, CP1 would have a less than significant impact on Delta fisheries and hydrologic transport processed within the Bay-Delta.

Results of the comparison of Delta outflows are summarized by month and water-year type in Table 11-16. The comparison includes the estimated average monthly outflow under the basis-of-comparison conditions (Existing Condition and No-Action Alternative), the average monthly flow under CP1, and the percentage change between base flows and CP1 operations. Results of the analysis (Table 11-16) showed that Delta outflows were observed to be slightly lower under many of the CP1 operations, and slightly higher than basis-of-comparison conditions depending on month and water-year type. However, none of the changes were greater than 5 percent. Based on the results of this comparison of CP1, it was concluded that CP1 would have a less than significant impact on Delta fisheries and hydrologic transport processed within the Bay-Delta under Existing Condition and No-Action Alternative. Based on results of this analysis, it was concluded that CP1 would result in a less than significant impact on Delta fisheries as a consequence of changes in Delta outflow. Mitigation for this impact is not needed, and thus not proposed.

Table 11-16. Delta Outflow Under Existing Conditions, No-Action Alternative, and CP1

		Existing Condition	CP1 (Existing Condition)		No-Action Alternative	CP1 (Future Condition)	
Month	**Water Year**	**Base Flow (cfs)**	**Flow (cfs)**	**Percent Change**	**Base Flow (cfs)**	**Flow (cfs)**	**Percent Change**
January	Average	40,954	40,655	-0.7	40,167	39,963	-0.5
	W	84,978	84,638	-0.4	83,595	83,228	-0.4
	AN	47,101	46,375	-1.5	46,322	45,812	-1.1
	BN	19,833	19,847	0.1	19,369	19,420	0.3
	D	11,374	11,059	-2.8	10,881	10,717	-1.5
	C	8,434	8,310	-1.5	8,111	8,208	1.2
February	Average	52,699	52,168	-1.0	52,341	52,230	-0.2
	W	98,900	98,341	-0.6	98,330	98,012	-0.3
	AN	61,653	60,825	-1.3	60,800	60,420	-0.6
	BN	35,173	35,031	-0.4	35,441	35,289	-0.4
	D	20,356	19,574	-3.8	19,894	20,197	1.5
	C	12,605	12,351	-2.0	12,628	12,663	0.3
March	Average	42,610	42,461	-0.3	42,117	41,986	-0.3
	W	79,254	79,231	0.0	78,370	78,447	0.1
	AN	53,361	52,998	-0.7	52,361	51,980	-0.7
	BN	23,126	22,882	-1.1	23,136	23,060	-0.3
	D	18,943	18,735	-1.1	18,596	18,223	-2.0
	C	10,697	10,691	-0.1	10,749	10,719	-0.3
April	Average	27,104	27,061	-0.2	27,096	27,033	-0.2
	W	49,818	49,777	-0.1	49,806	49,753	-0.1
	AN	27,420	27,353	-0.2	27,778	27,474	-1.1
	BN	19,001	18,987	-0.1	18,938	18,925	-0.1
	D	12,735	12,659	-0.6	12,516	12,514	0.0
	C	8,586	8,575	-0.1	8,600	8,600	0.0
May	Average	20,470	20,430	-0.2	20,288	20,213	-0.4
	W	37,736	37,691	-0.1	37,173	37,146	-0.1
	AN	22,276	22,010	-1.2	22,205	21,893	-1.4
	BN	14,200	14,211	0.1	14,080	13,948	-0.9
	D	9,422	9,471	0.5	9,436	9,446	0.1
	C	5,141	5,146	0.1	5,306	5,303	0.0

Table 11-16. Delta Outflow Under Existing Conditions, No-Action Alternative, and CP1 (contd.)

		Existing Condition	CP1 (Existing Condition)		No-Action Alternative	CP1 (Future Condition)	
Month	**Water Year**	**Base Flow (cfs)**	**Flow (cfs)**	**Percent Change**	**Base Flow (cfs)**	**Flow (cfs)**	**Percent Change**
June	Average	13,104	13,096	-0.1	13,055	13,058	0.0
	W	23,675	23,685	0.0	23,303	23,343	0.2
	AN	12,563	12,594	0.2	12,587	12,580	-0.1
	BN	8,735	8,590	-1.7	9,027	8,775	-2.8
	D	6,611	6,686	1.1	6,656	6,787	2.0
	C	5,580	5,527	-1.0	5,615	5,656	0.7
July	Average	7,927	7,970	0.5	8,291	8,295	0.0
	W	11,228	11,240	0.1	11,501	11,493	-0.1
	AN	9,085	9,183	1.1	10,040	10,033	-0.1
	BN	7,314	7,390	1.0	7,897	7,962	0.8
	D	5,330	5,398	1.3	5,477	5,505	0.5
	C	4,229	4,205	-0.5	4,271	4,206	-1.5
August	Average	4,501	4,538	0.8	4,458	4,466	0.2
	W	5,233	5,228	-0.1	4,961	4,957	-0.1
	AN	4,000	4,000	0.0	4,039	4,039	0.0
	BN	4,000	4,000	0.0	4,144	4,166	0.5
	D	4,491	4,640	3.3	4,547	4,557	0.2
	C	4,017	4,059	1.0	4,017	4,043	0.7
September	Average	5,595	5,576	-0.3	5,262	5,277	0.3
	W	10,498	10,480	-0.2	9,510	9,497	-0.1
	AN	3,781	3,776	-0.1	3,464	3,507	1.2
	BN	3,516	3,445	-2.0	3,405	3,426	0.6
	D	3,050	3,051	0.0	3,277	3,308	1.0
	C	3,025	3,024	0.0	3,000	3,020	0.7
October	Average	5,313	5,288	-0.5	5,023	5,000	-0.5
	W	7,040	6,975	-0.9	6,464	6,384	-1.2
	AN	4,540	4,508	-0.7	4,335	4,298	-0.9
	BN	4,624	4,607	-0.4	4,427	4,456	0.7
	D	4,388	4,399	0.2	4,257	4,274	0.4
	C	4,534	4,538	0.1	4,434	4,424	-0.2
November	Average	9,688	9,538	-1.5	9,238	9,176	-0.7
	W	15,113	15,055	-0.4	14,412	14,349	-0.4
	AN	11,060	10,498	-5.1	10,265	9,969	-2.9
	BN	6,529	6,237	-4.5	6,248	6,158	-1.4
	D	6,755	6,742	-0.2	6,474	6,552	1.2
	C	4,648	4,671	0.5	4,631	4,631	0.0

Table 11-16. Delta Outflow Under Existing Conditions, No-Action Alternative, and CP1 (contd.)

		Existing Condition	CP1 (Existing Condition)		No-Action Alternative	CP1 (Future Condition)	
Month	Water Year	Base Flow (cfs)	Flow (cfs)	Percent Change	Base Flow (cfs)	Flow (cfs)	Percent Change
December	Average	22,933	22,736	-0.9	22,289	22,182	-0.5
	W	47,953	47,299	-1.4	46,800	46,448	-0.8
	AN	18,119	18,219	0.5	17,859	17,845	-0.1
	BN	13,712	13,674	-0.3	12,890	12,719	-1.3
	D	8,645	8,578	-0.8	8,366	8,467	1.2
	C	5,728	5,845	2.0	5,460	5,553	1.7

Key:
AN = above-normal
BN = below-normal
C = critical
cfs = cubic feet per second
CP = Comprehensive Plan
D = dry
W = wet

Impact Aqua-18 (CP1): Effects to Delta Fishery Habitat Resulting from Changes to Delta Inflow Changes in upstream reservoir storage have the potential to affect Delta inflow. Delta inflow may affect hydrologic conditions within Delta channels, hydraulic residence times, salinity gradients, and the transport and movement of various life stages of fish, invertebrates, phytoplankton, and nutrients into and through the Delta. Delta inflow serves as a surrogate metric for a variety of habitat conditions within the Delta that directly, or indirectly, affects fish and other aquatic resources. Based on the results of hydrologic modeling comparing Delta inflow under Existing Condition, No-Action Alternative, and CP1, CP1 would have a less than significant effect on Delta fisheries and hydrologic transport processed within the Bay-Delta.

Results of the comparison of Delta inflows under the Existing Condition and No-Action Alternative with CP1 are summarized by month and water-year type in Table 11-17. The comparison includes the estimated average monthly inflow under the basis-of-comparison conditions, the average monthly flow under CP1, and the percentage change between base flows and CP1 operations. Delta inflows were observed to be slightly lower under many of the CP1 operations and slightly higher than basis-of-comparison conditions, depending on month and water-year type. None of the Existing Condition or No-Action Alternative comparisons with CP1 exceeded 5 percent. Based on the results of this comparison of CP1, it was concluded that CP1 would have a less than significant effect on Delta fisheries and hydrologic transport processed within the Bay-Delta as a consequence of changes in Delta inflow relative to the Existing Condition and No-Action Alternative. Mitigation for this impact is not needed, and thus not proposed.

Table 11-17. Delta Inflow Under Existing Conditions, No-Action Alternative, and CP1

		Existing Condition	CP1 (Existing Condition)		No-Action Alternative	CP1 (Future Condition)	
Month	**Water Year**	**Base Flow (cfs)**	**Flow (cfs)**	**Percent Change**	**Base Flow (cfs)**	**Flow (cfs)**	**Percent Change**
January	Average	50,193	49,947	-0.5	49,674	49,453	-0.4
	W	93,590	93,289	-0.3	92,710	92,362	-0.4
	AN	56,641	55,937	-1.2	55,935	55,434	-0.9
	BN	30,176	30,197	0.1	29,939	29,942	0.0
	D	21,201	20,978	-1.1	20,927	20,768	-0.8
	C	16,560	16,544	-0.1	16,312	16,296	-0.1
February	Average	61,147	60,787	-0.6	60,691	60,684	0.0
	W	108,058	107,635	-0.4	107,699	107,477	-0.2
	AN	70,137	69,461	-1.0	69,901	69,434	-0.7
	BN	44,310	44,261	-0.1	43,831	43,751	-0.2
	D	28,791	28,136	-2.3	28,157	28,183	0.1
	C	18,694	18,866	0.9	18,099	19,052	5.3
March	Average	50,938	50,912	0.1	50,576	50,442	-0.3
	W	88,045	88,083	0.0	87,612	87,639	0.0
	AN	63,252	62,915	0.5	62,667	62,323	-0.5
	BN	32,287	32,250	0.1	31,760	31,781	0.1
	D	26,931	27,009	-0.3	26,504	26,109	-1.5
	C	15,999	15,998	0.0	16,299	16,242	-0.3
April	Average	33,715	33,658	-0.2	33,832	33,785	-0.1
	W	57,897	57,861	-0.1	58,185	58,150	-0.1
	AN	35,063	34,909	-0.4	35,403	35,145	-0.7
	BN	26,022	26,004	-0.1	25,955	25,938	-0.1
	D	17,991	17,905	-0.5	17,853	17,879	0.1
	C	12,534	12,528	0.0	12,653	12,646	-0.1
May	Average	27,783	27,742	-0.1	27,762	27,703	-0.2
	W	47,155	47,107	-0.1	46,817	46,795	0.0
	AN	30,016	29,706	-1.0	30,446	30,066	-1.2
	BN	21,135	21,161	0.1	21,177	21,092	-0.4
	D	15,555	15,618	0.4	15,529	15,629	0.6
	C	9,671	9,682	0.1	9,827	9,797	-0.3
June	Average	23,254	23,304	0.2	23,559	23,576	0.1
	W	35,726	35,778	0.1	35,503	35,571	0.2
	AN	23,868	23,981	0.5	24,400	24,347	-0.2
	BN	18,814	18,585	-1.2	20,111	19,837	-1.4
	D	15,726	15,915	1.2	15,789	16,120	2.1
	C	12,089	12,187	0.8	12,516	12,365	-1.2
July	Average	18,889	19,216	1.7	20,470	20,603	0.6
	W	23,568	23,697	0.5	24,661	24,754	0.4
	AN	19,796	20,029	1.2	22,429	22,513	0.4
	BN	18,549	19,026	2.6	21,709	21,710	0.0
	D	16,344	16,960	3.8	17,176	17,597	2.5
	C	12,058	12,303	2.0	12,928	12,918	-0.1

Table 11-17. Delta Inflow Under Existing Conditions, No-Action Alternative, and CP1 (contd.)

		Existing Condition	CP1 (Existing Condition)		No-Action Alternative	CP1 (Future Condition)	
Month	**Water Year**	**Base Flow (cfs)**	**Flow (cfs)**	**Percent Change**	**Base Flow (cfs)**	**Flow (cfs)**	**Percent Change**
August	Average	18,889	19,216	1.7	16,281	16,353	0.4
	W	23,568	23,697	0.5	17,995	18,050	0.3
	AN	19,796	20,029	1.2	17,543	17,576	0.2
	BN	18,549	19,026	2.6	17,273	17,315	0.2
	D	16,344	16,960	3.8	15,167	15,304	0.9
	C	12,058	12,303	2.0	11,816	11,905	0.8
September	Average	16,480	15,522	-5.8	16,625	16,703	0.5
	W	23,176	18,137	-21.7	22,459	22,448	0.0
	AN	15,742	14,259	-9.4	15,814	15,890	0.5
	BN	14,961	15,030	0.5	15,198	15,247	0.3
	D	12,749	14,061	10.3	14,118	14,329	1.5
	C	10,076	13,887	37.8	10,220	10,329	1.1
October	Average	15,542	15,522	-0.1	14,833	14,816	-0.1
	W	18,176	18,137	-0.2	17,270	17,276	0.0
	AN	14,399	14,259	-1.0	13,708	13,534	-1.3
	BN	15,010	15,030	0.1	14,436	14,365	-0.5
	D	13,980	14,061	0.6	13,490	13,531	0.3
	C	13,942	13,887	-0.4	13,153	13,225	0.5
November	Average	19,409	19,356	-0.3	19,043	19,024	-0.1
	W	26,007	25,963	-0.2	25,720	25,589	-0.5
	AN	20,432	19,994	-2.1	19,604	19,502	-0.5
	BN	16,833	16,608	-1.3	16,510	16,485	-0.1
	D	15,836	15,990	1.0	15,453	15,664	1.4
	C	12,458	12,659	1.6	12,354	12,322	-0.3
December	Average	33,195	33,020	-0.5	32,657	32,578	-0.2
	W	58,863	58,219	-1.1	58,092	57,725	-0.6
	AN	28,400	28,684	1.0	28,098	28,147	0.2
	BN	23,545	23,608	0.3	22,831	22,643	-0.8
	D	19,116	18,932	-1.0	19,010	19,060	0.3
	C	14,756	14,875	0.8	14,041	14,391	2.5

Key:
AN = above-normal
BN = below-normal
C = critical
cfs = cubic feet per second
CP = Comprehensive Plan
D = dry
W = wet

Impact Aqua-19 (CP1): Effects to Delta Fisheries Resulting from Changes in Sacramento River Inflow Project operation would result in a variable response in Sacramento River flow, resulting in both increases and decreases in river flow above basis-of-comparison conditions depending on month and water year. This impact would be less than significant.

Flow within the Sacramento River has been identified as an important factor affecting the survival of emigrating juvenile Chinook salmon; important to the downstream transport of planktonic fish eggs and larvae such as delta and longfin smelt, striped bass and shad; and important for seasonal floodplain inundation that has been identified as important habitat for successful spawning and larval rearing by species such as Sacramento splittail and as seasonal foraging habitat for juvenile Chinook salmon and steelhead. Sacramento River flows are also important in the transport of organic material and nutrients from the upper regions of the watershed downstream into the Delta. A reduction in Sacramento River flow as a result of CP1, depending on the season and magnitude of change, could adversely affect habitat conditions for both resident and migratory fish species. An increase in river flow is generally considered to be beneficial for aquatic resources within the normal range of typical project operations and flood control. Very large changes in river flow could also affect sediment erosion, scour, deposition, suspended and bedload transport, and other geomorphic processes within the river and watershed.

Results of hydrologic modeling, by month and year type, for Sacramento River flow are presented in Table 11-18. Results of these analyses show a variable response in Sacramento River flow with CP1 operations resulting in both increases and decreases in river flow above basis-of-comparison conditions depending on month and water-year type. One comparison showed a change greater than 5 percent between the basis-of-comparison and an alternative. The model river flow under the future condition for CP1 in a critical year in February was greater than 5 percent from the basis-of-comparison; however, in this case, the river flow under CP1 was higher than the basis-of-comparison and would not be expected to result in an adverse fishery impact, but rather would be expected to contribute to improved habitat conditions under this low-flow condition. All other comparisons between the basis-of-comparison and CP1 operations were less than 5 percent. Based on these results it was concluded that the impact of CP1 on fish habitat and transport mechanisms within the lower Sacramento River and Delta would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Table 11-18. Sacramento River Inflow Under Existing Conditions, No-Action Alternative, and CP1

		Existing Condition	CP1 (Existing Condition)		No-Action Alternative	CP1 (Future Condition)	
Month	**Water Year**	**Base Flow (cfs)**	**Flow (cfs)**	**Percent Change**	**Base Flow (cfs)**	**Flow (cfs)**	**Percent Change**
January	Average	34,680	34,529	-0.4	34,363	34,270	-0.3
	W	56,231	56,064	-0.3	55,714	55,693	0.0
	AN	44,117	43,775	-0.8	44,049	43,706	-0.8
	BN	25,272	25,291	0.1	25,024	25,027	0.0
	D	18,166	17,941	-1.2	17,888	17,728	-0.9
	C	14,298	14,283	-0.1	14,028	14,012	-0.1
February	Average	40,650	40,378	-0.7	40,345	40,429	0.2
	W	61,746	61,643	-0.2	61,676	61,759	0.1
	AN	51,527	50,846	-1.3	51,346	50,878	-0.9
	BN	34,676	34,629	-0.1	34,309	34,230	-0.2
	D	24,116	23,401	-3.0	23,562	23,589	0.1
	C	15,834	16,007	1.1	15,345	16,255	5.9
March	Average	35,093	35,098	0.0	35,018	34,935	-0.2
	W	52,808	52,875	-0.1	52,720	52,745	0.0
	AN	47,679	47,394	0.6	47,821	47,721	-0.2
	BN	25,629	25,592	0.1	25,210	25,231	0.1
	D	22,908	23,054	-0.6	22,615	22,290	-1.4
	C	13,443	13,441	0.0	13,907	13,850	-0.4
April	Average	24,190	24,141	-0.2	24,317	24,276	-0.2
	W	39,645	39,633	0.0	39,901	39,887	0.0
	AN	26,322	26,169	-0.6	26,721	26,462	-1.0
	BN	18,746	18,728	-0.1	18,673	18,655	-0.1
	D	13,900	13,814	-0.6	13,782	13,807	0.2
	C	10,362	10,356	-0.1	10,534	10,525	-0.1
May	Average	20,098	20,057	-0.2	20,119	20,060	-0.3
	W	32,904	32,856	-0.1	32,639	32,617	-0.1
	AN	22,928	22,618	-1.4	23,355	22,975	-1.6
	BN	14,923	14,949	0.2	14,997	14,912	-0.6
	D	12,055	12,118	0.5	12,060	12,160	0.8
	C	7,622	7,634	0.2	7,821	7,791	-0.4
June	Average	17,718	17,768	0.3	18,092	18,109	0.1
	W	24,331	24,384	0.2	24,141	24,210	0.3
	AN	17,986	18,099	0.6	18,678	18,624	-0.3
	BN	15,806	15,577	-1.5	17,160	16,886	-1.6
	D	14,015	14,202	1.3	14,146	14,476	2.3
	C	10,907	11,005	0.9	11,406	11,254	-1.3

Table 11-18. Sacramento River Inflow Under Existing Conditions, No-Action Alternative, and CP1 (contd.)

		Existing Condition	CP1 (Existing Condition)		No-Action Alternative	CP1 (Future Condition)	
Month	**Water Year**	**Base Flow (cfs)**	**Flow (cfs)**	**Percent Change**	**Base Flow (cfs)**	**Flow (cfs)**	**Percent Change**
July	Average	15,270	15,597	2.1	16,870	17,002	0.8
	W	16,088	16,216	0.8	17,160	17,252	0.5
	AN	16,682	16,915	1.4	19,335	19,419	0.4
	BN	16,500	16,976	2.9	19,698	19,699	0.0
	D	14,988	15,602	4.1	15,871	16,291	2.6
	C	11,077	11,322	2.2	11,974	11,964	-0.1
August	Average	12,649	12,881	1.8	13,790	13,862	0.5
	W	13,724	13,719	0.0	13,840	13,895	0.4
	AN	12,721	12,938	1.7	15,183	15,216	0.2
	BN	12,319	12,543	1.8	15,145	15,187	0.3
	D	13,162	13,780	4.7	13,769	13,904	1.0
	C	9,865	10,055	1.9	10,738	10,826	0.8
September	Average	13,697	13,703	0.0	13,863	13,942	0.6
	W	18,936	18,938	0.0	18,242	18,232	-0.1
	AN	13,088	13,102	0.1	13,160	13,236	0.6
	BN	12,543	12,408	-1.1	12,817	12,866	0.4
	D	10,847	10,939	0.8	12,238	12,448	1.7
	C	8,577	8,619	0.5	8,737	8,846	1.2
October	Average	12,719	12,750	0.2	12,068	12,052	-0.1
	W	14,766	14,891	0.8	14,040	14,050	0.1
	AN	12,049	11,905	-1.2	11,379	11,206	-1.5
	BN	12,322	12,342	0.2	11,758	11,687	-0.6
	D	11,249	11,330	0.7	10,747	10,788	0.4
	C	11,619	11,563	-0.5	10,823	10,895	0.7
November	Average	15,858	15,805	-0.3	15,501	15,486	-0.1
	W	21,159	21,118	-0.2	20,878	20,745	-0.6
	AN	17,210	16,774	-2.5	16,355	16,284	-0.4
	BN	13,687	13,459	-1.7	13,377	13,356	-0.2
	D	12,805	12,959	1.2	12,475	12,686	1.7
	C	10,129	10,328	2.0	10,012	9,979	-0.3
December	Average	26,148	26,050	-0.4	25,710	25,697	-0.1
	W	44,908	44,551	-0.8	44,459	44,263	-0.4
	AN	22,225	22,410	0.8	21,941	22,051	0.5
	BN	19,129	19,191	0.3	18,434	18,246	-1.0
	D	16,164	15,983	-1.1	16,042	16,102	0.4
	C	12,587	12,705	0.9	11,848	12,199	3.0

Key:
AN = above-normal
BN = below-normal
C = critical
cfs = cubic feet per second
CP = Comprehensive Plan
D = dry
W = wet

Impact Aqua-20 (CP1): Effects to Delta Fisheries Resulting from Changes in San Joaquin River Flow at Vernalis Project operation would result in no discernable change in San Joaquin River flows at Vernalis, and, therefore, no effect on Delta fisheries or transport mechanisms within the lower San Joaquin River and Delta from CP1 relative to No-Action Alternative and the Existing Condition.

Flow within the San Joaquin River has been identified as an important factor affecting the survival of juvenile Chinook salmon migrating downstream from the tributaries through the mainstem San Joaquin River and Delta; important to the downstream transport of planktonic fish eggs and larvae such as striped bass; and important for seasonal floodplain inundation that is considered to be important habitat for successful spawning and larval rearing by species such as Sacramento splittail and as seasonal foraging habitat for juvenile Chinook salmon. San Joaquin River flows are also important in the transport of organic material and nutrients from the upper regions of the watershed downstream into the Delta. A reduction in San Joaquin River flow as a result of CP1 operations, depending on the season and magnitude of change, could adversely affect habitat conditions for both resident and migratory fish species. An increase in river flow is generally considered to be beneficial for aquatic resources within the normal range of typical project operations and flood control. Very large changes in river flow could also affect sediment erosion, scour, deposition, suspended and bedload transport, and other geomorphic processes within the river and watershed.

Results of the comparative analysis of CalSim-II, by month and year-type, for the Existing Condition and CP1 for San Joaquin River flow are summarized in Table 11-19. Results of these analyses show that CP1 would have no effect on seasonal flows under existing conditions within the San Joaquin River. Similarly, modeling results showed that CP1 would have no effect on flows or fish habitat under Future Conditions. Therefore, CP1 would have no effect on Delta fisheries or transport mechanisms within the lower San Joaquin River and Delta under CP1 relative to the Existing Condition and No-Action Alternative. Mitigation for this impact is not needed, and thus not proposed.

Table 11-19. San Joaquin River Flow at Vernalis Under Existing Conditions, and CP1

		Existing Condition	CP1 (Existing Condition)	
Month	**Water Year**	**Base Flow (cfs)**	**Flow (cfs)**	**Percent Change**
January	Average	4,772	4,772	0.00
	W	9,255	9,254	0.00
	AN	4,339	4,339	0.00
	BN	2,971	2,971	0.00
	D	2,084	2,084	0.00
	C	1,624	1,624	0.00
February	Average	6,434	6,433	0.00
	W	11,637	11,637	0.00
	AN	6,271	6,271	0.00
	BN	5,742	5,740	0.00
	D	2,506	2,506	0.00
	C	2,020	2,021	0.00
March	Average	6,339	6,338	0.00
	W	12,420	12,419	0.00
	AN	5,792	5,791	0.00
	BN	4,539	4,538	0.00
	D	2,372	2,372	0.00
	C	1,760	1,760	0.00
April	Average	6,006	6,006	0.00
	W	10,455	10,455	0.00
	AN	5,976	5,976	0.00
	BN	5,241	5,241	0.00
	D	3,050	3,050	0.00
	C	1,722	1,722	0.00
May	Average	6,022	6,022	0.00
	W	10,991	10,991	0.00
	AN	5,420	5,420	0.00
	BN	4,987	4,987	0.00
	D	2,895	2,896	0.00
	C	1,752	1,752	0.00
June	Average	4,631	4,631	0.00
	W	9,577	9,576	0.00
	AN	4,946	4,946	0.00
	BN	2,320	2,321	0.00
	D	1,478	1,480	0.10
	C	1,022	1,022	0.00
July	Average	3,221	3,222	0.00
	W	6,646	6,646	0.00
	AN	2,779	2,779	0.00
	BN	1,755	1,755	0.00
	D	1,260	1,261	0.00
	C	895	895	0.00

Table 11-19. San Joaquin River Flow at Vernalis Under Existing Conditions, and CP1 (contd.)

		Existing Condition	CP1 (Existing Condition)	
Month	**Water Year**	**Base Flow (cfs)**	**Flow (cfs)**	**Percent Change**
August	Average	2,113	2,114	0.00
	W	3,350	3,350	0.00
	AN	2,010	2,010	0.00
	BN	1,827	1,828	0.00
	D	1,347	1,348	0.10
	C	1,021	1,022	0.00
September	Average	2,366	2,366	0.00
	W	3,433	3,434	0.00
	AN	2,293	2,293	0.00
	BN	2,077	2,077	0.00
	D	1,764	1,764	0.00
	C	1,368	1,368	0.00
October	Average	2,486	2,486	0.00
	W	2,915	2,915	0.00
	AN	2,099	2,099	0.00
	BN	2,428	2,428	0.00
	D	2,417	2,417	0.00
	C	2,113	2,113	0.00
November	Average	2,561	2,561	0.00
	W	3,311	3,311	0.00
	AN	2,104	2,104	0.00
	BN	2,334	2,334	0.00
	D	2,315	2,315	0.00
	C	2,026	2,026	0.00
December	Average	2,561	2,561	0.00
	W	3,311	3,311	0.00
	AN	2,104	2,104	0.00
	BN	2,334	2,334	0.00
	D	2,315	2,315	0.00
	C	2,026	2,026	0.00

Key:
AN = above-normal
BN = below-normal
C = critical
cfs = cubic feet per second
CP = Comprehensive Plan
D = dry
W = wet

Impact Aqua-21 (CP1): Reduction in Low Salinity Habitat Conditions Resulting from an Upstream Shift in X2 *Location* Project operation would result in a less than 0.5 km movement upstream or downstream from the X2 location. This impact would be less than significant.

Operations of upstream storage reservoirs have the potential to affect the location of X2 as a result of changes in freshwater flows from the upstream tributaries through the Delta. For purposes of evaluating changes in habitat quantity and quality for estuarine species, a significance criterion of an upstream change in X2 location within 1 km of the basis-of-comparison condition was considered to be less than significant. The criterion was applied to a comparison of hydrologic model results for basis-of-comparison conditions and CP1, by month and water year, for February through May. Results of the comparison for the Existing Condition versus CP1 are summarized in Table 11-20. These results showed that changes in X2 location under CP1 were less than 1 km (all were less than 0.5 km) with both variable upstream and downstream movement of the X2 location, depending on month and water year. These results are consistent with model results for Delta outflow that showed a less than significant change in flows under CP1.

Results of a comparative analysis of changes in X2 location between the No-Action Alternative and CP1 assuming future operating conditions are also summarized in Table 11-20. Results of these comparisons showed very little difference (less than 0.2 km) in the X2 location between the No-Action Alternative and CP1. Based on these results, it was concluded that CP1 would have a less than significant impact on low salinity habitat conditions within the Bay-Delta. Mitigation for this impact is not needed, and thus not proposed.

Table 11-20. X2 Under Existing Conditions, No-Action Alternative, and CP1

		Existing Condition	CP1 (Existing Condition)		No-Action Alternative	CP1 (Future Conditions)	
Month	**Water Year**	**Base Flow (cfs)**	**Flow (cfs)**	**Percent Change**	**Base Flow (cfs)**	**Flow (cfs)**	**Percent Change**
February	Average	65	66	20.00	66	65	0.00
	W	55	55	10.00	55	55	0.00
	AN	61	61	10.00	61	61	10.00
	BN	68	68	0.00	68	68	0.00
	D	73	74	50.00	73	73	0.00
	C	77	77	20.00	77	77	-20.00
March	Average	65	65	10.00	65	65	0.00
	W	56	56	0.00	56	56	0.00
	AN	60	60	10.00	60	60	10.00
	BN	68	68	10.00	68	68	0.00
	D	72	72	30.00	72	72	10.00
	C	77	77	10.00	77	77	0.00
April	Average	68	68	0.00	68	68	0.00
	W	59	59	0.00	59	59	0.00
	AN	64	64	10.00	64	64	10.00
	BN	70	70	0.00	70	70	0.00
	D	74	74	10.00	74	74	0.00
	C	78	78	0.00	78	78	0.00
May	Average	71	71	0.00	71	71	0.00
	W	62	62	0.00	62	62	0.00
	AN	67	67	10.00	67	67	10.00
	BN	72	72	0.00	72	72	10.00
	D	76	76	0.00	76	76	0.00
	C	83	83	0.00	82	82	0.00

Key:
AN = above-normal
BN = below-normal
C = critical
cfs = cubic feet per second
CP = Comprehensive Plan
D = dry
W = wet

Impact Aqua-22 (CP1): Increase in Mortality of Species of Primary Management Concern as a Result of Increased Reverse Flows in Old and Middle Rivers Project operation would result in an increase of reverse flows in Old and Middle rivers. The increase in reverse flows would be expected to contribute to a small increase in the vulnerability of juvenile striped bass, threadfin shad, and other resident warm-water fish to increased salvage and potential losses. This impact would be potentially significant.

Results of the analysis showed several occurrences when reverse flows within Old and Middle rivers were greater under CP1 than basis-of-comparison

conditions by more than 5 percent. These events occurred typically in dry and critical water years, which would be expected as a result of greater export operations under CP1. During February, operations under CP1 resulted in an increase in reverse flow greater than 5 percent during critical years (Table 11-21). Based on results of the delta smelt analysis of the relationship between reverse flows and delta smelt salvage, the increase from approximately 4,300 cfs under the basis-of-comparison in a critical water year to approximately 4,700 cfs would not be expected to result in a significant increase in adverse impacts to delta smelt. Juvenile Chinook salmon and steelhead are migrating through the Delta during February, and an increase in average monthly reverse flows of 300 to 400 cfs would be expected to increase the potential risk of increased mortality. However, given the tidal volumes and hydrodynamics of the Old and Middle river region, it is not expected that the change in reverse flows in February in a critical year would result in a detectable change in fish survival. The majority of juvenile Chinook salmon emigrating from the San Joaquin River typically migrate downstream later in dry years and would not be expected to occur in high numbers within Old and Middle rivers in February.

The increase in reverse flows estimated to occur under CP1 in critical years in June, and under critical, dry, and below-normal years in July, exceeded 5 percent. The increased reverse flows in June of critical years occurred at a time of the year when water temperatures in the Delta were elevated and juvenile Chinook salmon or steelhead would not be expected to occur in the area. Juvenile delta smelt may occur in the area in June; however, a change in Old and Middle river flows of approximately 100 to 200 cfs may result in a small increase in their vulnerability to CVP and SWP salvage, but this increase is expected to be less than significant. As water temperatures increase in the Delta during June and July, the majority of delta smelt are located farther downstream in Suisun Bay where water temperatures are more suitable. The increase in reverse flows estimated from modeling in June of a critical year and in July of below-normal, dry, and critical years would be expected to contribute to a small increase in the vulnerability of juvenile striped bass, threadfin shad, and other resident warm-water fish to increased salvage and potential losses as a result of increased reverse flows. The increased reverse flows in low-flow years would be expected to result in a low, but potentially significant, increase in mortality for resident warm-water fish inhabiting the south Delta under CP1 relative to the Existing Condition.

Table 11-21. Old and Middle River Reverse Flows for Existing Conditions, No-Action Alternative, and CP1

		Existing Condition	CP1 (Existing Condition)		No-Action Alternative	CP1 (Future Condition)	
Month	**Water Year**	**Base Flow (cfs)**	**Flow (cfs)**	**Percent Change**	**Base Flow (cfs)**	**Flow (cfs)**	**Percent Change**
January	Average	-6,592	-6,629	-0.6	-6,968	-6,955	0.2
	W	-5,026	-5,053	-0.5	-5,624	-5,638	-0.3
	AN	-7,598	-7,612	-0.2	-7,828	-7,831	0.0
	BN	-7,717	-7,717	0.0	-8,042	-8,004	0.5
	D	-7,540	-7,604	-0.8	-7,880	-7,883	0.0
	C	-6,243	-6,330	-1.4	-6,402	-6,316	1.3
February	Average	-4,930	-5,059	-2.6	-4,996	-5,076	-1.6
	W	-3,582	-3,683	-2.8	-3,857	-3,931	-1.9
	AN	-5,663	-5,777	-2.0	-6,276	-6,210	1.1
	BN	-5,723	-5,791	-1.2	-5,301	-5,357	-1.1
	D	-6,175	-6,265	-1.5	-6,211	-5,998	3.4
	C	-4,326	-4,658	-7.7	-4,004	-4,714	-17.7
March	Average	-3,975	-4,067	-2.3	-4,148	-4,145	0.1
	W	-2,052	-2,095	-2.1	-2,394	-2,355	1.6
	AN	-5,528	-5,548	-0.4	-5,933	-5,960	-0.5
	BN	-5,264	-5,421	-3.0	-4,948	-5,021	-1.5
	D	-5,245	-5,460	-4.1	-5,313	-5,295	0.3
	C	-3,181	-3,187	-0.2	-3,479	-3,458	0.6
April	Average	-1,984	-1,974	0.5	-2,049	-2,059	-0.5
	W	-1,525	-1,528	-0.2	-1,709	-1,722	-0.7
	AN	-2,825	-2,758	2.4	-2,791	-2,826	-1.3
	BN	-2,488	-2,485	0.1	-2,460	-2,455	0.2
	D	-2,098	-2,089	0.4	-2,128	-2,142	-0.7
	C	-1,382	-1,386	-0.3	-1,447	-1,438	0.7
May	Average	-1,649	-1,648	0.1	-1,729	-1,740	-0.6
	W	-1,147	-1,144	0.2	-1,265	-1,269	-0.3
	AN	-2,312	-2,278	1.5	-2,627	-2,575	2.0
	BN	-1,693	-1,704	-0.7	-1,755	-1,790	-2.0
	D	-2,088	-2,098	-0.5	-2,026	-2,091	-3.2
	C	-1,364	-1,369	-0.4	-1,361	-1,338	1.7
June	Average	-2,858	-2,902	-1.5	-3,210	-3,220	-0.3
	W	-2,219	-2,251	-1.4	-2,387	-2,409	-0.9
	AN	-3,532	-3,594	-1.8	-4,011	-3,975	0.9
	BN	-3,752	-3,686	1.8	-4,578	-4,561	0.4
	D	-3,341	-3,428	-2.6	-3,476	-3,629	-4.4
	C	-1,801	-1,915	-6.3	-2,194	-2,045	6.8

Table 11-21. Old and Middle River Reverse Flows for Existing Conditions, No-Action Alternative, and CP1 (contd.)

		Existing Condition	CP1 (Existing Condition)		No-Action Alternative	CP1 (Future Condition)	
Month	**Water Year**	**Base Flow (cfs)**	**Flow (cfs)**	**Percent Change**	**Base Flow (cfs)**	**Flow (cfs)**	**Percent Change**
July	Average	-3,942	-4,160	-5.5	-4,813	-4,912	-2.1
	W	-3,493	-3,583	-2.6	-4,027	-4,104	-1.9
	AN	-3,967	-4,070	-2.6	-5,167	-5,237	-1.4
	BN	-4,733	-5,040	-6.5	-6,665	-6,616	0.7
	D	-4,859	-5,279	-8.7	-5,378	-5,680	-5.6
	C	-2,592	-2,795	-7.8	-3,154	-3,197	-1.4

Key:
AN = above-normal
BN = below-normal
C = critical
cfs = cubic feet per second
CP = Comprehensive Plan
D = dry
W = wet

Results of the comparison of Old and Middle river reverse flows are summarized in Table 11-21. Results of the analysis show that in the majority of years and months, reverse flows under CP1 do not exceed basis-of-comparison conditions by more than 5 percent. CP1 exceeded basis-of-comparison conditions during February of a critical year by approximately 700 cfs. The increase in reverse flows would be expected, particularly in a critical year, to contribute to an increase in the potential for losses of adult delta smelt and other species, which is considered to be potentially significant. During June in a critical water year, under CP1, the magnitude of reverse flows was reduced more than 5 percent but would be expected to contribute to a less than significant biological benefit based on both the low reverse flow under the basis-of-comparison and under CP1. An increase in reverse flow above the basis-of-comparison of approximately 300 to 600 cfs during dry years in July would be expected to contribute to an increase in the risk of losses to resident warm-water fish species. Increased reverse flows in July would not be expected to adversely affect delta or longfin smelt, juvenile Chinook salmon, or steelhead based on their seasonal migration patterns and geographic distribution. The potential increase in losses during February and July under future operating conditions is considered to be potentially significant. Mitigation for this impact is not proposed because operations will be guided by RPAs established by NMFS and USFWS BOs.

Impact Aqua-23 (CP1): Increase in the Risk of Entrainment or Salvage of Species of Primary Management Concern at CVP and SWP Export Facilities Due to Changes in CVP and SWP Exports Proposed operations may result in an increase in CVP and SWP exports, which is assumed to result in a direct proportional increase in the risk of fish being entrained and salvaged at the facilities. This is a considered a less than significant impact to Chinook salmon,

steelhead, and longfin smelt. This is considered a potentially significant impact to delta smelt, striped bass, and splittail. Future operations of the SWP and CVP export facilities would continue to be managed and regulated in accordance with incidental take limits established for each of the protected fish by USFWS, NMFS, and DFG.

Results of the entrainment loss modeling at the CVP and SWP export facilities are presented in Table 11-22 for CP1. The initial modeling was conducted using average fish densities developed from past fish salvage monitoring at the SWP and CVP export facilities. Average monthly water exports were used in the analysis based on hydrologic simulation modeling. The indices of the potential risk of entrainment for some species, such as Chinook salmon, were not estimated separately for each species (e.g., winter-run Chinook salmon) in these initial analyses. If the proposed project is developed in the future a more detailed species-specific analysis of potential changes in fish salvage losses, in addition to an assessment of the population-level effects on each species, would be required for use as a basis for developing a biological assessment and BOs and incidental take permits for project operations. These indices were calculated for wet, above-normal, below-normal, dry, and critical water-year types, and for an average across all years (no water-year type specified). The total numbers of fish lost annually, by species, are presented in Attachment 13. The difference between the non-operations related and operations related fish mortality is represented as the entrainment index, shown in the tables, to represent the effect of project operations on each fish species for the CVP and SWP.

The greatest change in the risk of entrainment at the CVP and SWP export facilities would be expected to occur in dry and critical water-year types when export rates are increased, especially during February and summer months. Entrainment indices as a result of CP1 operations show a relatively minor increase, on average, in salvage for most species (e.g., delta smelt, steelhead, Chinook salmon, and longfin smelt). Although the risk of entrainment showed both increases and decreases depending on species and water-year type, the general trend was a small incremental increase in the risk of entrainment/salvage losses at the CVP and SWP export facilities when compared to the Existing Condition. Species with relatively lower abundance at the CVP and SWP, such as longfin smelt, during months of the highest exports, would appear to be less affected by CP1 operations, with entrainment indices representing a net benefit as a result of CP1 relative to the Existing Condition. Species with relatively higher abundance at the CVP and SWP fish facilities, such as splittail and striped bass, show increased mortality due to higher exports during June and July, as these species are generally collected at their highest abundances during these months. Chinook salmon entrainment, whose mortality at the facilities is highest during February, March, and June, appears to increase as a result of generally higher project export rates during these months when compared to the Existing Condition.

Table 11-22. Entrainment at the CVP and SWP facilities Under Existing Conditions, No-Action Alternative, and CP1

Species	Water Year	CP1 Minus Existing Condition	Percent Change	CP1 Minus No-Action Alternative	Percent Change
Delta Smelt	Average	243	0.3	217	0.3
	W	126	0.1	158	0.2
	AN	-191	-0.2	-802	-0.9
	BN	61	0.1	414	0.6
	D	605	1.1	1,395	2.5
	C	599	1.9	-636	-2.0
Salmon	Average	526	0.5	332	0.3
	W	351	0.3	260	0.2
	AN	-157	-0.1	-665	-0.5
	BN	316	0.3	481	0.5
	D	991	1.2	1,024	1.2
	C	1,136	2.3	277	0.6
Longfin Smelt	Average	-5	-0.0	44	0.3
	W	-6	-0.0	22	0.1
	AN	-155	-0.9	-165	-0.9
	BN	38	0.3	121	0.8
	D	41	0.3	246	2.1
	C	27	0.4	-93	-1.4
Steelhead	Average	51	1.1	26	0.5
	W	39	0.7	28	0.5
	AN	35	0.7	-22	-0.4
	BN	26	0.5	14	0.3
	D	47	1.1	-61	-1.4
	C	128	4.1	213	7.0
Striped Bass	Average	22,122	1.7	8,913	0.6
	W	10,057	0.6	7,950	0.5
	AN	17,172	1.2	-189	0.0
	BN	14,246	1.1	-3,684	-0.2
	D	43,219	3.8	39,951	3.4
	C	30,758	4.6	-11,763	-1.6
Splittail	Average	4,308	1.6	1,686	0.6
	W	2,276	0.6	1,791	0.5
	AN	3,375	1.1	-1,088	-0.3
	BN	1,089	0.4	-863	-0.3
	D	8,546	3.7	10,151	4.3
	C	7,044	6.1	-5,495	-4.0

Key:
AN = above-normal
BN = below-normal
C = critical
CP = Comprehensive Plan
CVP = Central Valley Project
D = dry
SWP = State Water Project
W = wet

Results of the entrainment risk calculations for delta smelt showed a change of less than 1 percent from Existing Condition in wet, above-normal, and below-normal water years and an increase in risk ranging from approximately 1 to 4 percent (Table 11-22) during dry and critical water years. The risk of increased losses of delta smelt was greatest in the dry years with a net reduction in losses under CP1 relative to the No-Action Alternative. Although the incremental change in the risk of delta smelt losses resulting from CVP and SWP export operations are small, the delta smelt population abundance is currently at such critically low levels that even a small increase in the risk of losses is considered to be potentially significant. The increase in risk is also expected to contribute to cumulative factors affecting the survival of delta smelt.

The estimated change in the risk of losses for Chinook salmon under CP1 follow a similar pattern to that described for delta smelt. Overall, CP1 resulted in a small increase in the risk of losses relative to both the Existing Condition and No-Action Alternative. The loss index for salmon under CP1 also showed increased risk in wet, below-normal, dry, and critical years. Given the numbers of juvenile Chinook salmon produced each year in the Central Valley, the relatively small incremental increase in the risk of entrainment/salvage at the CVP and SWP export facilities is considered to be a less than significant direct effect but would contribute incrementally to the overall cumulative factors affecting juvenile Chinook salmon survival within the Delta and population dynamics of the stocks.

The estimated change in the risk of longfin smelt entrainment/salvage compared with the Existing Condition and No-Action Alternative shows small positive and negative changes depending on water-year type (Table 11-22). These small changes in the risk of entrainment are considered to be less than significant.

The estimated change in the risk to steelhead of entrainment/salvage at the CVP and SWP export facilities under CP1 are summarized in Table 11-22. The small positive and negative changes in risk under wet, above-normal, below-normal, and dry water years are considered to be less than significant. The increase in risk of steelhead losses in critical water years is considered to be less than significant based on the abundance of juvenile steelhead migrating through the Delta, but would contribute directly to cumulative factors affecting the survival and population dynamics of Central Valley steelhead. The predicted increase in potential entrainment risk for steelhead under critically dry water years represents an initial estimate of the change (percentage) between the proposed project operations and the existing conditions and no-project alternatives and does not allow the predicted losses to be evaluated at the population-level. As noted above, more detailed modeling and analysis of potential steelhead losses would be required as part of preparing a project-specific analysis of entrainment losses for use in the Section 7 biological assessment and BOs for future project operations and incidental take of steelhead. As part of this more detailed analysis additional actions may be identified to further reduce and avoid potential adverse effects to steelhead.

The change in risk to juvenile striped bass for entrainment/salvage at the CVP and SWP export facilities are summarized in Table 11-22. The change in risk in wet, above-normal, and below-normal water years are considered to be less than significant based on the abundance of striped bass but would contribute to the cumulative factors affecting striped bass survival and population dynamics in the Delta. The losses of juvenile striped bass increased substantially under dry and critical year conditions, which would be expected with an increase in exports during the summer months. Under existing conditions, the risk of increased losses ranged from 3.8 to 7.6 percent (approximately 30,000 to 60,000 fish), which is considered to be potentially significant. The increased losses under the three alternatives, particularly in drier water years when juvenile striped bass production is lower, would be expected to contribute to the cumulative effects of factors affecting juvenile striped bass survival in the Delta.

Results of the risk estimates for juvenile splittail losses relative to the Existing Condition and No-Action Alternative show a pattern similar to other species (Table 11-22). The increased risk index was 1.3 percent or less in wet, above-normal, and below-normal water years, and was considered to be a less than significant impact. The loss index increased during dry and critically dry water years. Higher risk of entrainment/salvage losses in drier water years has a potentially greater effect of abundance of juvenile splittail since reproductive success and overall juvenile abundance is typically lower within the Delta in dry years. The increased risk of losses in drier years was considered to be potentially significant. The increased losses would also contribute to cumulative factors affecting survival of juvenile splittail within the Delta.

Impact Aqua-23 (CP1) is considered to be less than significant for Chinook salmon, steelhead, and longfin smelt, but potentially significant for delta smelt, striped bass, and splittail. Mitigation for this impact is not proposed because operations will be guided by RPAs established by NMFS and USFWS BOs.

CVP/SWP Service Areas

Impact Aqua-24 (CP1): Impacts on Aquatic Habitats and Fish Populations in the CVP and SWP Service Areas Resulting from Modifications to Existing Flow Regimes Project implementation could result in modified flow regimes that would reduce the frequency and magnitude of high winter flows along the Sacramento River; however, hydrologic effects in tributaries and reservoirs with CVP and SWP dams are expected to be less than impacts on the lower Sacramento River. Changes in hydrology could affect aquatic habitats that provide habitat for the fish communities. However, these changes are unlikely to result in substantial effects on the distribution or abundance of these species in the CVP and SWP service areas. Therefore, this impact would be less than significant.

Project implementation could result in modified flow regimes that would reduce the frequency and magnitude of high winter flows along the Sacramento River;

however, the hydrologic effects in tributaries (e.g., San Joaquin River, canals) and reservoirs (e.g., New Melones and San Luis) with CVP and SWP dams are expected to be less than impacts on the lower Sacramento River. The change in hydrology and reservoir levels could affect aquatic habitats that provide habitat for the fish communities, but these changes are unlikely to result in substantial effects on the distribution or abundance of these species in the CVP and SWP service areas. The effects from CP1 on CVP and SWP reservoir elevations, filling, spilling, and planned releases, and the resulting flows downstream from those reservoirs, would be small and well within the range of variability that commonly occurs in these reservoirs and downstream. Therefore, this impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

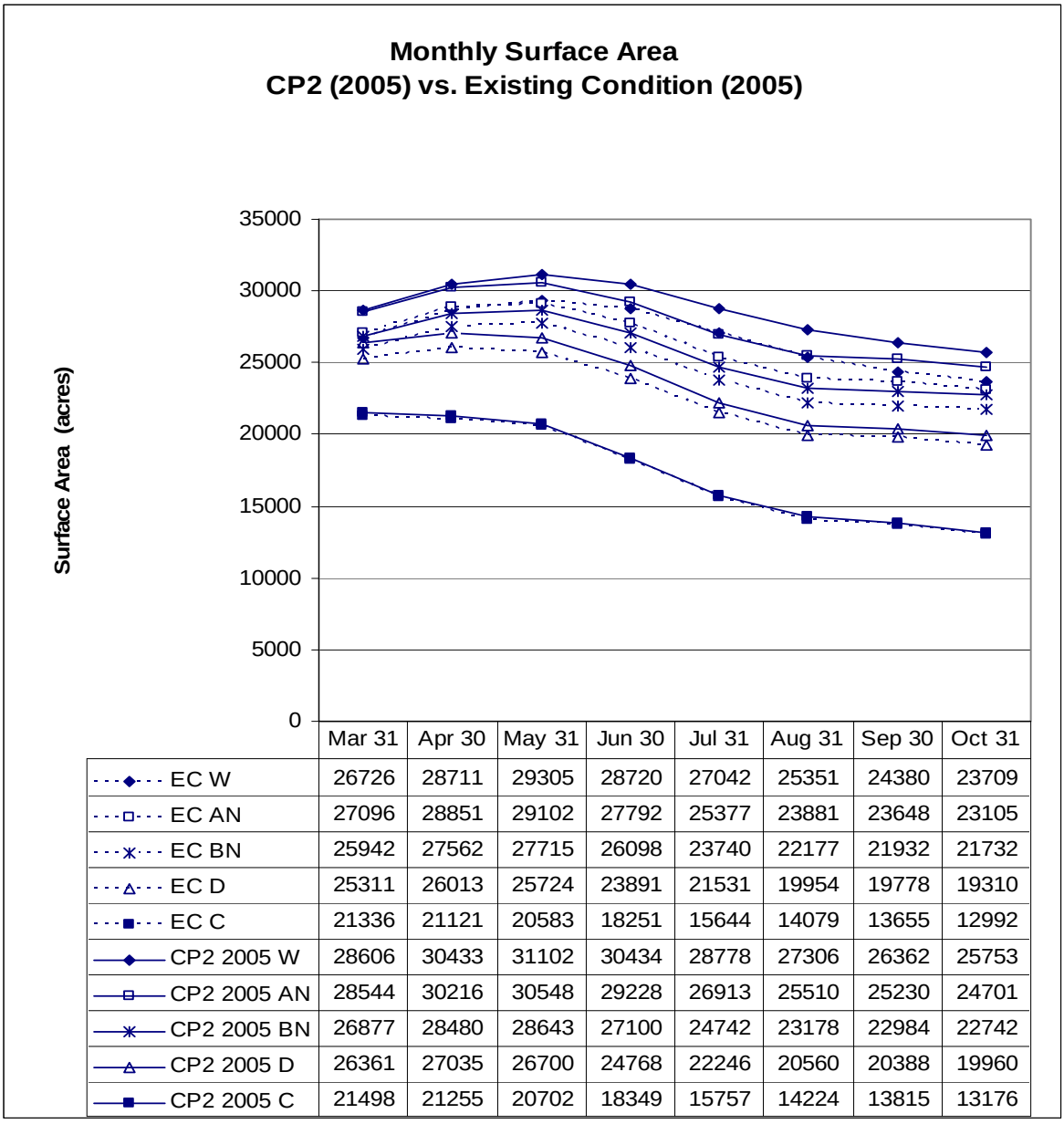
CP2 – 12.5-Foot Dam Raise, Anadromous Fish Survival and Water Supply Reliability

Like CP1, CP2 focuses on enlargement of Shasta Dam and Reservoir consistent with the goals of the 2000 CALFED ROD, and was formulated for the primary purposes of increased water supply reliability and increased survival of anadromous fish. CP2 consists of raising Shasta Dam by 12.5 feet, an elevation change that would increase the full pool by 14.5 feet and enlarge the total storage space in the reservoir by 443,000 acre-feet. This alternative would help reduce future shortages by increasing the reliability of the water supply in drought and average years. The increased cold-water pool also would contribute to improved seasonal water temperatures on the upper Sacramento River for anadromous fish.

Shasta Lake and Vicinity

Impact Aqua-1 (CP2): Effects on Nearshore, Warm-Water Habitat in Shasta Lake from Project Operations Under CP2, project operations would contribute to an increase in the surface area and WSEL of Shasta Lake, which would in turn increase the area and productivity of nearshore, warm-water habitat. CP2 operations would also result in reduced monthly fluctuations in WSEL, which would contribute to increased reproductive success, young-of-the-year production, and the juvenile growth rate of warm-water fish species. Similar to CP1, the value of existing structural improvements would be diminished, large areas of the shoreline would not be cleared, and the vegetation along these sections will be inundated periodically. In the short term, this vegetation will provide warm-water lacustrine habitat, with decay expected to occur over several decades. This impact would be less than significant.

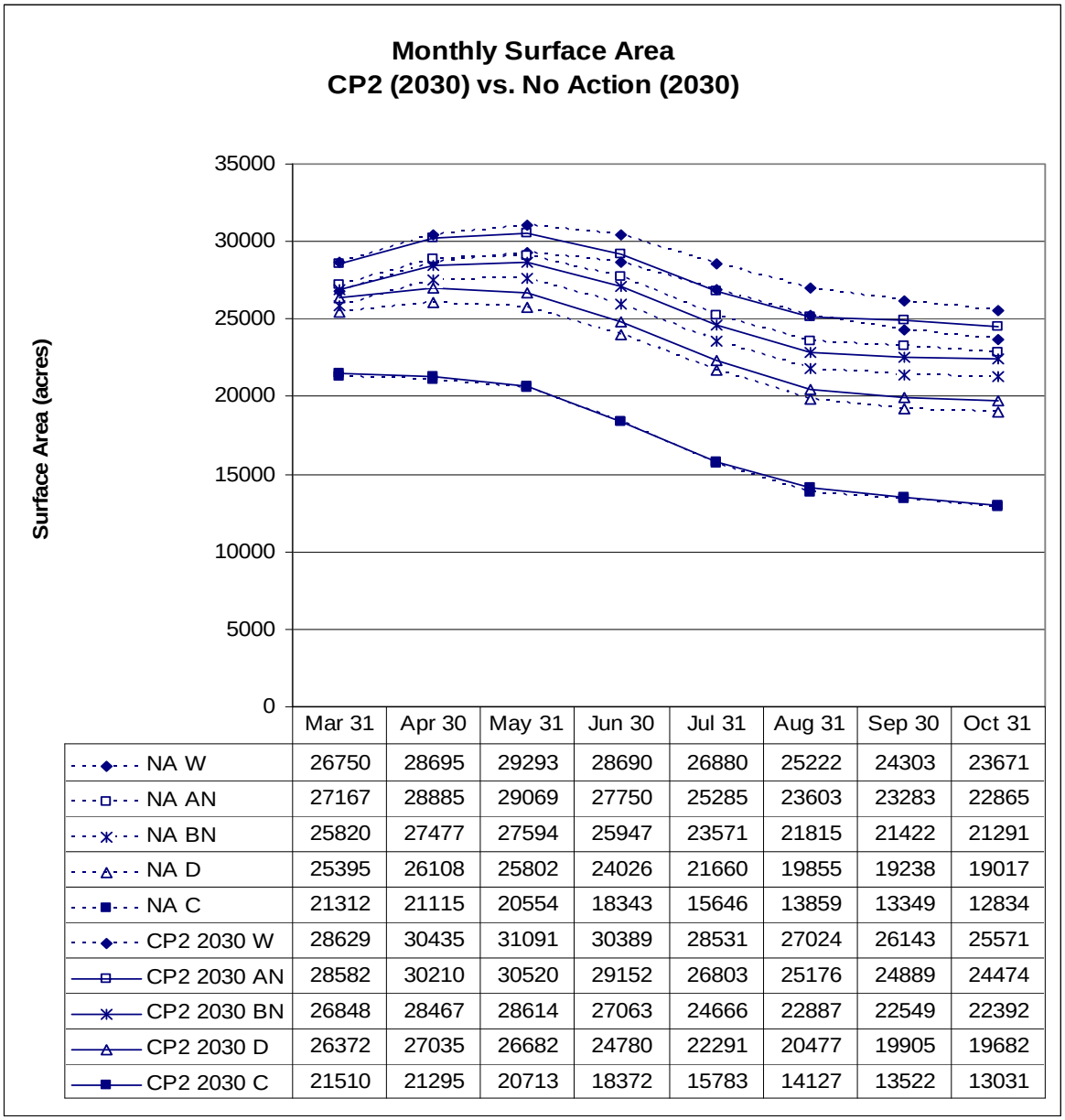
This impact would be similar to Impact Aqua-1 (CP1), but the surface area would be larger under the 12.5-foot dam raise than under the 6.5-foot dam raise. CalSim-II modeling shows that the surface area of Shasta Lake would be larger under the CP2, the Existing Condition or No-Action Alternative in all five water-year types (Figures 11-11 and 11-12).



	Mar 31	Apr 30	May 31	Jun 30	Jul 31	Aug 31	Sep 30	Oct 31
EC W	26726	28711	29305	28720	27042	25351	24380	23709
EC AN	27096	28851	29102	27792	25377	23881	23648	23105
EC BN	25942	27562	27715	26098	23740	22177	21932	21732
EC D	25311	26013	25724	23891	21531	19954	19778	19310
EC C	21336	21121	20583	18251	15644	14079	13655	12992
CP2 2005 W	28606	30433	31102	30434	28778	27306	26362	25753
CP2 2005 AN	28544	30216	30548	29228	26913	25510	25230	24701
CP2 2005 BN	26877	28480	28643	27100	24742	23178	22984	22742
CP2 2005 D	26361	27035	26700	24768	22246	20560	20388	19960
CP2 2005 C	21498	21255	20702	18349	15757	14224	13815	13176

Key:
AN = above-normal water
BN= below-normal water years
C = critical water years
CP = Comprehensive Plan
D = dry water years
EC = Existing Condition
W = wet water years

Figure 11-11. Monthly Surface Area for Each Water-Year Type Within the Shasta Lake Vicinity of the Primary Study Area, CP2 vs. Existing Condition



	Mar 31	Apr 30	May 31	Jun 30	Jul 31	Aug 31	Sep 30	Oct 31
NA W	26750	28695	29293	28690	26880	25222	24303	23671
NA AN	27167	28885	29069	27750	25285	23603	23283	22865
NA BN	25820	27477	27594	25947	23571	21815	21422	21291
NA D	25395	26108	25802	24026	21660	19855	19238	19017
NA C	21312	21115	20554	18343	15646	13859	13349	12834
CP2 2030 W	28629	30435	31091	30389	28531	27024	26143	25571
CP2 2030 AN	28582	30210	30520	29152	26803	25176	24889	24474
CP2 2030 BN	26848	28467	28614	27063	24666	22887	22549	22392
CP2 2030 D	26372	27035	26682	24780	22291	20477	19905	19682
CP2 2030 C	21510	21295	20713	18372	15783	14127	13522	13031

Key:
AN = above-normal water
BN= below-normal water years
C = critical water years
CP = Comprehensive Plan
D = dry water years
NA = No-Action
W = wet water years

Figure 11-12. Monthly Surface Area for Each Water-Year Type Within the Shasta Lake Vicinity of the Primary Study Area, CP2 vs. No-Action

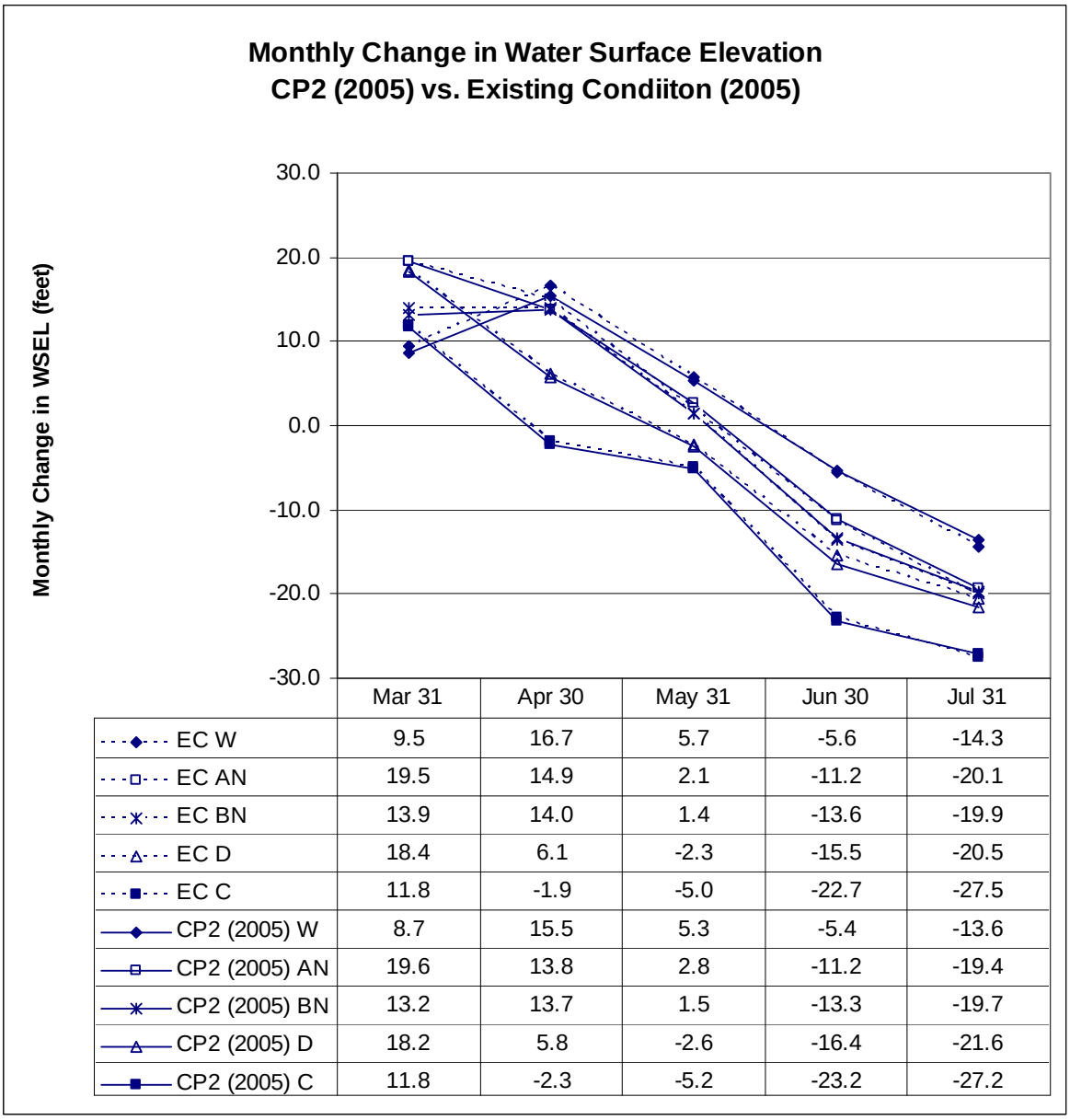
Monthly WSEL fluctuations were compared with projections for water supply demand. For CP2, with a 2005 water supply demand, 20 percent of monthly changes in projected WSEL (i.e., 5 of the 25 total projections made for the 5 months from March through July for all five water-year types) showed increased monthly WSEL fluctuations relative to the Existing Condition and 80 percent showed reduced monthly WSEL fluctuations (Figure 11-13). For CP2, with a projected 2030 water supply demand, 36 percent of monthly changes in projected WSEL showed increased WSEL fluctuations relative to the No-Action Alternative and 64 percent showed reduced monthly WSEL fluctuations (Figure 11-14). Under CP2, none of the changes in monthly WSEL fluctuation is different enough from the Existing Condition to warrant the investigation of daily WSEL fluctuation.

Increases in the overall surface area and WSEL under CP2 would increase the area of available warm-water habitat and stimulate biological productivity, including fish production, of the entire lake for a period of time, possibly for several decades. Furthermore, reductions in the magnitude of monthly WSEL fluctuations could contribute to increased reproductive success, young-of-the-year production, and juvenile growth rate of warm-water fish species. Therefore, this impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact Aqua-2 (CP2): Effects on Nearshore, Warm-Water Habitat in Shasta Lake from Project Construction Localized increases in soil erosion and resulting runoff sedimentation, and turbidity resulting from project construction in the vicinity of Shasta Dam and at utility, road, and other facility relocation areas could affect nearshore warm-water habitat. This impact would be similar to Impact Aqua-2 (CP1). However, CP2 would have a larger project footprint and would take longer to implement. However, the environmental commitments for all action would result in less than significant impacts. Mitigation for this impact is not needed, and thus not proposed.

Impact Aqua-3 (CP2): Effects on Cold-Water Habitat in Shasta Lake Under CP2, operations-related changes in the ratio of the volume of cold-water storage to surface area would increase the availability of suitable habitat for cold-water fish in Shasta Lake, including rainbow trout. This impact would be beneficial.

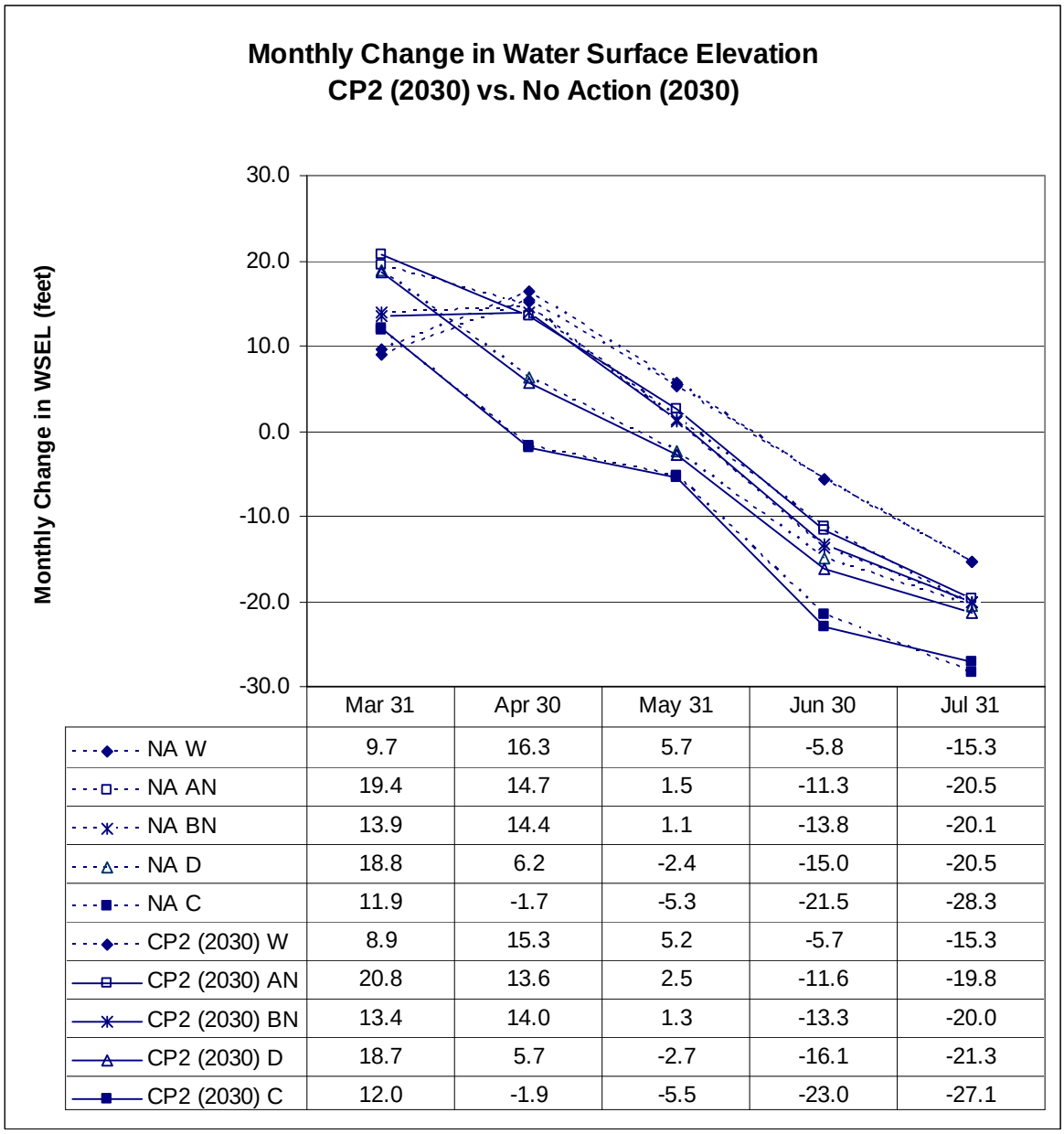
This impact would be similar to Impact Aqua-3 (CP1). However, it would be of greater magnitude owing to a greater increase in the ratio of the volume of cold water storage in the lake to the surface area of the lake. CalSim-II modeling shows that under CP2 with a 2030 water supply demand, the ratio of cold-water storage to surface area is higher than under the No-Action Alternative in all water years and during all months modeled. The greatest projected increases over the No-Action Alternative occur between June 30 and August 31, which is the critical holding and rearing period for cold-water fishes in reservoirs, and the increases are greatest in wet and above-normal water years (Figure 11-15).



	Mar 31	Apr 30	May 31	Jun 30	Jul 31
EC W	9.5	16.7	5.7	-5.6	-14.3
EC AN	19.5	14.9	2.1	-11.2	-20.1
EC BN	13.9	14.0	1.4	-13.6	-19.9
EC D	18.4	6.1	-2.3	-15.5	-20.5
EC C	11.8	-1.9	-5.0	-22.7	-27.5
CP2 (2005) W	8.7	15.5	5.3	-5.4	-13.6
CP2 (2005) AN	19.6	13.8	2.8	-11.2	-19.4
CP2 (2005) BN	13.2	13.7	1.5	-13.3	-19.7
CP2 (2005) D	18.2	5.8	-2.6	-16.4	-21.6
CP2 (2005) C	11.8	-2.3	-5.2	-23.2	-27.2

Key:
AN = above-normal water
BN= below-normal water years
C = critical water years
CP = Comprehensive Plan
D = dry water years
NA = No-Action
W = wet water years

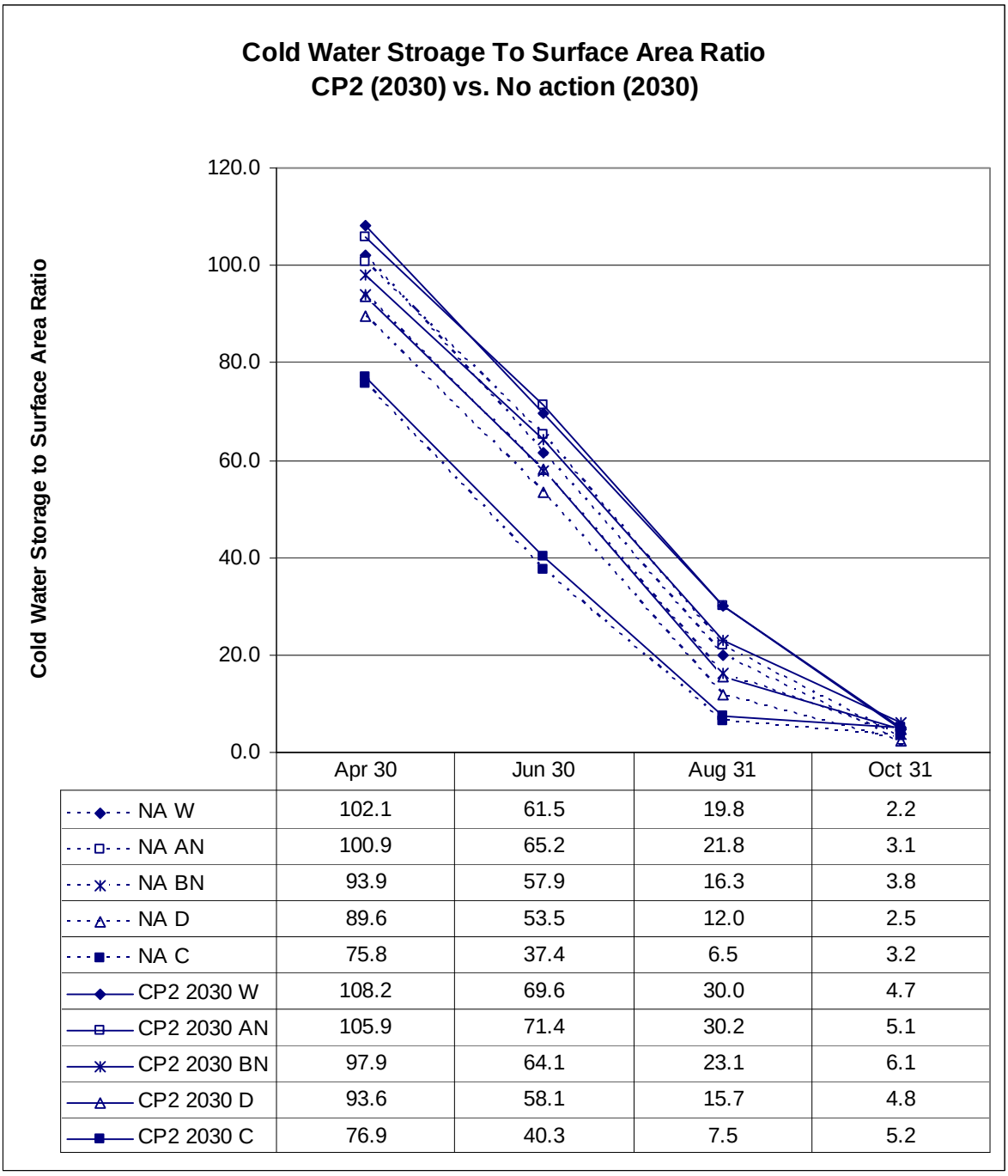
Figure 11-13. Monthly Change in WSEL for Each Water-Year Type Within the Shasta Lake Vicinity of the Primary Study Area, CP2 vs. Existing Condition



	Mar 31	Apr 30	May 31	Jun 30	Jul 31
NA W	9.7	16.3	5.7	-5.8	-15.3
NA AN	19.4	14.7	1.5	-11.3	-20.5
NA BN	13.9	14.4	1.1	-13.8	-20.1
NA D	18.8	6.2	-2.4	-15.0	-20.5
NA C	11.9	-1.7	-5.3	-21.5	-28.3
CP2 (2030) W	8.9	15.3	5.2	-5.7	-15.3
CP2 (2030) AN	20.8	13.6	2.5	-11.6	-19.8
CP2 (2030) BN	13.4	14.0	1.3	-13.3	-20.0
CP2 (2030) D	18.7	5.7	-2.7	-16.1	-21.3
CP2 (2030) C	12.0	-1.9	-5.5	-23.0	-27.1

Key:
AN = above-normal water
BN= below-normal water years
C = critical water years
CP = Comprehensive Plan
D = dry water years
NA = No-Action
W = wet water years

Figure 11-14. Monthly Change in WSEL for Each Water-Year Type Within the Shasta Lake Vicinity of the Primary Study Area, CP2 vs. No-Action



	Apr 30	Jun 30	Aug 31	Oct 31
NA W	102.1	61.5	19.8	2.2
NA AN	100.9	65.2	21.8	3.1
NA BN	93.9	57.9	16.3	3.8
NA D	89.6	53.5	12.0	2.5
NA C	75.8	37.4	6.5	3.2
CP2 2030 W	108.2	69.6	30.0	4.7
CP2 2030 AN	105.9	71.4	30.2	5.1
CP2 2030 BN	97.9	64.1	23.1	6.1
CP2 2030 D	93.6	58.1	15.7	4.8
CP2 2030 C	76.9	40.3	7.5	5.2

Key:
AN = above-normal water
BN= below-normal water years
C = critical water years
CP = Comprehensive Plan
D = dry water years
NA = No-Action
W = wet water years

Figure 11-15. Monthly Cold-water Storage to Surface Area Ratio for Each Water-Year Type Within the Shasta Lake Vicinity of the Primary Study Area, CP2 vs. Existing Condition

CP2 would increase the availability of suitable habitat for cold-water fish in Shasta Lake. Therefore, this impact would be beneficial. Mitigation for this impact is not needed, and thus not proposed.

Impact Aqua-4 (CP2): Effects on Special-Status Aquatic Mollusks Under CP2, habitat for special-status mollusks could become inundated. Seasonal fluctuations in the surface area and WSEL of Shasta Lake could also adversely affect special-status aquatic mollusks that may occupy habitat in or near Shasta Lake and its tributaries. Tributary investigations are ongoing and will provide additional information and analysis for inclusion in the FEIS. This impact would be potentially significant. Mitigation for this impact is proposed in Section 11.3.4.

Impact Aqua-5 (CP2): Effects on Special-Status Fish Species The expansion of the surface area of Shasta Lake and the inundation of additional tributary habitat under CP2 could affect one species designated as sensitive by USFS, the hardhead. Tributary investigations are ongoing and will provide additional information and analysis for inclusion in the FEIS. This impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact Aqua-6 (CP2): Creation or Removal of Barriers to Fish Between Tributaries and Shasta Lake Under CP2, project implementation would result in the periodic inundation of steep and low-gradient tributaries to Shasta Lake up to the 1,084-foot contour, the maximum inundation level under this alternative. Tributary investigations are ongoing and will provide additional information and analysis for inclusion in the FEIS. However, based on digital topographic data and stream channel data generated from field inventories, there do not appear to be any substantial barriers between the 1,070-foot and 1,084-foot contours that would be inundated under this alternative. This impact would be less than significant.

This impact would be similar to Impact Aqua-6 (CP1). However, the maximum inundation level would be higher under CP2. Most of the tributaries are too steep (i.e., greater than 7 percent) up to the 1,084-foot contour to be passable by fish; the tributaries that are low-gradient up to the 1,084-foot contour, and thus allow fish passage remain low-gradient well upstream from this contour. Therefore, this impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact Aqua-7 (CP2): Effects on Spawning and Rearing Habitat of Adfluvial Salmonids in Low-Gradient Tributaries to Shasta Lake CP2 would result in additional periodic inundation of potential spawning and rearing habitat for adfluvial salmonids in low-gradient tributaries. Tributary investigations are ongoing and will provide additional information and analysis for inclusion in the FEIS. A total of 7.4 miles of low-gradient reaches that could provide some spawning and rearing habitat for adfluvial salmonids would be affected by CP2,

which is only about 1.8 percent of the low-gradient habitat upstream from Shasta Lake. This impact would be less than significant.

As described in Chapter 4, "Geology, Geomorphology, Minerals, and Soils," CP2 would inundate perennial reaches with gradients of less than 7 percent that could provide potentially suitable spawning and rearing habitat for adfluvial salmonids. The lengths of low-gradient tributaries to each arm of Shasta Lake that would be periodically inundated are as follows:

- Sacramento River Arm 3.1 miles
- McCloud River Arm 1.4 miles
- Pit River Arm 1.4 miles
- Big Backbone Creek Arm 0.6 miles
- Squaw Creek 0.9 miles

This impact would be similar to Aqua-7 (CP1). However, it would periodically inundate a larger amount of habitat in low-gradient reaches to Shasta Lake, but the total amount inundated would be only 1.8 percent of the low-gradient habitat upstream from the lake. Therefore, this impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact Aqua-8 (CP2): Effects on Aquatic Connectivity in Non-Fish-Bearing Tributaries to Shasta Lake CP2 would result in periodic inundation of the lower reaches of high-gradient, non-fish-bearing tributaries to Shasta Lake. Tributary investigations are ongoing and will provide additional information and analysis for inclusion in the FEIS. Only 17.3 miles of non-fish-bearing tributary habitat would be affected by CP2, which is only about 0.7 percent of this habitat upstream from Shasta Lake. This impact would be less than significant.

As described in Chapter 4, CP2 would inundate tributary segments with channel slopes in excess of 7 percent. Although these segments do not typically support salmonid populations, they do provide riparian and aquatic habitat for a variety of organisms and serve as corridors that connect habitat types. The lengths of non-fish-bearing tributaries for each arm of Shasta Lake that would be periodically inundated are as follows:

- Sacramento River Arm 3.9 miles
- McCloud River Arm 2.8 miles
- Pit River Arm 2.5 miles
- Big Backbone Creek Arm 1.8 miles
- Squaw Creek Arm 1.3 miles
- Main Body 5.0 miles

This impact would be similar to Aqua-8 (CP1). However, it would periodically inundate a larger amount of habitat in low-gradient reaches to Shasta Lake, but the total amount inundated would be only 0.7 percent of the low-gradient habitat upstream from the lake. Therefore, this impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact Aqua-9 (CP2): Effects on Water Quality at Livingston Stone Hatchery Reclamation provides the water supply to the Livingston Stone Hatchery from a pipeline emanating from Shasta Dam. This supply would not be interrupted by any activity associated with CP2. There would be no impact.

This impact is the same as Impact Aqua-9 (CP1) and there would be no impact. Mitigation for this impact is not needed, and thus not proposed.

Upper Sacramento River (Shasta Dam to RBDD)

Impact Aqua-10 (CP2): Loss or Degradation of Aquatic Habitat in the Upper Sacramento River During Construction Activities Construction-related increases in sediments and turbidity would adversely affect aquatic habitats and fish populations within the upper Sacramento River immediately downstream from project construction activities. This impact would be less than significant.

This impact would be similar to Impact Aqua-10 (CP1). The impact could be greater because of the increased activity associated with a 12.5-foot raise compared to a 6.5-foot raise. However, the environmental commitments for all action would result in less than significant impacts. Mitigation for this impact is not needed, and thus not proposed.

Impact Aqua-11 (CP2): Release and Exposure of Contaminants in the Upper Sacramento River During Construction Activities Construction-related activities could result in the release and exposure of contaminants, resulting in adverse effects on aquatic habitats, the aquatic food web, and fish populations, including special-status species, within the primary study area downstream from project construction activities. However, environmental commitments would be in place to reduce the impacts to less than significant.

This impact would be similar to Impact Aqua-11 (CP1). The impact could be greater because of the increased activity associated with a 12.5-foot raise compared to a 6.5-foot raise. The potential release of hazardous materials into Shasta Lake or the Sacramento River could result in the reduction of aquatic habitats and fish populations if proper procedures are not implemented to contain the discharge. However, the environmental commitments for all action would result in less than significant impacts. Mitigation for this impact is not needed, and thus not proposed.

Impact Aqua-12 (CP2): Changes in Flow and Water Temperature in the Upper Sacramento River Resulting from Project Operation – Chinook Salmon Project operation would result in improved flow and water temperature conditions in

the upper Sacramento River for fish species of management concern. This impact would be beneficial.

Winter-Run Chinook Salmon

Production

Based on the 1999 through 2006 population average, the overall average winter-run production for the 82-year period was similar for CP2 relative to the No-Action Alternative and the Existing Condition (Attachments 1A and 2A). The maximum increase in production relative to the No-Action Alternative was 44 percent for CP2, while the largest decrease in production relative to the No-Action Alternative was 29 percent under CP2 (Attachment 1A). The maximum increase in production relative to the Existing Condition was 34 percent for CP2, while the largest decrease in production relative to the Existing Condition was 4 percent under CP2 (Attachment 2A).

With one exception (1977 at -32 percent), years with the lowest production over the simulation period showed the largest increase in production under CP2 conditions.

Under CP2, critical water years 1924, 1931, and 1934 had substantial increases in production relative to the No-Action Alternative for winter-run Chinook salmon, ranging from 8 percent to 65 percent. Dry water year 1944 had a substantial increase (7 percent) compared to the No-Action Alternative. Critical water year 1977 had a decrease in production of around 32 percent, and dry water year 1932 had a decrease in production of 7 percent.

Under CP2, critical water years 1924, 1933, and 1977 had increases in production relative to the Existing Condition for winter-run Chinook salmon, ranging from 5 percent to 23 percent. Only one below-normal water year, 1936, had a substantial increase (5 percent) compared to the Existing Condition. No years had decreases in production greater than 5 percent.

When the spawning population was set at AFRP goal, the overall average winter-run Chinook salmon production was similar for CP2 relative to the No-Action Alternative (Attachment 3A). The maximum increase in production relative to the No-Action Alternative was 28 percent for CP2. The largest decrease in production relative to the No-Action Alternative was 20 percent for CP2. All years with the lowest production under the No-Action Alternative typically had the greatest percent increase in production under CP2, with one exception, 1977, a 20-percent decrease.

Mortality

Based on the 1999 through 2006 population average, the greatest mortality to winter-run Chinook salmon under CP2 occurred to the egg incubation life stage, followed by fry, and lastly to presmolts and immature smolts. Nonoperational conditions were the primary causes of mortality for all life stages under all Comprehensive Plans. Table 11-4 displays the overall mortalities for each

Comprehensive Plan that were caused by nonoperational factors versus those caused by operations (i.e., water temperature and flow) (Attachments 2B and 3B). Mortalities caused by the project decrease as the proposed dam height increases from 6.5 to 18.5 feet.

When removing nonoperations-related mortality, allowing comparison of mortality for operations-related activities only, fry were the primary life stage affected, but operations-related activities had a greater effect on eggs than on presmolts and no effect on immature smolts. The same trends for each alternative were observed, with the bulk of the mortality affecting the fry and egg incubation life stages, and both water temperature and flow causing mortality (Table 11-5).

In critical water years, mortality to eggs due to unsuitable water temperatures was the primary cause of operations-related mortalities for CP2, followed by mortality to fry (more by flow and density than water temperature), then to eggs from redd superimposition, followed by presmolts (affected first by temperature then flow), and then immature smolts (affected by flow). Attachments 2C and 3C contain tables of mortality to winter-run sorted by water-year type, and Table 11-6 outlines the rankings classified under each Comprehensive Plan for each water-year type.

In dry water years, mortality to fry when moving to new habitats was the primary cause of operations-related mortalities for all Comprehensive Plans, followed by mortality to eggs due to redd superimposition. Third was mortality to eggs due to unsuitable water temperatures, followed by mortality to presmolts while moving to new habitats.

Below-normal, above-normal, and wet water years also had the greatest number of winter-run perish as fry caused by forced movement to habitat downstream, followed by mortality to eggs due to redd superimposition, then the loss of eggs from unsuitable water temperatures, and forced movement of presmolts to downstream habitats.

Years with the highest mortality were the same for the No-Action Alternative and the Existing Condition and CP2, and were 1924, 1931, 1933, 1934, 1977, and 1992. Each of these years was a critical water year, and was preceded by either a critical (1933, 1976, 1991), dry (1930, 1932) or below-normal (1923) water-year type. Years with the lowest mortality varied between all water-year types. Years in which the project has the greatest effect on winter-run were also years in which the lowest production occurred (Attachments 2C and 3C).

When the spawning population was set at the AFRP goal, winter-run Chinook salmon mortality caused by operations-related activities decreased under CP2 compared to No-Action Alternative conditions. Under CP2, mortality caused by operations-related activities would decrease from non-operations related mortality by over 10 percent. Under CP2, the greatest mortality to winter-run

occurred to the egg incubation life stage, followed by presmolts, then fry, and lastly to immature smolts. Nonoperational conditions were the primary causes of mortality for all life stages under all alternatives.

Because winter-run Chinook salmon have, overall, a reduced mortality, winter-run Chinook salmon would benefit from actions taken in CP2. Mitigation for this impact is not needed, and thus not proposed.

Spring-Run Chinook Salmon

Production

Based on the 1999 through 2006 population average, similar to CP1, overall average spring-run Chinook salmon production for CP2 remained relatively close to the No-Action Alternative and the Existing Condition (Attachments 4A and 5A). The maximum increase in production relative to the No-Action Alternative was 37 percent for CP2. The largest decrease in production relative to the No-Action Alternative was 21 percent under CP2 (Attachment 4A). The maximum increase in production relative to the Existing Condition was 49 percent for CP2 in 1932. The largest decrease in production relative to the Existing Condition was 49 percent under CP2 in 1977 (Attachment 5A).

Under CP2, critical water years 1924, 1931, 1977, 1992, and 1994 had increases in production relative to the No-Action Alternative, ranging from 13 to 37 percent. Dry water years 1925 and 1932, and below-normal water year 1959, had increases in production ranging from 6 percent to 10 percent. Critical water year 1934 had a decrease in production of 21 percent.

Under CP2, six critical water years (1924, 1933 1934, 1992, 1994, 2001) had substantial increases in production relative to the Existing Condition, ranging from 6 percent to 19 percent. Two dry water years, 1932 and 2002, had increases ranging from 6 percent to 70 percent compared to the Existing Condition. One below-normal water year (1959) had a 7 percent increase in production relative to the No-Action Alternative. Two critical water years (1977 and 1988) and one dry water year (1926) resulted in decreases in production relative to the Existing Condition (6 percent to 49 percent).

When the spawning population equaled the AFRP goal, overall average spring-run Chinook salmon production was similar for CP2 relative to the No-Action Alternative (Attachment 6A). The maximum increase in production relative to the No-Action Alternative was 100 percent for CP2. The largest decrease in production relative to the No-Action Alternative was 32 percent for CP2. Years with the lowest production under the No-Action Alternative typically had the greatest percent increase in production under CP2, with one exception, 1934, a 33-percent decrease.

Mortality

Based on the 1999 through 2006 population average, the greatest mortality to spring-run Chinook salmon under CP2 occurred to eggs, followed by presmolts,

then fry. Nonoperational conditions were the primary causes of mortality for all life stages under all Comprehensive Plans. Table 11-7 displays the overall mortalities for each Comprehensive Plan that were caused by nonoperational factors versus those caused by operations (i.e., water temperature and flow) (Attachments 4B and 5B). Mortalities caused by CP2 decrease as the proposed dam height increases from 6.5 to 18.5 feet (Tables 11-7 and 11-8). When removing nonoperations-related mortality, leaving mortality due to operations-related activities, only eggs and fry were affected (Table 11-8).

Similar to the No-Action Alternative, critical water years had mortality to eggs due to unsuitable water temperatures as the primary cause of operations-related mortalities, followed by mortality to eggs both prespawned and during incubation caused by dewatering the redds, then to fry from forced movement to downstream habitats. Attachments 4C and 5C contains tables of mortality to spring-run Chinook salmon sorted by water-year type. Table 11-11 outlines the rankings classified under each Comprehensive Plan for each water-year type based.

In dry, below-normal and above-normal water years, CP2 was dominated by egg temperature mortality, followed by mortality resulting from redd dewatering. Mortality to prespawned eggs occurred in only two dry years but no below-normal water years. Mortality to fry from forced movement was relatively low in only several more years (Table 11-9).

In wet water years, spring-run eggs under conditions created by CP2 were more affected by redd dewatering than by unsuitable water temperatures (Table 11-9).

Years with the highest operations-related mortality were the same for all the Comprehensive Plans and were 1924, 1931, 1932, 1933, 1934, 1977, and 1992. Except for 1932 (a dry water year), each of these years was a critical water-year type and was preceded by either a below, dry, or (predominantly) a critical water year. However, years with the lowest mortality varied between all water-year types. Years in which the project had the greatest impact on spring-run Chinook salmon were also years in which the lowest production occurred, with nearly all of the mortality occurring in the egg incubation life stage (Attachments 4C and 5C).

When the spawning population was equal to the AFRP goal, spring-run Chinook salmon mortality caused by the operations-related activities decreased under CP2 compared to No-Action Alternative conditions (Attachment 6B). Under CP2, mortality caused by operations-related activities would decrease from non-operations related mortality by over 34 percent. Under CP2, the greatest mortality to spring-run occurred to the egg incubation life stage, followed by presmolts, then fry, and lastly to immature smolts. Nonoperational conditions were the primary causes of mortality for all life stages under all alternatives.

Because spring-run Chinook salmon have, overall, a reduced mortality, spring-run Chinook salmon would benefit from actions taken in CP2. Mitigation for this impact is not needed, and thus not proposed.

Fall-Run Chinook Salmon

Production

Based on the 1999 through 2006 population average, overall average fall-run Chinook salmon production for the simulation period was similar for CP2 relative to the No-Action Alternative and the Existing Condition (Attachments 7A and 8A). The maximum increase in production relative to the No-Action Alternative was 83 percent for CP2. The largest decrease in production relative to the No-Action Alternative was 8 percent under CP2 (Attachment 7A). The maximum increase in production relative to the Existing Condition was 44 percent for CP2. The largest decrease in production relative to the Existing Condition was 34 percent under CP2 (Attachment 8A).

In critical, dry, and below-normal water years, when production was lowest over the simulation period, the increase in production resulting from operations-related activities was greatest. In above-normal and wet water years, however, the lowest production years typically had a slight decrease in production under CP2 conditions relative to the No-Action Alternative.

Under CP2, critical water years 1931, 1934, and 1977 had increases in production relative to the No-Action Alternative, ranging from 8 to 83 percent. Four dry water years (1926, 1932, 1955, and 1964) had between 5 and 12 percent increases in production compared to the No-Action Alternative. Production increased by 9 percent to 47 percent in below-normal water years 1937 and 1945 relative to the No-Action Alternative. Below-normal water year 1979 and wet water year 1999 resulted in a decreased production relative to the No-Action Alternative of between 6 and 8 percent.

Under CP2, critical water year 1924 and dry water years 1926, 1939, and 1964 had increases in production relative to the Existing Condition of between 6 and 44. Three below-normal water years (1937, 1945 and 1950) had an increase in production relative to the Existing Condition of 6 percent to 30 percent. One critical (1977), one below-normal (1979), one above-normal (1957) and five wet (1969 and 1999) water years resulted in decreased production relative to the Existing Condition of between 5 and 34 percent.

When the spawning population was equal to the AFRP goal, overall average fall-run Chinook salmon production was similar for CP2 relative to the No-Action Alternative (Attachment 9A). The maximum increase in production relative to the No-Action Alternative was 81 percent for CP2. The largest decrease in production relative to the No-Action Alternative was 6 percent for CP2. In critical, dry, and below-normal water years, years with the lowest production under the No-Action Alternative typically had the greatest percent increase in production under CP2. In above-normal and wet water years,

however, the lowest production years typically had a slight decrease in production under CP2 conditions relative to the No-Action Alternative. In above-normal and wet water years, however, the lowest production years typically remained similar or had a slight decrease in production under CP1 conditions relative to the No-Action Alternative.

Mortality

Based on the 1999 through 2006 population average, the greatest mortality to fall-run Chinook salmon under CP2 occurs to the egg incubation life stage, followed by presmolts, then fry, and lastly to immature smolts. Nonoperational conditions were the primary causes of mortality for all life stages. Table 11-8 displays the overall mortalities for each alternative that were caused by nonoperational factors versus those caused by the operations (i.e., water temperature and flow) (Attachments 7B and 8B). Mortalities caused by operations-related activities were lower for CP2 than for the No-Action Alternative (Tables 11-10 and 11-11).

When removing nonoperations-related mortality, allowing comparison of mortality for operations-related activities only, egg incubation was still the primary life stage affected, but operations-related activities had a greater effect on fry than on presmolts and an even lesser effect on immature smolts. The same trends for each Comprehensive Plan were observed, with the bulk of the mortality affecting the egg incubation life stage, with flow triggering more of the mortality (Table 11-11).

In all water-year types the greatest portion of mortality occurred to fry caused by forced movement to downstream habitats. Prespawn, incubation, and superimposition mortality were greater than mortality to eggs caused by unsuitable water temperatures and presmolt habitat movement.

In critical water years, CP2 show the same general trend in mortality factors as the No-Action Alternative and Existing Condition, except CP2 had greater mortality during the prespawn phase, than to fry caused by forced movement. Least affected were presmolts and then immature smolts by both water temperatures and forced movement. Attachments 7C and 8C contain tables of mortality to fall-run sorted by water-year type, and Table 11-12 outlines the rankings classified under each Comprehensive Plan for each water-year type.

As with critical water years, dry water years were dominated by mortality to fry due to forced movement downstream, followed by redd dewatering or scouring and redd superimposition. There was additional mortality to fall-run Chinook salmon presmolts and immature smolts from both forced movement and unsuitable water temperatures (Table 11-12).

Below-normal and above-normal water years were relatively similar for CP2 compared with the No-Action Alternative and the Existing Condition. The mortality factors were dominated by mortality to fry due to forced movement

downstream, followed by redd superimposition, dewatering or scouring. Mortality to presmolts caused by forced downstream movement was a greater factor affecting fall-run populations than was egg mortality caused by unsuitable water temperatures or mortality to immature smolts and fry due to unsuitable water temperatures (Table 11-12).

As with the water-year types discussed above, under wet water year conditions, the majority of the mortality also occurred to fry due to forced downstream movement, followed by redd superimposition, and redd dewatering or scouring, mortality to presmolts and immature smolts from downstream movement were the lowest mortality rates resulting from operations-related activities. Least affected were eggs due to unsuitable water temperatures, both prespawn and postspawn.

Years with the highest mortality were the same for CP2 as for the No-Action Alternative and CP1: 1934, 1935, 1970, 1978, and 1993. With the exception of 1970, each of these years was preceded by a critical water year. Overall, years with the lowest mortality tended to be dry or critical water years.

Years with the highest mortality were the same for CP2 as for the Existing Condition and CP1: 1957, 1982, 1985, 1994, and 1997. Overall, years with the lowest mortality tended to be dry water years.

When the spawning population was set at the AFRP goal, fall-run Chinook salmon mortality caused by the operations-related activities decreased under CP2 compared to No-Action Alternative conditions (Attachment 9B). Under CP2, mortality caused by operations-related activities would decrease from non-operations related mortality by 14 percent. Under CP2, the greatest mortality to fall-run Chinook salmon occurred to the egg incubation life stage, followed by fry, then presmolts, and lastly to immature smolts. Nonoperational conditions were the primary causes of mortality for all life stages under all alternatives.

Because fall-run Chinook salmon have, overall, a reduced mortality, fall-run Chinook salmon would benefit from actions taken in CP2. Mitigation for this impact is not needed, and thus not proposed.

Late Fall-Run Chinook Salmon

Production

Based on the 1999 through 2006 population average, overall average late fall-run Chinook salmon production for the 82-year period was similar for CP2 relative to the No-Action Alternative and the Existing Condition (Attachments 10A and 11A). The maximum increase in production relative to the No-Action Alternative was 8 percent for CP2. The largest decrease in production relative to the No-Action Alternative was 6 percent under CP2 (Attachment 10A). The maximum increase in production relative to the Existing Condition was 14 percent for CP2 in 1985. The largest decrease in production relative to the Existing Condition was 5 percent under CP2 (Attachment 11A).

Under CP2, production increased for critical water year 1976, dry water years 1926 and 1985, and below-normal water year 1923 by 6 to 7 percent relative to the No-Action Alternative. One dry (1944) had decreased production of 6 percent compared to the No-Action Alternative.

Under CP2, two dry water years (1926 and 1985), and one wet water year (1975) had increases (ranging from 5 to 14 percent) compared to the Existing Condition. No year had decreases greater than 5 percent compared to the Existing Condition.

When the spawning population equaled the AFRP goal, overall average late fall-run Chinook salmon production was similar for CP2 relative to the No-Action Alternative (Attachment 12A). The maximum increase in production relative to the No-Action Alternative was 12 percent for CP2. The largest decrease in production relative to the No-Action Alternative was 7 percent for CP2. Production remained relatively similar regardless of water-year type.

Mortality

Based on the 1999 through 2006 population average, the greatest mortality to late fall-run Chinook salmon under CP2 occurred to the egg incubation life stage, followed by fry, then presmolts, and lastly to immature smolts. Nonoperational conditions were the primary causes of mortality for all life stages under CP2. Table 11-13 displays overall mortalities for each Comprehensive Plan that were caused by nonoperational factors versus those caused by operations (i.e., water temperature and flow) (Attachments 10B and 11B). Mortalities caused by the project decreased for all Comprehensive Plans relative to the No-Action Alternative.

When removing nonoperations-related mortality, allowing the comparison of mortality for operations-related activities only, fry became the primary life stage affected, and operations-related activities had a greater effect on eggs than on presmolts, and an even lesser effect on immature smolts. Most of the mortality occurred as a result of flow conditions rather than water temperature (Table 11-14).

Mortality to fry resulting from unsuitable water temperatures only occurred at low levels to late fall-run during critical, dry, and below-normal water years. In all water-year types, under CP2, mortality to fry during forced movement to downstream habitats was the primary cause of operations-related mortality.

In critical, dry, and below-normal water years, the causes of operations-related mortality follow similar trends for all Comprehensive Plans with a few exceptions. In general, the effects of flow (and density) had the greatest effect on mortality. Forced movement of fry resulted in the greatest mortality, followed by flow effects on eggs via scouring, dewatering, or superimposition. Next affected were presmolts and immature smolts by unsuitable water

temperatures, and lastly temperature effects on eggs and flow effects on presmolts and immature smolts and fry (Table 11-15).

Wet and above-normal water years were overall similar to critical, dry, and below-normal water years except that mortality to fry due to unsuitable water temperatures disappeared.

Years with the highest mortality were the same as for the No-Action Alternative, Existing Condition, and CP1. All water-year types were covered. Three years were preceded by a wet water year, one preceded by an above-normal water year, and at least one below-normal water year (Attachments 10C and 11C).

When the spawning population was equal to the AFRP goal, late fall-run Chinook salmon mortality caused by the operations-related activities was slightly less under CP2 than under No-Action Alternative conditions. Under CP2, mortality caused by operations-related activities would decrease from non-operations related mortality by 29 percent. Under CP2, the greatest mortality to late fall-run occurred to the egg incubation life stage, followed by presmolts, then fry, and lastly to immature smolts. Nonoperational conditions were the primary causes of mortality for all life stages under all alternatives (Attachment 12B).

Because late fall-run Chinook salmon have, overall, a reduced mortality, late fall-run Chinook salmon would benefit from actions taken in CP2. Mitigation for this impact is not needed, and thus not proposed.

Impact Aqua-13 (CP2): Changes in Flow and Water Temperatures in the Upper Sacramento River Resulting from Project Operation – Steelhead, Green Sturgeon, Sacramento Splittail, American Shad, and Striped Bass Project operation would result in slightly improved flow and water temperature conditions in the upper Sacramento River for steelhead, green sturgeon, Sacramento splittail, American shad, and striped bass. This impact would be less than significant.

This impact would be similar to Impact Aqua-13 (CP1). The impact could be greater because the increased reservoir capacity associated with a 12.5-foot raise compared to a 6.5-foot raise would allow additional water volume (and flows) to be stored behind the raised dam.

Flow-Related Effects Similar to CP1, monthly mean flows at all model locations (i.e., below Shasta Dam, below Keswick Dam, above Bend Bridge, and above RBDD) within the upper Sacramento River under CP2 would be essentially equivalent (less than 2 percent difference) to flows under the Existing Condition and No-Action Alternative simulated for all months (see the *Hydrology, Hydraulics, and Water Management Technical Report* for complete modeling results). Potential flow-related effects on fish species of management

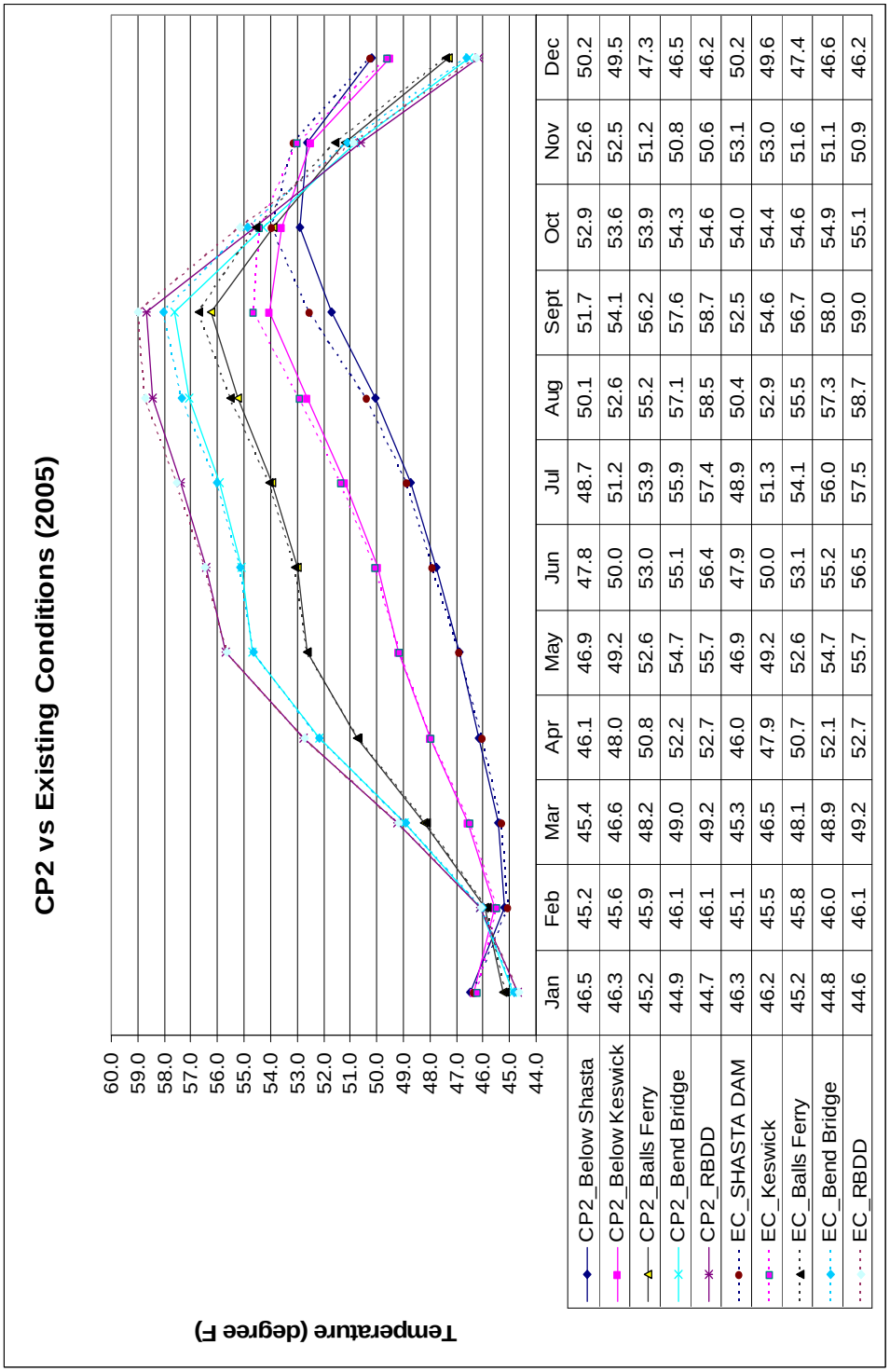
concern in the upper Sacramento River from this alternative would be minimal. All potential changes in flows and stages would diminish rapidly downstream from RBDD because of the increasing effect of inflows from tributaries and of diversions and flood bypasses.

There would be no discernable flow-related effects on steelhead, green sturgeon, Sacramento splittail, American shad, or striped bass in the upper Sacramento River related to changes in monthly mean flows under CP2, relative to the Existing Condition and No-Action Alternative. Functional flows for migration, attraction, spawning, egg incubation, and rearing/emigration for all these fish species would be unchanged. Therefore, flow-related impacts on these fish species would be less than significant.

Water Temperature-Related Effects Similar to CP1, monthly mean water temperatures at all model locations (i.e., below Shasta Dam, below Keswick Dam, above Bend Bridge, and above RBDD) within the upper Sacramento River under CP2 would be the same or fractionally less than those under the Existing Condition and No-Action Alternative simulated for all months (Figures 11-16 and 11-17) (see the *Hydrology, Hydraulics, and Water Management Technical Report* for complete modeling results). As discussed above, the modeling simulations may not fully account for real-time management of the cold-water pool and TCD (through the SRTTG) to achieve maximum cold-water benefits. Therefore, the modeled changes in water temperature (i.e., small benefits) are likely conservative and understated to some varying degree. Nevertheless, potential water temperature-related effects on fish species of management concern in the upper Sacramento River from CP2 would be minimal. During most years, releases from Shasta Lake would be unchanged.

Overall, the greatest cooling effect (less than 1°F) would occur during critical years and during the late summer (i.e., July through September), because of the increased cold-water pool volume within Shasta Lake, even following an extended dry period. All potential changes in flows and stages would diminish downstream from RBDD because of increasing effect of inflows from tributaries and of diversions and flood bypasses.

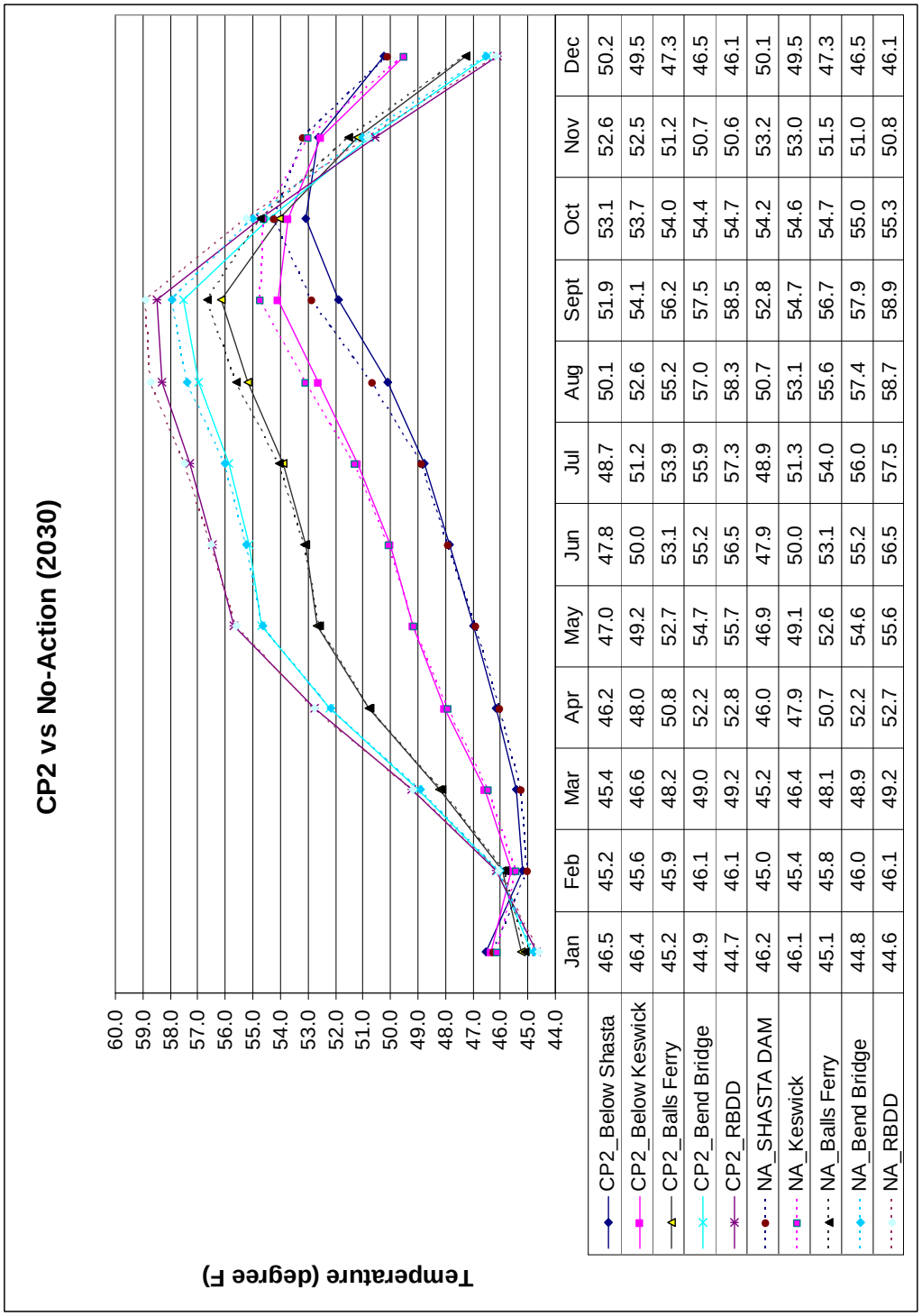
There would be very small water temperature-related effects on steelhead, green sturgeon, Sacramento splittail, American shad, or striped bass in the upper Sacramento River related to slightly cooler monthly mean water temperatures under CP2, relative to the Existing Condition and the No-Action Alternative. Mean monthly water temperatures would not rise above important thermal tolerances for the species life stages relevant to the upper Sacramento River. Therefore, water temperature-related effects on these fish species would be less than significant. Mitigation for this impact is not needed, and thus not proposed.



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
CP2_Below Shasta	46.5	45.2	45.4	46.1	46.9	47.8	48.7	50.1	51.7	52.9	52.6	50.2
CP2_Below Keswick	46.3	45.6	46.6	48.0	49.2	50.0	51.2	52.6	54.1	53.6	52.5	49.5
CP2_Balls Ferry	45.2	45.9	48.2	50.8	52.6	53.0	53.9	55.2	56.2	53.9	51.2	47.3
CP2_Bend Bridge	44.9	46.1	49.0	52.2	54.7	55.1	55.9	57.1	57.6	54.3	50.8	46.5
CP2_RBDD	44.7	46.1	49.2	52.7	55.7	56.4	57.4	58.5	58.7	54.6	50.6	46.2
EC_SHASTA DAM	46.3	45.1	45.3	46.0	46.9	47.9	48.9	50.4	52.5	54.0	53.1	50.2
EC_Keswick	46.2	45.5	46.5	47.9	49.2	50.0	51.3	52.9	54.6	54.4	53.0	49.6
EC_Balls Ferry	45.2	45.8	48.1	50.7	52.6	53.1	54.1	55.5	56.7	54.6	51.6	47.4
EC_Bend Bridge	44.8	46.0	48.9	52.1	54.7	55.2	56.0	57.3	58.0	54.9	51.1	46.6
EC_RBDD	44.6	46.1	49.2	52.7	55.7	56.5	57.5	58.7	59.0	55.1	50.9	46.2

Key:
CP = Comprehensive Plan
EC = Existing condition
RBDD = Red Bluff Diversion Dam

Figure 11-16. Changes in Mean Monthly Water Temperature at Modeled Locations in the Sacramento River Within the Primary Study Area (Existing Condition)



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
CP2_Below Shasta	46.5	45.2	45.4	46.2	47.0	47.8	48.7	50.1	51.9	53.1	52.6	50.2
CP2_Below Keswick	46.4	45.6	46.6	48.0	49.2	50.0	51.2	52.6	54.1	53.7	52.5	49.5
CP2_Balls Ferry	45.2	45.9	48.2	50.8	52.7	53.1	53.9	55.2	56.2	54.0	51.2	47.3
CP2_Bend Bridge	44.9	46.1	49.0	52.2	54.7	55.2	55.9	57.0	57.5	54.4	50.7	46.5
CP2_RBDD	44.7	46.1	49.2	52.8	55.7	56.5	57.3	58.3	58.5	54.7	50.6	46.1
NA_SHASTA DAM	46.2	45.0	45.2	46.0	46.9	47.9	48.9	50.7	52.8	54.2	53.2	50.1
NA_Keswick	46.1	45.4	46.4	47.9	49.1	50.0	51.3	53.1	54.7	54.6	53.0	49.5
NA_Balls Ferry	45.1	45.8	48.1	50.7	52.6	53.1	54.0	55.6	56.7	54.7	51.5	47.3
NA_Bend Bridge	44.8	46.0	48.9	52.2	54.6	55.2	56.0	57.4	57.9	55.0	51.0	46.5
NA_RBDD	44.6	46.1	49.2	52.7	55.6	56.5	57.5	58.7	58.9	55.3	50.8	46.1

Key:
CP = Comprehensive Plan
EC = Existing condition
RBDD = Red Bluff Diversion Dam

Figure 11-17. Changes in Mean Monthly Water Temperature at Modeled Locations in the Sacramento River Within the Primary Study Area (No-Action Alternative)

Impact Aqua-14 (CP2): Reduction in Ecologically Important Geomorphic Processes in the Upper Sacramento River Resulting from Reduced Frequency and Magnitude of Intermediate to High Flows CP2 operations could result in reduced intermediate to large flows that are necessary for channel forming and maintenance, meander migration, and creation of seasonally inundated floodplains, all of which are processes necessary for the maintenance of important aquatic habitat functions and values for the fish and macroinvertebrate community. A reduction in these ecologically important geomorphic processes and related aquatic habitat functions and values in the Sacramento River and lowermost (confluence) areas of tributaries would be a potentially significant impact.

This impact would be similar to Impact Aqua-14 (CP1). The impact could be greater because the increased reservoir capacity associated with a 12.5-foot raise compared to a 6.5-foot raise would allow for additional water volume (and flows) to be stored behind the raised dam. Sediment transport, deposition, and scour regulate the formation of key habitat features such as point bars, gravel deposits, and SRA habitat. Intermediate to high flows and associated stage elevation of water surface also provide a backwater effect on the lowermost segment of tributaries, which reduces the potential for downcutting. These processes are regulated by the magnitude and frequency of flow, with relatively large floods providing the energy required to mobilize sediment from the river bed, produce meander migration, increase stage elevation, and create seasonally inundated floodplains. CP2 operations could result in reduced intermediate to large flows that are necessary for channel forming and maintenance, meander migration, and creation of seasonally inundated floodplains.

CP2 would lead to a further reduction in the magnitude, duration, and frequency of intermediate to large flows. Overall, the project would increase the existing, ongoing impacts on geomorphic processes resulting from the operation of Shasta Dam that are necessary for channel forming and maintenance, meander migration, and creation of seasonally inundated floodplains.

These impacts would likely occur along the upper Sacramento River, downstream from Shasta Dam, throughout the primary study area. Reductions in the magnitude of high flows would likely be sufficient to reduce ecologically important processes along the upper Sacramento River, downstream from Shasta Dam, throughout the primary study area. These impacts would be potentially significant within the primary study area. Mitigation for this impact is proposed in Section 11.3.4.

Lower Sacramento River and Delta

Impact Aqua-15 (CP2): Changes in Flow and Water Temperatures in the Lower Sacramento River and Tributaries and Trinity River Resulting from Project Operation – Fish Species of Primary Management Concern Project operation would result in no discernable change in mean monthly flow or water temperature conditions in the lower Sacramento River; however, predicted

changes in flow in the Feather River, American River, and Trinity River could result in an adverse effect on Chinook salmon, steelhead, coho salmon, green sturgeon, Sacramento splittail, American shad, and striped bass if they were to occur. This impact would be potentially significant.

This impact would be similar to Impact Aqua-15 (CP1). The impact could be greater because the increased reservoir capacity associated with a 12.5-foot raise compared to a 6.5-foot raise would allow additional water volume (and increased cold-water pool) to be stored behind the raised dam.

Similar to CP1, monthly mean flows at model locations (i.e., Verona, Freeport) within the lower Sacramento River under CP2 would be essentially equivalent (less than 2 percent difference) to flows under the Existing Condition and No-Action Alternative conditions simulated for all months (see the *Hydrology, Hydraulics, and Water Management Technical Report* for complete modeling results). All potential changes in flows diminish rapidly downstream from RBDD because of the increasing effect of inflows from tributaries and of diversions and flood bypasses. Potential flow-related effects on fish species of management concern in the lower Sacramento River from this alternative would be minimal. Differences in mean monthly flow are generally small (less than 2 percent) and within the existing range of variability. All potential changes in water temperatures in the lower Sacramento River due to small changes in releases would diminish rapidly downstream because of increasing effect of inflows, atmospheric influences, and groundwater. Therefore, flow- and temperature-related impacts on fish species in the lower Sacramento River would be less than significant.

Also similar to CP1, monthly mean flows at all model locations within the lower Feather River, the American River, and Trinity River under CP2 would be essentially equivalent (less than 2 percent difference) to flows under the Existing Condition and No-Action Alternative simulated for most months; however, there are several months within the modeling record that show substantial changes (based on model simulations) to flows in tributaries (see the *Hydrology, Hydraulics, and Water Management Technical Report* for complete CalSim-II modeling results). All potential changes in flows could be diminished in these areas per existing operational rules and because of operation of upstream reservoirs (i.e., Lake Oroville, Folsom Lake, and Trinity Lake) and increasing effects of inflows from tributaries and of diversions and flood bypasses. Nevertheless, based on predicted changes in flow and associated flow-habitat relationships, potential flow-related impacts on species of management concern in the American, Feather, and Trinity rivers could occur and would be a potentially significant impact.

All potential changes in water temperatures in the lower Sacramento River and primary tributaries (i.e., Feather River and American River) due to altered releases from reservoirs diminished downstream because of the increasing effect of inflows, and atmospheric and groundwater influences.

As under CP1, effects of altered flow regimes resulting from implementation of CP2 are unlikely to extend into the lower Sacramento River and Delta because the Central Valley's reservoirs and diversions are managed as a single integrated system (consisting of the SWP and the CVP). The guidelines for this management, which are described in the CVP/SWP OCAP, have been designed to maintain standards for flow to the lower Sacramento River and Delta. CVP and SWP operations must be consistent with the OCAP to allow coverage by the OCAP permits and BOs. Thus, under CP2, this project is not anticipated to cause an alteration in flow to the Delta nor cause an alteration to water temperatures in the lower Sacramento River and primary tributaries within the extended study area sufficient to cause discernable effects on Chinook salmon, steelhead, green sturgeon, Sacramento splittail, American shad or striped bass relative to the Existing Condition and No-Action Alternative. Functional flows for fish migration, attraction, spawning, egg incubation, and rearing/emigration for all these fish species would be unchanged. Therefore, flow- and temperature-related effects on these fish species would be less than significant. Mitigation for this impact is proposed in Section 11.3.4.

Impact Aqua-16 (CP2): Reduction in Ecologically Important Geomorphic Processes in the Lower Sacramento River Resulting from Reduced Frequency and Magnitude of Intermediate to High Flows CP2 operation could result in reduced intermediate to large flows that are necessary for channel forming and maintenance, meander migration, and the creation of seasonally inundated floodplains, all of which are processes necessary for the maintenance of important aquatic habitat functions and values for the fish and macroinvertebrate community. A reduction in these ecologically important geomorphic processes and related aquatic habitat functions and values in the lower Sacramento River and lowermost (confluence) areas of tributaries) would be a potentially significant impact.

This impact would be similar to Impact Aqua-16 (CP1). The impact could be greater because the increased reservoir capacity associated with a 12.5-foot raise compared to a 6.5-foot raise would allow for additional water volume (and flows) to be stored behind the raised dam. Sediment transport, deposition, and scour regulate the formation of key habitat features such as point bars, gravel deposits, and SRA habitat. Intermediate to high flows and associated stage elevation of water surface also provide a backwater effect on the lowermost segment of tributaries, which reduces the potential for downcutting. These processes are regulated by the magnitude and frequency of flow, with relatively large floods providing the energy required to mobilize sediment from the bed, produce meander migration, increase stage elevation, create seasonally inundated floodplains, and inundate floodplain bypasses. Project operation could result in reduced intermediate to large flows that are necessary for channel forming and maintenance, meander migration, and the creation of seasonally inundated floodplains.

CP2 would lead to a further reduction in the magnitude, duration, and frequency of intermediate to large flows, relative to the Existing Condition and No-Action Alternative. Overall, the project would increase the existing, ongoing impacts on geomorphic processes resulting from operation of Shasta Dam that are necessary for channel forming and maintenance, meander migration, the creation of seasonally inundated floodplains, and the inundation of floodplain bypasses. These impacts would likely occur along the upper reaches of the lower Sacramento River. Reductions in the magnitude of high flows would likely be sufficient to reduce ecologically important processes along the upper Sacramento River and its floodplain bypasses. These impacts would be potentially significant. Mitigation for this impact is proposed in Section 11.3.4.

Impact Aqua-17 (CP2): Effects to Delta Fishery Habitat Resulting from Changes to Delta Outflow Based on results of hydrologic modeling comparing Delta outflow under the No-Action Alternative, Existing Condition, and CP2, CP2 would have a less than significant effect on Delta fisheries and hydrologic transport processed within the Bay-Delta.

Results of the comparison of Delta outflows between CP2 and the Existing Condition and No-Action Alternative are summarized by month and water-year type in Table 11-23. The comparison includes the estimated average monthly outflow under the basis-of-comparison conditions, the average monthly flow under CP2, and the percentage change between base flows and CP2 operations. Results of the analysis (Table 11-23) showed that Delta outflows were observed to be slightly lower under many of the CP2 operations as well as slightly higher than basis-of-comparison conditions, depending on month and water-year type. However, none of the changes were larger than 5 percent. Based on the results of this comparison of CP2, it was concluded that CP2 would have a less than significant effect on Delta fisheries and hydrologic transport processed within the Bay-Delta relative to the No-Action Alternative and Existing Condition. Based on results of this analysis, it was concluded that CP2 would result in a less than significant effect on fish habitat as a consequence of changes in Delta outflow relative to the Existing Condition. Mitigation for this impact is not needed, and thus not proposed.

Table 11-23. Delta Outflow Under Existing Conditions, No-Action Alternative, and CP2

		Existing Condition	CP2 (Existing Condition)		No-Action Alternative	CP2 (Future Condition)	
Month	**Water Year**	**Base Flow (cfs)**	**Flow (cfs)**	**Percent Change**	**Base Flow (cfs)**	**Flow (cfs)**	**Percent Change**
January	Average	40,954	40,634	-0.8	40,167	39,981	-0.5
	W	84,978	84,587	-0.5	83,595	83,446	-0.2
	AN	47,101	46,386	-1.5	46,322	45,596	-1.6
	BN	19,833	19,855	0.1	19,369	19,409	0.2
	D	11,374	11,023	-3.1	10,881	10,631	-2.3
	C	8,434	8,308	-1.5	8,111	8,219	1.3
February	Average	52,699	52,162	-1.0	52,341	51,984	-0.7
	W	98,900	98,153	-0.8	98,330	97,729	-0.6
	AN	61,653	60,663	-1.6	60,800	60,056	-1.2
	BN	35,173	35,099	-0.2	35,441	35,064	-1.1
	D	20,356	19,700	-3.2	19,894	20,172	1.4
	C	12,605	12,612	0.1	12,628	12,259	-2.9
March	Average	42,610	42,408	-0.5	42,117	41,994	-0.3
	W	79,254	79,245	0.0	78,370	78,416	0.1
	AN	53,361	52,855	-0.9	52,361	52,025	-0.6
	BN	23,126	22,952	-0.8	23,136	23,101	-0.2
	D	18,943	18,511	-2.3	18,596	18,233	-2.0
	C	10,697	10,696	0.0	10,749	10,735	-0.1
April	Average	27,104	27,073	-0.1	27,096	27,037	-0.2
	W	49,818	49,771	-0.1	49,806	49,740	-0.1
	AN	27,420	27,347	-0.3	27,778	27,479	-1.1
	BN	19,001	19,032	0.2	18,938	18,908	-0.2
	D	12,735	12,665	-0.6	12,516	12,543	0.2
	C	8,586	8,611	0.3	8,600	8,633	0.4
May	Average	20,470	20,414	-0.3	20,288	20,183	-0.5
	W	37,736	37,678	-0.2	37,173	37,133	-0.1
	AN	22,276	21,908	-1.7	22,205	21,699	-2.3
	BN	14,200	14,224	0.2	14,080	13,948	-0.9
	D	9,422	9,476	0.6	9,436	9,459	0.2
	C	5,141	5,141	0.0	5,306	5,303	-0.1

Table 11-23. Delta Outflow Under Existing Conditions, No-Action Alternative, and CP2 (contd.)

		Existing Condition	CP2 (Existing Condition)		No-Action Alternative	CP2 (Future Condition)	
Month	**Water Year**	**Base Flow (cfs)**	**Flow (cfs)**	**Percent Change**	**Base Flow (cfs)**	**Flow (cfs)**	**Percent Change**
June	Average	13,104	13,063	-0.3	13,055	13,071	0.1
	W	23,675	23,683	0.0	23,303	23,344	0.2
	AN	12,563	12,414	-1.2	12,587	12,591	0.0
	BN	8,735	8,585	-1.7	9,027	8,746	-3.1
	D	6,611	6,674	1.0	6,656	6,840	2.8
	C	5,580	5,510	-1.2	5,615	5,684	1.2
July	Average	7,927	7,956	0.4	8,291	8,309	0.2
	W	11,228	11,239	0.1	11,501	11,489	-0.1
	AN	9,085	9,168	0.9	10,040	10,093	0.5
	BN	7,314	7,387	1.0	7,897	7,934	0.5
	D	5,330	5,362	0.6	5,477	5,554	1.4
	C	4,229	4,186	-1.0	4,271	4,206	-1.5
August	Average	4,501	4,548	1.0	4,458	4,475	0.4
	W	5,233	5,223	-0.2	4,961	4,955	-0.1
	AN	4,000	4,000	0.0	4,039	4,037	0.0
	BN	4,000	4,000	0.0	4,144	4,153	0.2
	D	4,491	4,670	4.0	4,547	4,580	0.7
	C	4,017	4,090	1.8	4,017	4,093	1.9
September	Average	5,595	5,566	-0.5	5,262	5,271	0.2
	W	10,498	10,471	-0.3	9,510	9,469	-0.4
	AN	3,781	3,765	-0.4	3,464	3,501	1.1
	BN	3,516	3,436	-2.3	3,405	3,424	0.6
	D	3,050	3,047	-0.1	3,277	3,325	1.5
	C	3,025	3,000	-0.8	3,000	3,016	0.5
October	Average	5,313	5,284	-0.5	5,023	5,016	-0.1
	W	7,040	6,976	-0.9	6,464	6,430	-0.5
	AN	4,540	4,544	0.1	4,335	4,253	-1.9
	BN	4,624	4,589	-0.8	4,427	4,459	0.7
	D	4,388	4,376	-0.3	4,257	4,273	0.4
	C	4,534	4,528	-0.1	4,434	4,480	1.1
November	Average	9,688	9,528	-1.7	9,238	9,168	-0.7
	W	15,113	15,048	-0.4	14,412	14,308	-0.7
	AN	11,060	10,463	-5.4	10,265	10,008	-2.5
	BN	6,529	6,240	-4.4	6,248	6,151	-1.6
	D	6,755	6,703	-0.8	6,474	6,553	1.2
	C	4,648	4,707	1.3	4,631	4,637	0.1

Table 11-23. Delta Outflow Under Existing Conditions, No-Action Alternative, and CP2 (contd.)

		Existing Condition	CP2 (Existing Condition)		No-Action Alternative	CP2 (Future Condition)	
Month	**Water Year**	**Base Flow (cfs)**	**Flow (cfs)**	**Percent Change**	**Base Flow (cfs)**	**Flow (cfs)**	**Percent Change**
December	Average	22,933	22,670	-1.1	22,289	22,005	-1.3
	W	47,953	47,211	-1.5	46,800	46,141	-1.4
	AN	18,119	17,944	-1.0	17,859	17,467	-2.2
	BN	13,712	13,547	-1.2	12,890	12,565	-2.5
	D	8,645	8,700	0.6	8,366	8,452	1.0
	C	5,728	5,823	1.6	5,460	5,593	2.4

Key:
AN = above-normal
BN = below-normal
C = critical
cfs = cubic feet per second
CP = Comprehensive Plan
D = dry
W = wet

Impact Aqua-18 (CP2): Effects to Delta Fishery Habitat Resulting from Changes to Delta Inflow Changes in upstream reservoir storage have the potential to affect Delta inflow. Delta inflow may affect hydrologic conditions within Delta channels, hydraulic residence times, salinity gradients, and the transport and movement of various life stages of fish, invertebrates, phytoplankton, and nutrients into and through the Delta. Delta inflow serves as a surrogate metric for a variety of habitat conditions within the Delta that directly, or indirectly, affects fish and other aquatic resources. Based on the results of hydrologic modeling comparing Delta inflow under CP2 to the Existing Condition and No-Action Alternative, CP2 would have a less than significant impact on Delta fisheries and hydrologic transport processed within the Bay-Delta.

Results of the comparison of Delta inflows between the No-Action Alternative, Existing Condition, and CP2 are summarized by month and water-year type in Table 11-24. The comparison includes the estimated average monthly inflow under the basis-of-comparison conditions, the average monthly flow under CP2, and the percentage change between base flows and CP2 operations. Delta inflows were observed to be slightly lower under many of the CP2 operations and slightly higher than basis-of-comparison conditions, depending on month and water-year type. None of the comparisons between the basis-of-comparison conditions and CP2 exceeded 5 percent. Based on the results of this comparison of CP2, it was concluded that CP2 would have a less than significant effect on Delta fisheries and hydrologic transport processed within the Bay-Delta as a consequence of changes in Delta inflow. Mitigation for this impact is not needed, and thus not proposed.

Table 11-24. Delta Inflow Under Existing Conditions, No-Action Alternative, and CP2

		Existing Condition	CP2 (Existing Condition)		No-Action Alternative	CP2 (Future Condition)	
Month	**Water Year**	**Base Flow (cfs)**	**Flow (cfs)**	**Percent Change**	**Base Flow (cfs)**	**Flow (cfs)**	**Percent Change**
January	Average	50,193	49,933	-0.5	49,674	49,461	-0.4
	W	93,590	93,236	-0.4	92,710	92,583	-0.1
	AN	56,641	55,947	-1.2	55,935	55,123	-1.5
	BN	30,176	30,205	0.1	29,939	29,949	0.0
	D	21,201	20,957	-1.1	20,927	20,675	-1.2
	C	16,560	16,574	0.1	16,312	16,308	0.0
February	Average	61,147	60,789	-0.6	60,691	60,472	-0.4
	W	108,058	107,441	-0.6	107,699	107,165	-0.5
	AN	70,137	69,377	-1.1	69,901	69,139	-1.1
	BN	44,310	44,371	0.1	43,831	43,585	-0.6
	D	28,791	28,161	-2.2	28,157	28,233	0.3
	C	18,694	19,218	2.8	18,099	18,695	3.3
March	Average	50,938	50,803	-0.3	50,576	50,415	-0.3
	W	88,045	88,068	0.0	87,612	87,628	0.0
	AN	63,252	62,650	-1.0	62,667	62,144	-0.8
	BN	32,287	32,258	-0.1	31,760	31,795	0.1
	D	26,931	26,713	-0.8	26,504	26,096	-1.5
	C	15,999	15,982	-0.1	16,299	16,264	-0.2
April	Average	33,715	33,671	-0.1	33,832	33,810	-0.1
	W	57,897	57,853	-0.1	58,185	58,145	-0.1
	AN	35,063	34,901	-0.5	35,403	35,134	-0.8
	BN	26,022	26,046	0.1	25,955	25,916	-0.2
	D	17,991	17,917	-0.4	17,853	17,997	0.8
	C	12,534	12,573	0.3	12,653	12,687	0.3
May	Average	27,783	27,728	-0.2	27,762	27,656	-0.4
	W	47,155	47,090	-0.1	46,817	46,778	-0.1
	AN	30,016	29,595	-1.4	30,446	29,847	-2.0
	BN	21,135	21,177	0.2	21,177	21,092	-0.4
	D	15,555	15,623	0.4	15,529	15,576	0.3
	C	9,671	9,708	0.4	9,827	9,814	-0.1
June	Average	23,254	23,311	0.2	23,559	23,622	0.3
	W	35,726	35,776	0.1	35,503	35,570	0.2
	AN	23,868	23,801	-0.3	24,400	24,356	-0.2
	BN	18,814	18,664	-0.8	20,111	19,855	-1.3
	D	15,726	15,957	1.5	15,789	16,224	2.8
	C	12,089	12,269	1.5	12,516	12,494	-0.2

Table 11-24. Delta Inflow Under Existing Conditions, No-Action Alternative, and CP2 (contd.)

		Existing Condition	CP2 (Existing Condition)		No-Action Alternative	CP2 (Future Condition)	
Month	**Water Year**	**Base Flow (cfs)**	**Flow (cfs)**	**Percent Change**	**Base Flow (cfs)**	**Flow (cfs)**	**Percent Change**
July	Average	18,889	19,194	1.6	20,470	20,666	1.0
	W	23,568	23,703	0.6	24,661	24,781	0.5
	AN	19,796	20,002	1.0	22,429	22,639	0.9
	BN	18,549	18,996	2.4	21,709	21,636	-0.3
	D	16,344	16,808	2.8	17,176	17,913	4.3
	C	12,058	12,424	3.0	12,928	12,775	-1.2
August	Average	18,889	19,194	1.6	16,281	16,369	0.5
	W	23,568	23,703	0.6	17,995	18,005	0.1
	AN	19,796	20,002	1.0	17,543	17,643	0.6
	BN	18,549	18,996	2.4	17,273	17,288	0.1
	D	16,344	16,808	2.8	15,167	15,509	2.3
	C	12,058	12,424	3.0	11,816	11,768	-0.4
September	Average	16,480	16,485	0.0	16,625	16,739	0.7
	W	23,176	23,169	0.0	22,459	22,423	-0.2
	AN	15,742	15,740	0.0	15,814	15,921	0.7
	BN	14,961	14,802	-1.1	15,198	15,304	0.7
	D	12,749	12,849	0.8	14,118	14,445	2.3
	C	10,076	10,164	0.9	10,220	10,353	1.3
October	Average	15,542	15,509	-0.2	14,833	14,873	0.3
	W	18,176	18,141	-0.2	17,270	17,338	0.4
	AN	14,399	14,232	-1.2	13,708	13,584	-0.9
	BN	15,010	15,008	0.0	14,436	14,456	0.1
	D	13,980	14,029	0.4	13,490	13,556	0.5
	C	13,942	13,889	-0.4	13,153	13,283	1.0
November	Average	19,409	19,379	-0.2	19,043	19,038	0.0
	W	26,007	25,956	-0.2	25,720	25,576	-0.6
	AN	20,432	19,929	-2.5	19,604	19,488	-0.6
	BN	16,833	16,666	-1.0	16,510	16,439	-0.4
	D	15,836	16,001	1.0	15,453	15,692	1.6
	C	12,458	12,809	2.8	12,354	12,474	1.0
December	Average	33,195	32,980	-0.7	32,657	32,419	-0.7
	W	58,863	58,111	-1.3	58,092	57,412	-1.2
	AN	28,400	28,483	0.3	28,098	27,869	-0.8
	BN	23,545	23,371	-0.7	22,831	22,491	-1.5
	D	19,116	19,184	0.4	19,010	19,024	0.1
	C	14,756	14,928	1.2	14,041	14,492	3.2

Key:
AN = above-normal
BN = below-normal
C = critical
cfs = cubic feet per second
CP = Comprehensive Plan
D = dry
W = wet

Impact Aqua-19 (CP2): Effects to Delta Fisheries Resulting from Changes in Sacramento River Inflow CP2 operation would result in a variable response in Sacramento River flow, resulting in both increases and decreases in river flow above basis-of-comparison conditions depending on month and water-year type. This impact would be less than significant.

Results of hydrologic modeling, by month and water-year type, comparing Sacramento River flow under CP2 relative to the Existing Condition and No-Action Alternative are presented in Table 11-25. Results of these analyses show a variable response in Sacramento River flow with CP2 operations resulting in both increases and decreases in river flow above basis-of-comparison conditions depending on month and water-year types. All comparisons between the basis-of-comparison and CP2 operations were less than 5 percent. Based on these results it was concluded that the impact of CP2 on fish habitat and transport mechanisms within the lower Sacramento River and Delta would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Table 11-25. Sacramento River Inflow Under Existing Conditions, No-Action Alternative, and CP2

		Existing Condition	CP2 (Existing Condition)		No-Action Alternative	CP2 (Future Condition)	
Month	**Water Year**	**Base Flow (cfs)**	**Flow (cfs)**	**Percent Change**	**Base Flow (cfs)**	**Flow (cfs)**	**Percent Change**
January	Average	34,680	34,513	-0.5	34,363	34,237	-0.4
	W	56,231	56,092	-0.2	55,714	55,732	0.0
	AN	44,117	43,587	-1.2	44,049	43,514	-1.2
	BN	25,272	25,302	0.1	25,024	25,034	0.0
	D	18,166	17,926	-1.3	17,888	17,635	-1.4
	C	14,298	14,312	0.1	14,028	14,027	0.0
February	Average	40,650	40,452	-0.5	40,345	40,274	-0.2
	W	61,746	61,636	-0.2	61,676	61,609	-0.1
	AN	51,527	50,768	-1.5	51,346	50,582	-1.5
	BN	34,676	34,725	0.1	34,309	34,064	-0.7
	D	24,116	23,492	-2.6	23,562	23,639	0.3
	C	15,834	16,358	3.3	15,345	15,941	3.9
March	Average	35,093	34,987	-0.3	35,018	34,901	-0.3
	W	52,808	52,864	0.1	52,720	52,735	0.0
	AN	47,679	47,124	-1.2	47,821	47,495	-0.7
	BN	25,629	25,588	-0.2	25,210	25,244	0.1
	D	22,908	22,758	-0.7	22,615	22,277	-1.5
	C	13,443	13,426	-0.1	13,907	13,872	-0.3
April	Average	24,190	24,157	-0.1	24,317	24,301	-0.1
	W	39,645	39,635	0.0	39,901	39,883	0.0
	AN	26,322	26,161	-0.6	26,721	26,452	-1.0
	BN	18,746	18,769	0.1	18,673	18,633	-0.2
	D	13,900	13,826	-0.5	13,782	13,926	1.0
	C	10,362	10,401	0.4	10,534	10,567	0.3

Table 11-25. Sacramento River Inflow Under Existing Conditions, No-Action Alternative, and CP2 (contd.)

		Existing Condition	CP2 (Existing Condition)		No-Action Alternative	CP2 (Future Condition)	
Month	**Water Year**	**Base Flow (cfs)**	**Flow (cfs)**	**Percent Change**	**Base Flow (cfs)**	**Flow (cfs)**	**Percent Change**
May	Average	20,098	20,043	-0.3	20,119	20,013	-0.5
	W	32,904	32,839	-0.2	32,639	32,601	-0.1
	AN	22,928	22,507	-1.8	23,355	22,757	-2.6
	BN	14,923	14,965	0.3	14,997	14,912	-0.6
	D	12,055	12,123	0.6	12,060	12,105	0.4
	C	7,622	7,660	0.5	7,821	7,808	-0.2
June	Average	17,718	17,776	0.3	18,092	18,155	0.3
	W	24,331	24,382	0.2	24,141	24,209	0.3
	AN	17,986	17,918	-0.4	18,678	18,634	-0.2
	BN	15,806	15,657	-0.9	17,160	16,904	-1.5
	D	14,015	14,245	1.6	14,146	14,579	3.1
	C	10,907	11,086	1.6	11,406	11,383	-0.2
July	Average	15,270	15,574	2.0	16,870	17,064	1.2
	W	16,088	16,222	0.8	17,160	17,278	0.7
	AN	16,682	16,888	1.2	19,335	19,545	1.1
	BN	16,500	16,946	2.7	19,698	19,625	-0.4
	D	14,988	15,450	3.1	15,871	16,605	4.6
	C	11,077	11,442	3.3	11,974	11,821	-1.3
August	Average	12,649	12,921	2.1	13,790	13,878	0.6
	W	13,724	13,684	-0.3	13,840	13,850	0.1
	AN	12,721	12,965	1.9	15,183	15,284	0.7
	BN	12,319	12,656	2.7	15,145	15,160	0.1
	D	13,162	13,811	4.9	13,769	14,108	2.5
	C	9,865	10,198	3.4	10,738	10,690	-0.4
September	Average	13,697	13,701	0.0	13,863	13,977	0.8
	W	18,936	18,929	0.0	18,242	18,207	-0.2
	AN	13,088	13,087	0.0	13,160	13,267	0.8
	BN	12,543	12,384	-1.3	12,817	12,923	0.8
	D	10,847	10,946	0.9	12,238	12,564	2.7
	C	8,577	8,660	1.0	8,737	8,870	1.5
October	Average	12,719	12,738	0.1	12,068	12,109	0.3
	W	14,766	14,896	0.9	14,040	14,112	0.5
	AN	12,049	11,879	-1.4	11,379	11,255	-1.1
	BN	12,322	12,321	0.0	11,758	11,777	0.2
	D	11,249	11,298	0.4	10,747	10,812	0.6
	C	11,619	11,566	-0.5	10,823	10,952	1.2
November	Average	15,858	15,828	-0.2	15,501	15,501	0.0
	W	21,159	21,110	-0.2	20,878	20,732	-0.7
	AN	17,210	16,710	-2.9	16,355	16,271	-0.5
	BN	13,687	13,523	-1.2	13,377	13,310	-0.5
	D	12,805	12,970	1.3	12,475	12,715	1.9
	C	10,129	10,479	3.5	10,012	10,131	1.2

Table 11-25. Sacramento River Inflow Under Existing Conditions, No-Action Alternative, and CP2 (contd.)

		Existing Condition	CP2 (Existing Condition)		No-Action Alternative	CP2 (Future Condition)	
Month	**Water Year**	**Base Flow (cfs)**	**Flow (cfs)**	**Percent Change**	**Base Flow (cfs)**	**Flow (cfs)**	**Percent Change**
December	Average	26,148	26,031	-0.4	25,710	25,571	-0.5
	W	44,908	44,475	-1.0	44,459	43,996	-1.0
	AN	22,225	22,290	0.3	21,941	21,901	-0.2
	BN	19,129	18,955	-0.9	18,434	18,094	-1.8
	D	16,164	16,236	0.4	16,042	16,066	0.1
	C	12,587	12,759	1.4	11,848	12,300	3.8

Key:
AN = above-normal
BN = below-normal
C = critical
cfs = cubic feet per second
CP = Comprehensive Plan
D = dry
W = wet

Impact Aqua-20 (CP2): Effects to Delta Fisheries Resulting from Changes in San Joaquin River Flow at Vernalis Project operation would result in no discernable change in San Joaquin River flows at Vernalis, and therefore no impact to Delta fisheries or transport mechanisms within the lower San Joaquin River and Delta would occur under CP2 relative to the No-Action Alternative or Existing Condition.

Results of the comparative analysis of model results, by month and water-year type, for basis-of-comparison conditions and CP2 for San Joaquin River flow under existing conditions are summarized in Table 11-26. Results of these analyses show that the proposed CP2 would have no effect on seasonal flows compared with Existing Conditions within the San Joaquin River. Similarly, modeling results showed that CP2 would have no effects on flows or fish habitat compared to the No-Action Alternative. Based on these results it was concluded that CP2 would have no impact on Delta fisheries or transport mechanisms within the lower San Joaquin River and Delta. Mitigation for this impact is not needed, and thus not proposed.

Table 11-26. San Joaquin River Flow at Vernalis Under Existing Conditions and CP2

		Existing Condition	CP2 (Existing Condition	
Month	**Water Year**	**Base Flow (cfs)**	**Flow (cfs)**	**Percent Change**
January	Average	4,772	4,772	0.0
	W	9,255	9,254	0.0
	AN	4,339	4,339	0.0
	BN	2,971	2,971	0.0
	D	2,084	2,084	0.0
	C	1,624	1,624	0.0
February	Average	6,434	6,433	0.0
	W	11,637	11,637	0.0
	AN	6,271	6,271	0.0
	BN	5,742	5,741	0.0
	D	2,506	2,506	0.0
	C	2,020	2,021	0.0
March	Average	6,339	6,338	0.0
	W	12,420	12,419	0.0
	AN	5,792	5,791	0.0
	BN	4,539	4,538	0.0
	D	2,372	2,372	0.0
	C	1,760	1,760	0.0
April	Average	6,006	6,006	0.0
	W	10,455	10,455	0.0
	AN	5,976	5,976	0.0
	BN	5,241	5,241	0.0
	D	3,050	3,050	0.0
	C	1,722	1,722	0.0
May	Average	6,022	6,022	0.0
	W	10,991	10,991	0.0
	AN	5,420	5,420	0.0
	BN	4,987	4,987	0.0
	D	2,895	2,896	0.0
	C	1,752	1,752	0.0
June	Average	4,631	4,631	0.00
	W	9,577	9,576	0.00
	AN	4,946	4,946	0.00
	BN	2,320	2,321	0.00
	D	1,478	1,480	0.10
	C	1,022	1,022	0.10
July	Average	3,221	3,222	0.00
	W	6,646	6,646	0.00
	AN	2,779	2,779	0.00
	BN	1,755	1,755	0.00
	D	1,260	1,261	0.00
	C	895	896	0.00
August	Average	2,113	2,114	0.00
	W	3,350	3,350	0.00
	AN	2,010	2,010	0.00
	BN	1,827	1,827	0.00
	D	1,347	1,348	0.10
	C	1,021	1,022	0.10

Table 11-26. San Joaquin River Flow at Vernalis Under Existing Conditions and CP2 (contd.)

		Existing Condition	CP2 (Existing Condition	
Month	**Water Year**	**Base Flow (cfs)**	**Flow (cfs)**	**Percent Change**
September	Average	2,366	2,366	0.00
	W	3,433	3,434	0.00
	AN	2,293	2,293	0.00
	BN	2,077	2,077	0.00
	D	1,764	1,764	0.00
	C	1,368	1,368	0.00
October	Average	2,486	2,486	0.00
	W	2,915	2,915	0.00
	AN	2,099	2,099	0.00
	BN	2,428	2,428	0.00
	D	2,417	2,417	0.00
	C	2,113	2,113	0.00
November	Average	2,561	2,561	0.00
	W	3,311	3,311	0.00
	AN	2,104	2,104	0.00
	BN	2,334	2,334	0.00
	D	2,315	2,315	0.00
	C	2,026	2,026	0.00
December	Average	2,561	2,561	0.00
	W	3,311	3,311	0.00
	AN	2,104	2,104	0.00
	BN	2,334	2,334	0.00
	D	2,315	2,315	0.00
	C	2,026	2,026	0.00

Key:
AN = above-normal
BN = below-normal
C = critical
cfs = cubic feet per second
CP = Comprehensive Plan
D = dry
W = wet

Impact Aqua-21 (CP2): Reduction in Low Salinity Habitat Conditions Resulting from an Upstream Shift in X2 *Location* CP2 operation would result in less than 0.5 km movement upstream or downstream from the X2 location. This impact would be less than significant.

The 1 km X2 criterion was applied to a comparison of CalSim-II results for the Existing Condition and No-Action Alternative and CP2, by month and water-year type, for February through May. Results of the comparison between Existing Condition and CP1 are summarized in Table 11-27. These results showed that changes in X2 location under CP2 were less than 1 km (all were less than 0.4 km) with both variable upstream and downstream movement of the X2 location, depending on month and water-year type. These results are consistent with model results for Delta outflow that showed a less than significant change in flows.

Table 11-27. X2 Under Existing Conditions, No-Action Alternative, and CP2

		Existing Condition	CP2 (Existing Condition)		No-Action Alternative	No-Action (Future Condition)	
Month	**Water Year**	**Base Flow (cfs)**	**Flow (cfs)**	**Percent Change**	**Base Flow (cfs)**	**Flow (cfs)**	**Percent Change**
February	Average	65	65	20.0	66	66	0.0
	W	55	55	10.0	55	55	10.0
	AN	61	61	20.0	61	61	10.0
	BN	68	68	0.0	68	68	0.0
	D	73	74	40.0	73	73	0.0
	C	77	77	10.0	77	77	10.0
March	Average	65	65	10.0	65	65	10.0
	W	56	56	0.0	56	56	0.0
	AN	60	60	10.0	60	60	10.0
	BN	68	68	0.0	68	68	0.0
	D	72	72	30.0	72	72	10.0
	C	77	77	0.0	77	77	0.0
April	Average	68	68	0.0	68	68	0.0
	W	59	59	0.0	59	59	0.0
	AN	64	64	10.0	64	64	10.0
	BN	70	70	0.0	70	70	0.0
	D	74	74	10.0	74	74	0.0
	C	78	78	0.0	78	78	0.0
May	Average	71	71	0.0	71	71	0.0
	W	62	62	0.0	62	62	0.0
	AN	67	67	0.0	67	67	0.0
	BN	72	72	0.0	72	72	0.0
	D	76	76	0.0	76	76	0.0
	C	83	83	0.0	82	82	0.0

Key:
AN = above-normal
BN = below-normal
C = critical
cfs = cubic feet per second
CP = Comprehensive Plan
D = dry
W = wet

Results of a comparative analysis of changes in X2 location between the Existing Condition and No-Action Alternative and CP2 conditions are summarized in Table 11-27. Results of these comparisons showed very little difference (less than 0.1 km) in the X2 location between the No-Action Alternative and CP2. Based on these results, it was concluded that CP2 would have a less than significant impact on low salinity habitat conditions within the Bay-Delta. Mitigation for this impact is not needed, and thus not proposed.

Impact Aqua-22 (CP2): Increase in Mortality of Species of Primary Management Concern as a Result of Increased Reverse Flows in the Old and Middle Rivers CP2 operation would result in an increase of reverse flows in

Old and Middle rivers. The increase in reverse flows would be expected to contribute to a small increase in the vulnerability of juvenile striped bass, threadfin shad, and other resident warm-water fish to increased salvage and potential losses. This impact would be potentially significant.

Results of the analysis showed several occurrences when reverse flows within Old and Middle rivers were greater than basis-of-comparison conditions by more than 5 percent. These events occurred typically in dry and critical water years, which would be expected as a result of greater export operations under CP2. During February (Table 11-28), operations under CP2 resulted in an increase in reverse flow greater than 5 percent during critical years. Based on results of the delta smelt analysis of the relationship between reverse flows and delta smelt salvage, the increase from approximately 4,300 cfs under the basis-of-comparison in a critical water year to approximately 4,700 cfs would not be expected to result in a significant increase in adverse effects to delta smelt. Juvenile Chinook salmon and steelhead are migrating through the Delta during February, and an increase in average monthly reverse flows of 300 to 400 cfs would be expected to increase the potential risk of increased mortality. However given the tidal volumes and hydrodynamics of the Old and Middle river region it is not expected that the change in reverse flows in February in a critical year would result in a detectable change in fish survival. The majority of juvenile Chinook salmon emigrating from the San Joaquin River typically migrate downstream later in dry years and would not be expected to occur in high numbers within Old and Middle rivers in February.

The increase in reverse flows estimated to occur under CP2 in critical water years in June and under critical, dry, and below-normal years in July exceeded 5 percent. The increased reverse flows in June of critical water years occurred at a time of the year when water temperatures in the Delta were elevated and juvenile Chinook salmon or steelhead would not be expected to occur in the area. Juvenile delta smelt may occur in the area in June; however a change in Old and Middle rivers flow of approximately 100 to 200 cfs may result in a small increase in their vulnerability to CVP and SWP salvage, but this increase is expected to be less than significant. As water temperatures increase in the Delta during June and July, the majority of delta smelt are located further downstream in Suisun Bay where temperatures are more suitable. The increase in reverse flows estimated from the modeling in June of a critical year and in July of below-normal, dry, and critical years would be expected to contribute to a small increase in the vulnerability of juvenile striped bass, threadfin shad, and other resident warm-water fish to increased salvage and potential losses as a result of increased reverse flows. The increased reverse flows in low-flow years would be expected to result in a low, but potentially significant, increase in mortality for resident warm-water fish inhabiting the south Delta under CP2 relative to the Existing Condition.

Table 11-28. Old and Middle Rivers Reverse Flows for Existing Conditions, No-Action Alternative, and CP2

		Existing Condition	CP2 (Existing Condition)		No-Action Alternative	CP2 (Future Condition)	
Month	**Water Year**	**Base Flow (cfs)**	**Flow (cfs)**	**Percent Change**	**Base Flow (cfs)**	**Flow (cfs)**	**Percent Change**
January	Average	-6,592	-6,635	-0.7	-6,968	-6,947	0.3
	W	-5,026	-5,052	-0.5	-5,624	-5,641	-0.3
	AN	-7,598	-7,610	-0.2	-7,828	-7,758	0.9
	BN	-7,717	-7,720	0.0	-8,042	-8,019	0.3
	D	-7,540	-7,617	-1.0	-7,880	-7,878	0.0
	C	-6,243	-6,354	-1.8	-6,402	-6,317	1.3
February	Average	-4,930	-5,066	-2.7	-4,996	-5,103	-2.1
	W	-3,582	-3,679	-2.7	-3,857	-3,910	-1.4
	AN	-5,663	-5,836	-3.1	-6,276	-6,263	0.2
	BN	-5,723	-5,827	-1.8	-5,301	-5,403	-1.9
	D	-6,175	-6,189	-0.2	-6,211	-6,055	2.5
	C	-4,326	-4,726	-9.3	-4,004	-4,748	-18.6
March	Average	-3,975	-4,025	-1.2	-4,148	-4,118	0.7
	W	-2,052	-2,074	-1.0	-2,394	-2,371	1.0
	AN	-5,528	-5,454	1.3	-5,933	-5,788	2.4
	BN	-5,264	-5,375	-2.1	-4,948	-5,000	-1.0
	D	-5,245	-5,408	-3.1	-5,313	-5,278	0.7
	C	-3,181	-3,170	0.3	-3,479	-3,463	0.4
April	Average	-1,984	-1,974	0.5	-2,049	-2,075	-1.3
	W	-1,525	-1,527	-0.1	-1,709	-1,729	-1.1
	AN	-2,825	-2,756	2.4	-2,791	-2,815	-0.8
	BN	-2,488	-2,482	0.2	-2,460	-2,452	0.4
	D	-2,098	-2,093	0.2	-2,128	-2,210	-3.9
	C	-1,382	-1,393	-0.8	-1,447	-1,445	0.2
May	Average	-1,649	-1,649	0.0	-1,729	-1,727	0.1
	W	-1,147	-1,141	0.5	-1,265	-1,266	-0.1
	AN	-2,312	-2,271	1.8	-2,627	-2,557	2.7
	BN	-1,693	-1,705	-0.7	-1,755	-1,790	-2.0
	D	-2,088	-2,098	-0.5	-2,026	-2,039	-0.7
	C	-1,364	-1,393	-2.1	-1,361	-1,351	0.8
June	Average	-2,858	-2,933	-2.6	-3,210	-3,246	-1.1
	W	-2,219	-2,251	-1.4	-2,387	-2,408	-0.8
	AN	-3,532	-3,594	-1.8	-4,011	-3,974	0.9
	BN	-3,752	-3,751	0.0	-4,578	-4,597	-0.4
	D	-3,341	-3,470	-3.8	-3,476	-3,667	-5.5
	C	-1,801	-1,990	-10.5	-2,194	-2,124	3.2
July	Average	-3,942	-4,153	-5.3	-4,813	-4,949	-2.8
	W	-3,493	-3,588	-2.7	-4,027	-4,127	-2.5
	AN	-3,967	-4,060	-2.4	-5,167	-5,287	-2.3
	BN	-4,733	-5,018	-6.0	-6,665	-6,580	1.3
	D	-4,859	-5,191	-6.8	-5,378	-5,884	-9.4
	C	-2,592	-2,903	-12.0	-3,154	-3,087	2.1

Key:
AN = above-normal
BN = below-normal
C = critical
cfs = cubic feet per second
CP = Comprehensive Plan
D = dry
W = wet

Results of the comparison of Old and Middle river reverse flows are summarized in Table 11-28. Results of the analysis show that in the majority of years and months reverse flows under CP2 do not exceed basis-of-comparison conditions by more than 5 percent. CP2 exceeded basis-of-comparison conditions during February of a critical year by approximately 700 cfs. The increase in reverse flows would be expected, particularly in a critical year, to contribute to an increase in the potential for losses of adult delta smelt and other species, which is considered to be potentially significant. During June in a critical water year under CP2, the magnitude of reverse flows was reduced more than 5 percent but would be expected to contribute to a less than significant biological benefit based on both the low reverse flow under the basis-of-comparison and under CP2. An increase in reverse flow above the basis-of-comparison of approximately 300 to 600 cfs during dry years in July would be expected to contribute to an increase in the risk of losses to resident warm-water fish species. Increased reverse flows in July would not be expected to adversely affect delta or longfin smelt, juvenile Chinook salmon, or steelhead based on their seasonal migration patterns and geographic distribution. The potential increase in losses relative to the No-Action Alternative during February and July under future operating conditions is considered to be potentially significant. Mitigation for this impact is not proposed because operations will be guided by RPAs established by NMFS and USFWS BOs.

Impact Aqua-23 (CP2): Increase in the Risk of Entrainment or Salvage of Species of Primary Management Concern at CVP and SWP Export Facilities Due to Changes in CVP and SWP Exports CP2 operations may result in an increase in CVP and SWP exports, which is assumed to result in a direct proportional increase in the risk of fish being entrained and salvaged at the facilities. This is considered a less than significant impact to Chinook salmon, steelhead, and longfin smelt. This is considered a potentially significant impact to delta smelt, striped bass, and splittail. Future operations of the SWP and CVP export facilities would continue to be managed and regulated in accordance with incidental take limits established for each of the protected fish by USFWS, NMFS, and DFG.

Results of the entrainment loss modeling at the CVP and SWP export facilities are presented in Table 11-29 for CP2. The initial modeling was conducted using average fish densities developed from past fish salvage monitoring at the SWP and CVP export facilities. Average monthly water exports were used in the analysis based on hydrologic simulation modeling. The indices of the potential risk of entrainment for some species, such as Chinook salmon, were not estimated separately for each species (e.g., winter-run Chinook) in these initial analyses. If the proposed project is developed in the future a more detailed species-specific analysis of potential changes in fish salvage losses, in addition to an assessment of the population-level effects on each species, would be required for use as a basis for developing a biological assessment and Section 7 BOs and incidental take permits for project operations. These indices were calculated for wet, above-normal, below-normal, dry, and critical water-

year types, and for an average across all years (no water-year type specified). The total numbers of fish lost annually, by species, are presented in Attachment 13. The difference between fish losses under CP2 relative to the No-Action Alternative and the Existing Condition is represented as the entrainment index, shown in the tables, to represent the effect of project operations on each fish species at the CVP and SWP facilities.

Results of the entrainment risk calculations for delta smelt showed a change of less than 1 percent from Existing Condition in wet, above-normal, and below-normal water years and an increase in risk ranging from approximately 1 to 4 percent during dry and critical water years (Table 11-29). The greatest increase in risk (3.9 percent) was estimated for CP2 in a critical year.

The risk of increased losses of delta smelt relative to the No-Action Alternative was greatest in the dry years with a net reduction in losses under CP2 in critical water years (Table 11-29). Although the incremental change in the risk of delta smelt losses resulting from CVP and SWP export operations are small, the delta smelt population abundance is currently at such critically low levels that even a small increase in the risk of losses is considered to be potentially significant. The increase in risk is also expected to contribute to cumulative factors affecting the survival of delta smelt.

The estimated change in the risk of losses for salmon follows a similar pattern to that described for delta smelt (Table 11-29). Overall, the CP2 results in a small increase in the risk of losses compared with both the No-Action Alternative and Existing Condition. The change in risk was less than 5 percent in wet, above-normal, and below-normal water years under CP2 compared with the Existing Condition, and is considered to be less than significant. The risk index increased from 1.1 percent to 3.7 percent in dry and critical years with the greatest increase observed for CP2 (3.7 percent). The loss index for salmon compared with No-Action Alternative also showed increased risk in wet, below-normal, dry, and critical years. Given the numbers of juvenile Chinook salmon produced each year in the Central Valley the relatively small incremental increase in the risk of entrainment/salvage at the CVP and SWP export facilities is considered to be a less than significant impact but would contribute incrementally to the overall cumulative factors affecting juvenile Chinook salmon survival within the Delta and population dynamics of the stocks.

The estimated change in the risk of longfin smelt entrainment/salvage under CP2 compared with the No-Action Alternative and Existing Condition shows small positive and negative changes depending on water-year type (Table 11-27). These small changes in the risk of entrainment are considered to be less than significant.

Table 11-29. Entrainment at the CVP and SWP Facilities under Existing Conditions, No-Action Alternative, and CP2

Species	Water Year	CP2 Minus Existing Condition	Percent Change	CP2 Minus No-Action Alternative	Percent Change
Delta Smelt	Average	370	0.5	134	0.2
	W	80	0.1	110	0.1
	AN	-283	-0.3	-1,082	-1.2
	BN	283	0.4	539	0.8
	D	713	1.3	897	1.6
	C	1,236	3.9	-218	-0.7
Salmon	Average	607	0.6	320	0.3
	W	269	0.2	229	0.2
	AN	-283	-0.2	-1,136	-0.9
	BN	524	0.5	645	0.6
	D	940	1.1	880	1.1
	C	1,824	3.7	753	1.5
Longfin Smelt	Average	1	0.0	7	0.0
	W	-19	-0.1	13	0.1
	AN	-183	-1.0	-241	-1.3
	BN	44	0.3	121	0.8
	D	44	0.4	105	0.9
	C	117	1.8	-40	-0.6
Steelhead	Average	55	1.2	33	0.7
	W	37	0.7	22	0.4
	AN	52	1.0	-23	-0.4
	BN	38	0.8	32	0.7
	D	25	0.6	-42	-1.0
	C	159	5.1	227	7.5
Striped Bass	Average	26,280	2.0	14,635	1.0
	W	9,779	0.6	8,882	0.5
	AN	16,390	1.2	2,825	0.2
	BN	22,063	1.7	-800	-0.1
	D	44,113	3.9	57,936	4.9
	C	50,092	7.6	8,033	-1.1
Splittail	Average	5,491	2.0	3,025	1.0
	W	2,286	0.6	1,955	0.5
	AN	3,183	1.0	-778	-0.2
	BN	3,439	1.3	198	0.1
	D	9,220	4.0	13,642	5.7
	C	11,545	9.9	-3,480	-2.5

Key:
AN = above-normal
BN = below-normal
C = critical
CP = Comprehensive Plan
D = dry
W = wet

The estimated change in the risk to steelhead of entrainment/salvage at the CVP and SWP export facilities are summarized in Table 11-29. The small positive and negative changes in risk under wet, above-normal, below-normal, and dry water years are considered to be less than significant. The increase in risk of steelhead losses in critical water years is considered to be less than significant based on the abundance of juvenile steelhead migrating through the Delta, but would contribute directly to cumulative factors affecting the survival and population dynamics of Central Valley steelhead. The predicted increase in potential entrainment risk for steelhead under critically dry water years represents an initial estimate of the change (percentage) between the proposed project operations and the existing conditions and no-project alternatives and does not allow the predicted losses to be evaluated at the population-level. As noted above, more detailed modeling and analysis of potential steelhead losses would be required as part of preparing a project-specific analysis of entrainment losses for use in the Section 7 biological assessment and BOs for future project operations and incidental take of steelhead. As part of this more detailed analysis additional actions may be identified to further reduce and avoid potential adverse effects to steelhead.

The change in risk to juvenile striped bass for entrainment/salvage at the CVP and SWP export facilities is summarized in Table 11-29. The change in risk in wet, above-normal, and below-normal water years is considered to be less than significant based on the abundance of striped bass, but would contribute to the cumulative factors affecting striped bass survival and population dynamics in the Delta. The losses of juvenile striped bass increased substantially under dry and critical year conditions, which would be expected with an increase in exports during the summer months. Compared with the Existing Condition, the risk of increased losses ranged from 3.8 percent to 7.6 percent (approximately 30,000 to 60,000 fish), which is considered to be potentially significant. The increased losses, particularly in drier water years when juvenile striped bass production is lower, would be expected to contribute to the cumulative effects of factors affecting juvenile striped bass survival in the Delta.

Results of the risk estimates for juvenile splittail losses show a pattern similar to other species (Table 11-29). The increased risk index was 1.3 percent or less in wet, above-normal, and below-normal water years, and was considered to be a less than significant effect. The loss index increased during dry and critically dry water years. Higher risk of entrainment/salvage losses in drier water years has a potentially greater effect of abundance of juvenile splittail since reproductive success and overall juvenile abundance is typically lower within the Delta in dry years. The increased risk of losses in drier years was considered to be potentially significant. The increased losses would also contribute to cumulative factors affecting survival of juvenile splittail within the Delta.

Impact Aqua-23 (CP1) is considered to be less than significant for Chinook salmon, steelhead, and longfin smelt, but potentially significant for delta smelt,

striped bass, and splittail. Mitigation for this impact is not proposed because operations will be guided by RPAs established by NMFS and USFWS BOs.

CVP/SWP Service Areas

Impact Aqua-24 (CP2): Impacts on Aquatic Habitats and Fish Populations in the CVP and SWP Service Areas Resulting from Modifications to Existing Flow Regimes Project implementation could result in modified flow regimes that would reduce the frequency and magnitude of high winter flows along the Sacramento River; however, the hydrologic effects in tributaries and reservoirs (e.g., New Melones and San Luis) with CVP and SWP dams are expected to be less than impacts on the lower Sacramento River. The change in hydrology could affect aquatic habitats that provide habitat for the fish community. These changes are unlikely to result in substantial effects on the distribution or abundance of these species in the CVP and SWP service areas. Therefore, this impact would be less than significant.

This impact would be similar to Impact Aqua-24 (CP1). The impact could be greater because the increased reservoir capacity associated with a 12.5-foot raise compared to a 6.5-foot raise would allow for additional water volume (and flows) to be stored behind the raised dam. However, these changes are unlikely to result in substantial effects on the distribution or abundance of these species in the CVP and SWP service areas. The effects from CP2 on CVP and SWP reservoir elevations, filling, spilling, and planned releases, and the resulting flows downstream from those reservoirs would be small and well within range of variability that commonly occurs in these reservoirs and downstream. Therefore, this impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

CP3 – 18.5-Foot Dam Raise, Anadromous Fish Survival and Water Supply

CP3 would be similar to CP1 and CP2. It focuses on the greatest practical enlargement of Shasta Dam and Reservoir consistent with the goals of the 2000 CALFED ROD, and was formulated for the primary purposes of increased water supply reliability and increased survival of anadromous fish. CP3 consists of raising Shasta Dam by 18.5 feet, an elevation change that would increase the full pool by 20.5 feet and enlarge the total storage space in the reservoir by 634,000 acre-feet to 5.19 million acre-feet. CP3 would help reduce future shortages by increasing the reliability of the water supply in drought and average years. The increased pool depth and volume would also contribute to improving seasonal water temperatures on the upper Sacramento River for anadromous fish.

Shasta Lake and Vicinity

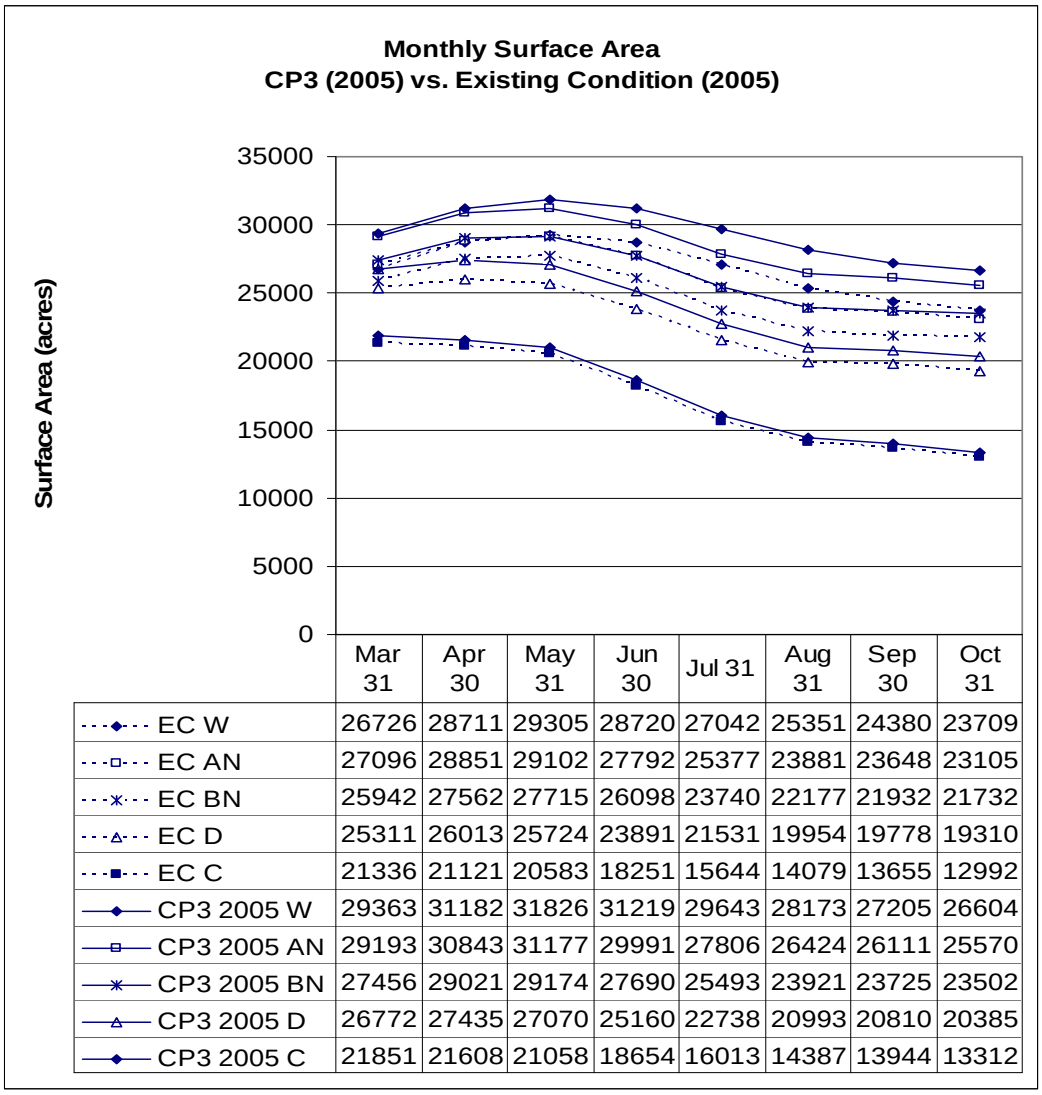
Impact Aqua-1 (CP3): Effects on Nearshore, Warm-Water Habitat in Shasta Lake from Project Operations Under CP3, project operations would contribute to an increase in the surface area and WSEL of Shasta Lake, which would in turn increase the area and productivity of nearshore, warm-water habitat. CP3 operations would also result in reduced monthly fluctuations in WSEL, which

would contribute to increased reproductive success, young-of-the-year production, and the juvenile growth rate of warm-water fish species. Similar to CP-1 the value of existing structural habitat improvements would be diminished to varying degrees, large areas of the shoreline would not be cleared, and the vegetation along these sections will be inundated periodically. In the short term, this vegetation will provide warm-water lacustrine habitat, with decay expected to occur over several decades. This impact would be less than significant.

This impact would be similar to Impacts Aqua-1 (CP1 and CP2), but the surface area would be larger under the 18.5-foot dam raise than under the 6.5-foot and 12.5-foot dam raises. CalSim-II modeling shows that the surface area of Shasta Lake would be larger under CP3 for both a 2005 and a 2030 water supply demand than under the Existing Condition or the No-Action Alternative in all five water-year types (Figures 11-18 and 11-19).

Monthly WSEL fluctuations were compared with projections for water supply demand. For CP3, with a 2005 water supply demand, 20 percent of monthly changes in projected WSELs (i.e., 5 of the 25 total projections made for the 5 months from March through July for all five water-year types) showed increased monthly WSEL fluctuations relative to the Existing Condition and 80 percent showed reduced monthly WSEL fluctuations (Figure 11-20). For CP3, with a projected 2030 water supply demand, 36 percent of monthly changes in projected WSELs showed increased WSEL fluctuations relative to the No-Action Alternative and 64 percent showed reduced monthly WSEL fluctuations (Figure 11-21). Under CP3, none of the changes in monthly WSEL fluctuation are different enough from the Existing Condition to warrant the investigation of daily WSEL fluctuation.

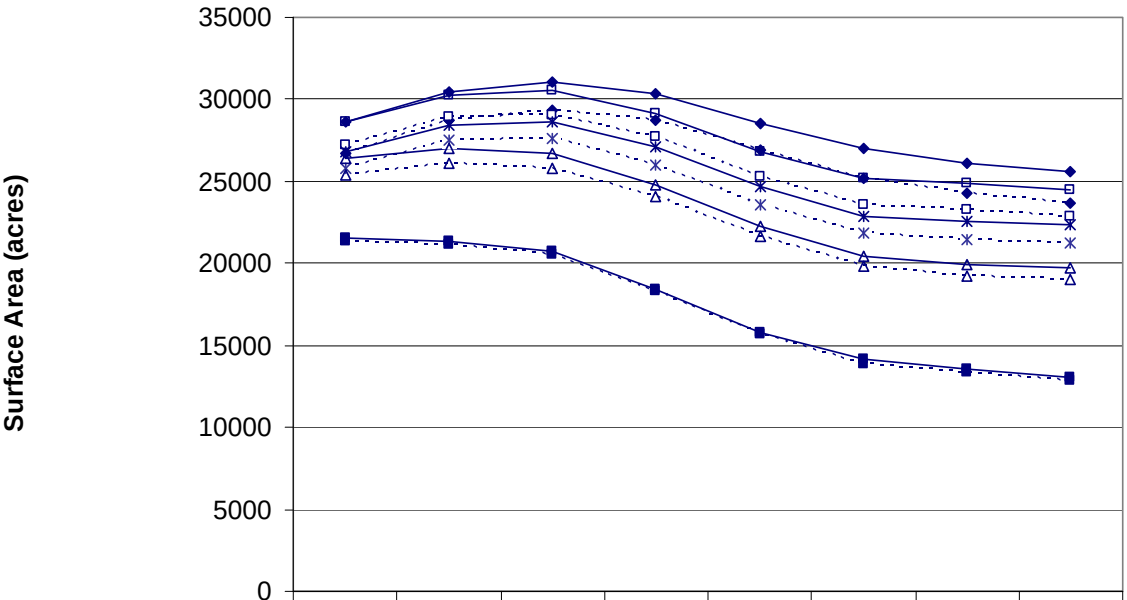
Increases in the overall surface area and WSEL under CP3 would increase the area of available warm-water habitat and stimulate biological productivity, including fish production, of the entire lake for a period of time, possibly for several decades. Furthermore, reductions in the magnitude of monthly WSEL fluctuations could contribute to increased reproductive success, young-of-the-year production, and juvenile growth rate of warm-water fish species. Therefore, this impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.



	Mar 31	Apr 30	May 31	Jun 30	Jul 31	Aug 31	Sep 30	Oct 31
EC W	26726	28711	29305	28720	27042	25351	24380	23709
EC AN	27096	28851	29102	27792	25377	23881	23648	23105
EC BN	25942	27562	27715	26098	23740	22177	21932	21732
EC D	25311	26013	25724	23891	21531	19954	19778	19310
EC C	21336	21121	20583	18251	15644	14079	13655	12992
CP3 2005 W	29363	31182	31826	31219	29643	28173	27205	26604
CP3 2005 AN	29193	30843	31177	29991	27806	26424	26111	25570
CP3 2005 BN	27456	29021	29174	27690	25493	23921	23725	23502
CP3 2005 D	26772	27435	27070	25160	22738	20993	20810	20385
CP3 2005 C	21851	21608	21058	18654	16013	14387	13944	13312

Key:
AN = above-normal water
BN= below-normal water years
C = critical water years
CP = Comprehensive Plan
EC = Existing Condition
D = dry water years
W = wet water years

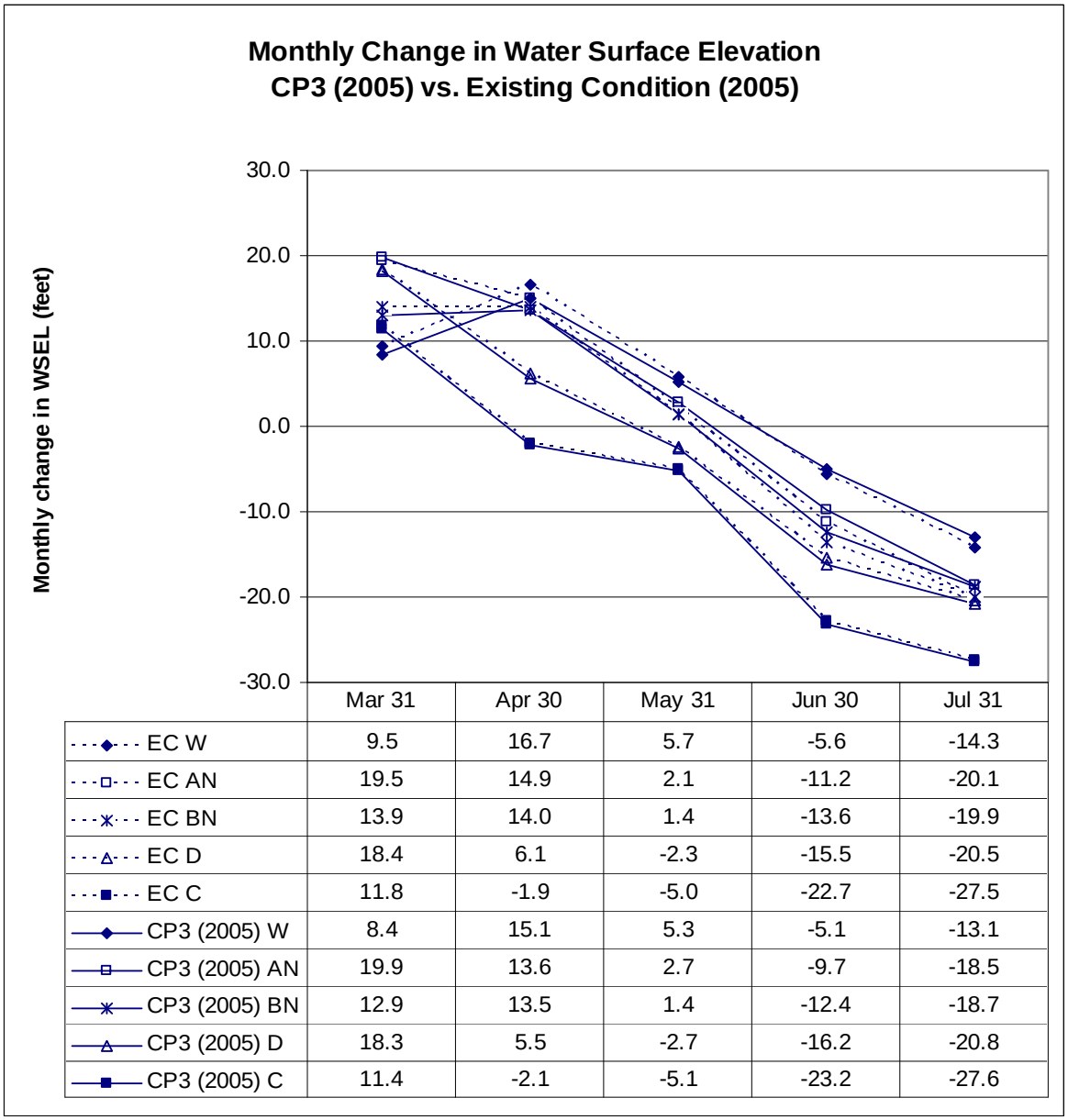
Figure 11-18. Monthly Surface Area for Each Water-Year Type Within the Shasta Lake Vicinity of the Primary Study Area, CP3 vs. Existing Condition



	Mar 31	Apr 30	May 31	Jun 30	Jul 31	Aug 31	Sep 30	Oct 31
NA W	26750	28695	29293	28690	26880	25222	24303	23671
NA AN	27167	28885	29069	27750	25285	23603	23283	22865
NA BN	25820	27477	27594	25947	23571	21815	21422	21291
NA D	25395	26108	25802	24026	21660	19855	19238	19017
NA C	21312	21115	20554	18343	15646	13859	13349	12834
CP3 2030 W	28629	30435	31091	30389	28531	27024	26143	25571
CP3 2030 AN	28582	30210	30520	29152	26803	25176	24889	24474
CP3 2030 BN	26848	28467	28614	27063	24666	22887	22549	22392
CP3 2030 D	26372	27035	26682	24780	22291	20477	19905	19682
CP3 2030 C	21510	21295	20713	18372	15783	14127	13522	13031

Key:
AN = above-normal water
BN= below-normal water years
C = critical water years
CP = Comprehensive Plan
D = dry water years
NA = No-Action
W = wet water years

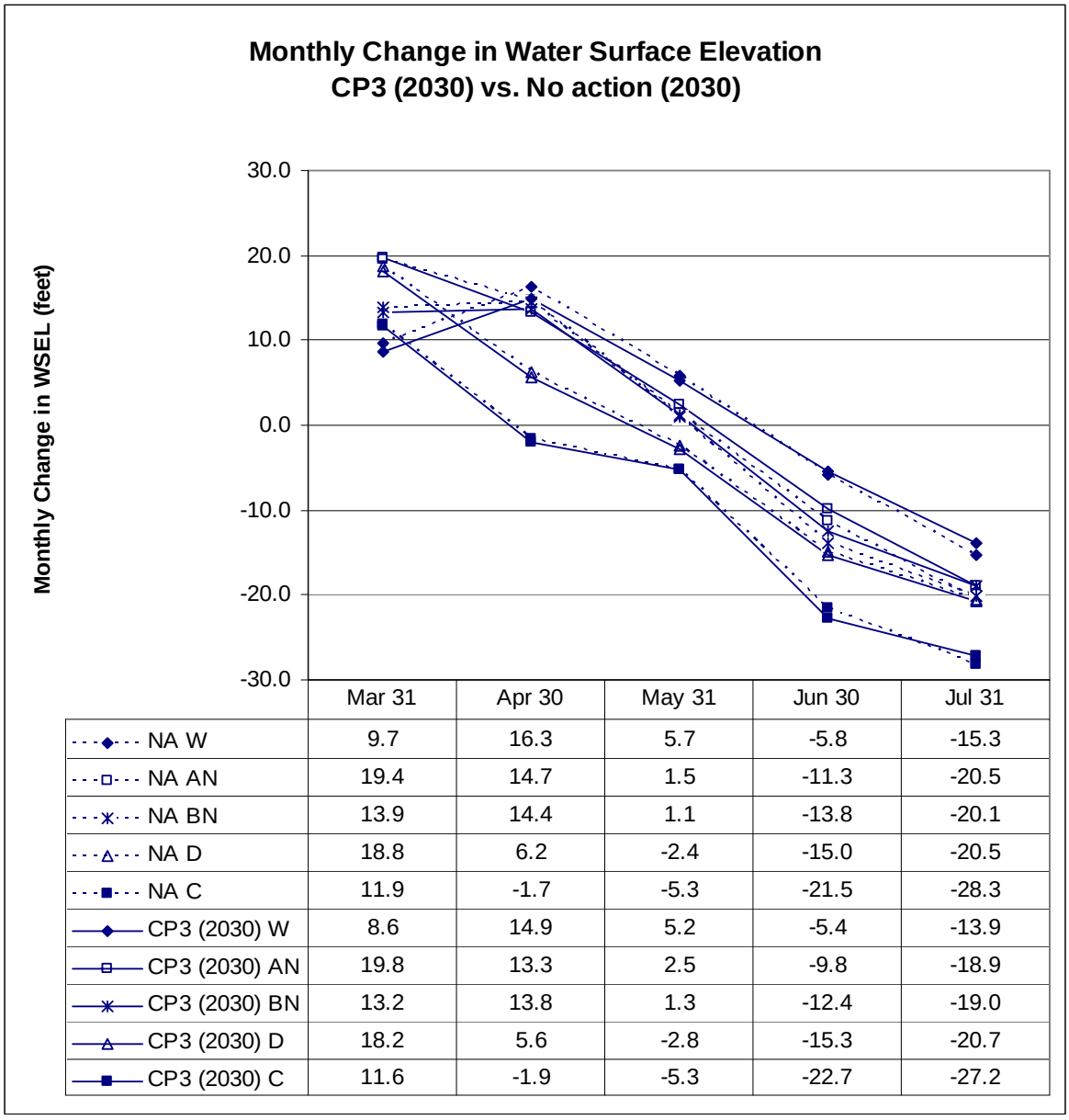
Figure 11-19. Monthly Surface Area for Each Water-Year Type Within the Shasta Lake Vicinity of the Primary Study Area, CP3 vs. No-Action Alternative



	Mar 31	Apr 30	May 31	Jun 30	Jul 31
EC W	9.5	16.7	5.7	-5.6	-14.3
EC AN	19.5	14.9	2.1	-11.2	-20.1
EC BN	13.9	14.0	1.4	-13.6	-19.9
EC D	18.4	6.1	-2.3	-15.5	-20.5
EC C	11.8	-1.9	-5.0	-22.7	-27.5
CP3 (2005) W	8.4	15.1	5.3	-5.1	-13.1
CP3 (2005) AN	19.9	13.6	2.7	-9.7	-18.5
CP3 (2005) BN	12.9	13.5	1.4	-12.4	-18.7
CP3 (2005) D	18.3	5.5	-2.7	-16.2	-20.8
CP3 (2005) C	11.4	-2.1	-5.1	-23.2	-27.6

Key:
AN = above-normal water
BN= below-normal water years
C = critical water years
CP = Comprehensive Plan
D = dry water years
EC = Existing Condition
W = wet water years

Figure 11-20. Monthly Change in WSEL for Each Water-Year Type Within the Shasta Lake Vicinity of the Primary Study Area, CP3 vs. Existing Condition



	Mar 31	Apr 30	May 31	Jun 30	Jul 31
NA W	9.7	16.3	5.7	-5.8	-15.3
NA AN	19.4	14.7	1.5	-11.3	-20.5
NA BN	13.9	14.4	1.1	-13.8	-20.1
NA D	18.8	6.2	-2.4	-15.0	-20.5
NA C	11.9	-1.7	-5.3	-21.5	-28.3
CP3 (2030) W	8.6	14.9	5.2	-5.4	-13.9
CP3 (2030) AN	19.8	13.3	2.5	-9.8	-18.9
CP3 (2030) BN	13.2	13.8	1.3	-12.4	-19.0
CP3 (2030) D	18.2	5.6	-2.8	-15.3	-20.7
CP3 (2030) C	11.6	-1.9	-5.3	-22.7	-27.2

Key:
AN = above-normal water
BN = below-normal water years
C = critical water years
CP = Comprehensive Plan
D = dry water years
NA = No-Action
W = wet water years

Figure 11-21. Monthly Change in WSEL for Each Water-Year Type Within the Shasta Lake Vicinity of the Primary Study Area, CP3 vs. No-Action Alternative

Impact Aqua-2 (CP3): Effects on Nearshore, Warm-Water Habitat in Shasta Lake from Project Construction Localized increases in soil erosion and resulting runoff sedimentation, and turbidity resulting from project construction in the vicinity of Shasta Dam and at utility, road, and other facility relocation areas could affect nearshore warm-water habitat. However, the environmental commitments for all action alternatives would result in less than significant impacts. Mitigation for this impact is not needed, and thus not proposed.

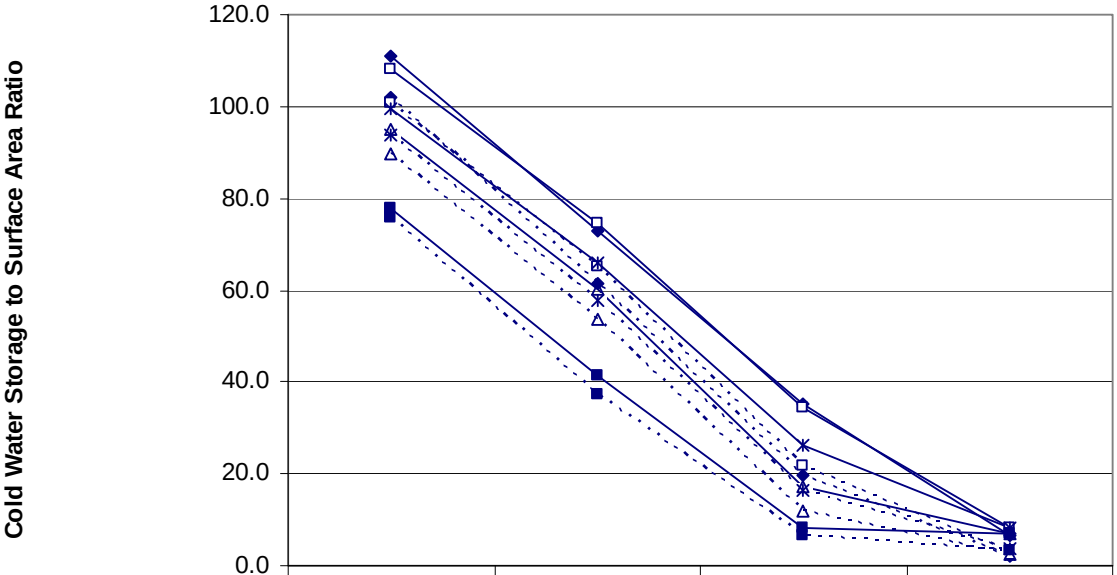
Impact Aqua-3 (CP3): Effects on Cold-Water Habitat in Shasta Lake Operations-related changes in the ratio of the volume of cold-water storage to surface area would increase the availability of suitable habitat for cold-water fish in Shasta Lake, including rainbow trout. This impact would be beneficial.

This impact would be similar to Impacts Aqua-3 (CP1 and CP2). However, it would be of greater magnitude owing to a greater increase in the ratio of the volume of cold-water storage in the lake to the surface area of the lake. CalSim-II modeling shows that under CP3 with a 2030 water supply demand, the ratio of cold-water storage to surface area is higher than under the No-Action Alternative in all water years and during all months modeled. The greatest projected increases over the No-Action Alternative occurred between June 30 and August 31, which is the critical holding and rearing period for cold-water fishes in reservoirs, and are greatest in wet, above-normal, and below-normal water years (Figure 11-22).

CP3 would increase the availability of suitable habitat for cold-water fish in Shasta Lake. Therefore, this impact would be beneficial. Mitigation for this impact is not needed, and thus not proposed.

Impact Aqua-4 (CP3): Effects on Special-Status Aquatic Mollusks Under CP3, habitat for special-status mollusks could be inundated. Seasonal fluctuations in the surface area and WSEL of Shasta Lake could also adversely affect special-status aquatic mollusks that could occupy habitat in or near Shasta Lake and its tributaries. This impact would be potentially significant.

This impact would be similar to Impacts Aqua-4 (CP1 and CP2). However, a larger area would be inundated under CP3, which could result in an increase in impacts to these species and their habitat. Seasonal fluctuations in the surface area and WSEL of Shasta Lake could adversely affect special-status mollusks that may occupy habitat in or near Shasta Lake and its tributaries. Tributary investigations are ongoing and will provide additional information and analysis for inclusion in the FEIS. Therefore, this impact would be potentially significant. Mitigation for this impact is proposed in Section 11.3.4.



	Apr 30	Jun 30	Aug 31	Oct 31
NA W	102.1	61.5	19.8	2.2
NA AN	100.9	65.2	21.8	3.1
NA BN	93.9	57.9	16.3	3.8
NA D	89.6	53.5	12.0	2.5
NA C	75.8	37.4	6.5	3.2
CP3 2030 W	110.9	73.0	35.2	6.7
CP3 2030 AN	108.1	74.4	34.6	8.2
CP3 2030 BN	99.5	66.1	26.3	8.1
CP3 2030 D	94.9	60.0	17.4	7.1
CP3 2030 C	78.0	41.6	8.2	6.8

Key:
AN = above-normal water
BN= below-normal water years
C = critical water years
CP = Comprehensive Plan
D = dry water years
NA = No-Action
W = wet water years

Figure 11-22. Monthly Cold-water Storage to Surface Area Ratio for Each Water-Year Type Within the Shasta Lake Vicinity of the Primary Study Area, CP3 vs. Existing Condition

Impact Aqua-5 (CP3): Effects on Special-Status Fish Species The expansion of the surface area of Shasta Lake and the inundation of additional tributary habitat under CP3 could affect one species designated as sensitive by USFS, the hardhead. This impact would be less than significant.

This impact would be similar to Impact Aqua-5 (CP1 and CP2), but its magnitude would be greater owing to an increase in surface area and WSEL and expansion of the area subject to inundation. Tributary investigations are ongoing and will provide additional information and analysis for inclusion in the FEIS. Therefore, this impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact Aqua-6 (CP3): Creation or Removal of Barriers to Fish between Tributaries and Shasta Lake Under CP3, project implementation would result in the periodic inundation of steep and low-gradient tributaries to Shasta Lake up to the 1,090-foot contour, the maximum inundation level under this alternative. Tributary investigations are ongoing and will provide additional information and analysis for inclusion in the FEIS. However, based on digital topographic data and stream channel data generated from field inventories, there do not appear to be any substantial barriers between the 1,070-foot and 1,090-foot contours that would be inundated under this alternative. This impact would be less than significant.

This impact would be similar to Impacts Aqua-6 (CP1 and CP2). However, the maximum inundation level would be higher under this alternative. Most of the tributaries are too steep (i.e., greater than 7 percent) up to the 1,090-foot contour to be passable by fish; the tributaries that are low-gradient up to the 1,090-foot contour, and thus, allow fish passage remain low-gradient well upstream from this contour. Therefore, this impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact Aqua-7 (CP3): Effects on Spawning and Rearing Habitat of Adfluvial Salmonids in Low-Gradient Tributaries to Shasta Lake CP3 would result in additional periodic inundation of potentially suitable spawning and rearing habitat for adfluvial salmonids in the Sacramento River, McCloud River, Pit River, Big Backbone Creek, and Squaw Creek upstream from Shasta Lake. Eleven miles of low-gradient reaches that could potentially provide some spawning and rearing habitat for adfluvial salmonids would be affected by CP2, which is only about 2.8 percent of the low-gradient habitat upstream from Shasta Lake. Tributary investigations are ongoing and will provide additional information and analysis for inclusion in the FEIS. This impact would be less than significant.

As described in Chapter 4, “Geology, Geomorphology, Minerals, and Soils,”CP3 would inundate perennial reaches with gradients of less than 7 percent that could provide spawning and rearing habitat for adfluvial salmonids.

The lengths of low-gradient tributaries to each arm that would be periodically inundated are as follows:

- Sacramento River Arm 4.0 miles
- McCloud River Arm 2.7 miles
- Pit River Arm 1.9 miles
- Big Backbone Creek Arm 1.1 miles
- Squaw Creek Arm 1.3 miles

This impact would be similar to Aqua-7 (CP1 and CP2). However, it would periodically inundate a larger amount of habitat in low-gradient reaches to Shasta Lake, but the total amount inundated would be only 2.8 percent of the low-gradient habitat upstream from the lake. Therefore, this impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact Aqua-8 (CP3): Effects on Aquatic Connectivity in Non-Fish-Bearing Tributaries to Shasta Lake CP3 would result in periodic inundation of the lower reaches of high-gradient, non-fish-bearing tributaries to Shasta Lake. Only 24.0 miles of non-fish-bearing tributary habitat would be affected by CP3, which is only about 1 percent of the total length of non-fish-bearing tributaries upstream from Shasta Lake. Tributary investigations are ongoing and will provide additional information and analysis for inclusion in the FEIS. This impact would be less than significant.

As described in Chapter 4, "Geology, Geomorphology, Minerals, and Soils" CP3 would inundate tributary segments with channel slopes in excess of 7 percent. Although these segments do not typically support salmonid populations, they do provide riparian and aquatic habitat for a variety of organisms and serve as corridors that connect habitat types. The lengths of non-fish-bearing tributaries for each arm of Shasta Lake that would be periodically inundated are as follows:

- Sacramento River Arm 5.5 miles
- McCloud River Arm 4.1 miles
- Pit River Arm 3.5 miles
- Big Backbone Creek Arm 2.7 miles
- Squaw Creek Arm 1.9 miles
- Main Body 6.3 miles

This impact would be similar to Aqua-8 (CP1 and CP2). However, it would periodically inundate a larger amount of habitat in high-gradient reaches to Shasta Lake, but the total amount inundated would be only 1 percent of the

non-fish-bearing tributaries upstream from the lake. Therefore, this impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact Aqua-9 (CP3): Effects on Water Quality at Livingston Stone Hatchery Reclamation provides the water supply to the Livingston Stone Hatchery from a pipeline emanating from Shasta Dam. This supply would not be interrupted by any activity associated with CP3. There would be no impact.

This impact is the same as Impact Aqua-9 (CP1), and there would be no impact. Mitigation for this impact is not needed, and thus not proposed.

Upper Sacramento River (Shasta Dam to RBDD)

Impact Aqua-10 (CP3): Loss or Degradation of Aquatic Habitat in the Upper Sacramento River during Construction Activities Construction-related increases in sediments and turbidity would adversely affect aquatic habitats and fish populations within the upper Sacramento River immediately downstream from project construction activities. This impact would be less than significant.

This impact would be similar to Impact Aqua-10 (CP1). The impact could be greater because of the increased activity associated with an 18.5-foot dam raise compared to a 6.5-foot dam raise. However, the environmental commitments for all action would result in less than significant impacts. Mitigation for this impact is not needed, and thus not proposed

Impact Aqua-11 (CP3): Release and Exposure of Contaminants in the Upper Sacramento River During Construction Activities Construction-related activities could result in the release and exposure of contaminants, resulting in adverse effects on aquatic habitats, the aquatic food web, and fish populations, including special-status species, within the primary study area downstream from project construction activities. This impact would be less than significant.

This impact would be similar to Impact Aqua-11 (CP1). The impact could be greater because of the increased activity associated with an 18.5-foot raise compared to a 6.5-foot raise. However, the environmental commitments for all action would result in less than significant impacts. Mitigation for this impact is not needed, and thus not proposed

Impact Aqua-12 (CP3): Changes in Flow and Water Temperature in the Upper Sacramento River Resulting from Project Operation – Chinook Salmon Project operation would result in improved overall flow and water temperature conditions in the upper Sacramento River for fish species of management concern. This impact would be beneficial.

Winter-Run Chinook Salmon

Production

Based on the 1999 through 2006 population average, overall average winter-run production for the 82-year period was similar for CP3 relative to the No-Action

Alternative and the Existing Condition (Attachments 1A and 2A). The maximum increase in production relative to the No-Action Alternative was 74 percent for CP3, and the largest decrease in production relative to the No-Action Alternative was 5 percent (Attachment 1A). The maximum increase in production relative to the Existing Condition was 27 percent for CP3 in 1977, and the largest decrease in production relative to the Existing Condition was 8 percent in 1931 (Attachment 2A).

With one exception (1977, a 3 percent decrease), years with the lowest production over the simulation period had the largest increase in production under CP3 conditions.

Under CP3, critical water years 1924, 1931, 1933, and 1934, and dry water year 1944 had increases in production compared to the No-Action Alternative, ranging from 8 to 74 percent.

Under CP3, critical water years (1924, 1934, 1977, 1992) had increases in production compared to the Existing Condition, ranging from 5 to 27 percent. One critical (1931), and one above-normal (1978) water year had decreases in production of 5 and 8 percent.

When the spawning population equaled the AFRP goal, overall average winter-run Chinook salmon production was similar for CP3 relative to the No-Action Alternative (Attachment 3A). The maximum increase in production relative to the No-Action Alternative was 42 percent for CP3. The largest decrease in production relative to the No-Action Alternative was 8 percent for CP3. Years with the lowest production under the No-Action Alternative typically had the greatest percent increase in production under CP3.

Mortality

Based on the 1999 through 2006 population average, the greatest mortality to winter-run Chinook salmon under CP3 occurred to the egg incubation life stage, followed by presmolts, then fry, and lastly to immature smolts. Nonoperational conditions were the primary causes of mortality for all life stages under all Comprehensive Plans. Table 11-4 displays the overall mortalities for each Comprehensive Plan that were caused by nonoperational factors versus those caused by operations (i.e., water temperature and flow) (Attachments 1B and 2B). Mortalities caused by the project decrease as the proposed dam height increases from 6.5 to 18.5 feet.

When removing nonoperations-related mortality, allowing comparison of mortality for operations-related activities only, fry were the primary life stage affected, but operations-related activities had a greater effect on egg incubation than on presmolts and no effect on immature smolts. The same trends for each Comprehensive Plan were observed, with the bulk of the mortality affecting the fry and egg incubation life stages, and both water temperature and flow causing the mortality (Table 11-5).

In critical water years, mortality to eggs due to unsuitable water temperatures was the primary cause of operations-related mortalities for CP3, followed by mortality to fry (more by flow and density than water temperature), then to eggs from redd superimposition, followed by presmolts (affected first by water temperature then flow) and then immature smolts (affected by flow). Attachments 1C and 2C contains tables of mortality to winter-run Chinook salmon sorted by water-year type, and Table 11-6 outlines the ranks classified under each Comprehensive Plan for each water-year type.

In dry water years, mortality to fry when moving to new habitats was the primary cause of operations-related mortalities for CP3, as for the No-Action Alternative, followed by mortality to eggs due to redd superimposition. Third was the mortality to eggs due to unsuitable water temperatures, and then followed by mortality to presmolts while moving to new habitats.

Below-normal, above-normal, and wet water years also had the greatest number of winter-run Chinook salmon perish as fry caused by forced movement to habitat downstream, followed by mortality to eggs due to redd superimposition, then the loss of eggs from unsuitable water temperatures, and forced movement of presmolts to downstream habitats.

Years with the highest mortality were the same for the No-Action Alternative and CP1 through CP3: 1924, 1931, 1933, 1934, 1977, and 1992. Each of these years was a critical water year, and was preceded by either a critical (1933, 1976, 1991), dry (1930 and 1932), or below-normal (1923) water-year type. Years in which CP3 had the greatest impact on winter-run were also the years in which the lowest production occurred (Attachments 1C and 2C).

When the spawning population equaled the AFRP goal, winter-run Chinook salmon mortality caused by the operations-related activities decreased under CP3 compared to No-Action Alternative conditions (Attachment 3B). Under CP3, mortality caused by operations-related activities would decrease from non-operations related mortality by 11 percent. Under CP3, the greatest mortality to winter-run Chinook salmon occurred to the egg incubation life stage, followed by presmolts, then fry, and lastly to immature smolts. Nonoperational conditions were the primary causes of mortality for all life stages under all alternatives.

Because winter-run Chinook salmon have, overall, a reduced mortality, winter-run Chinook salmon would benefit from actions taken in CP3. Mitigation for this impact is not needed, and thus not proposed.

Spring-Run Chinook Salmon

Production

Based on the 1999 through 2006 population average, overall average spring-run Chinook salmon production for the 82-year period remained relatively close to the No-Action Alternative and Existing Condition. The maximum increase in

production relative to the No-Action Alternative was 162 percent for CP3. The largest decrease in production relative to the No-Action Alternative was 8 percent for CP3 (Attachment 4A). The maximum increase in production relative to the Existing Condition was 121 percent for CP3. The largest decrease in production relative to the Existing Condition was 79 percent for CP3 (Attachment 5A).

Under CP3, critical water years 1924, 1931, 1933, 1977, 1988, 1992, and 1994 had increases in production compared to the No-Action Alternative, ranging from 6 to 162 percent. Dry water years 1925, 1926, and 1932, and below-normal water year 1959 resulted in increases in production over the No-Action Alternative ranging from 5 to 118 percent. Wet water year 1969 resulted in a production decrease of around 8 percent.

Under CP3, five critical water years (1924, 1933, 1934, 1992, and 2001) had increases in production compared to the Existing Condition, ranging from 6 to 121 percent. Two dry water years (1932 and 2002) resulted in increases over the Existing Condition ranging from 6 to 70 percent. Two below-normal water years (1935 and 1959), and one above-normal water year (2000), had increases in production ranging from 5 to 8 percent. Three critical water years (1931, 1977 and 1988), and one wet water year (1969) had decreases in production relative to the Existing Condition ranging from 8 to 79 percent.

When the spawning population equaled the AFRP goal, overall average spring-run Chinook salmon production was similar for CP3 relative to the No-Action Alternative (Attachment 6A). The maximum increase in production relative to the No-Action Alternative was 123 percent for CP3. The largest decrease in production relative to the No-Action Alternative was 8 percent for CP3. Years with the lowest production under the No-Action Alternative typically had the greatest percent increase in production under CP3.

Mortality

Based on the 1999 through 2006 population average, the greatest mortality to spring-run Chinook salmon under CP3 occurred to the eggs, followed by presmolts, then fry. Nonoperational conditions were the primary causes of mortality for all life stages under all Comprehensive Plans. Table 11-5 displays the overall mortalities for each Comprehensive Plan that were caused by nonoperational factors versus those caused by the operations (i.e., water temperature and flow) (Attachments 4B and 5B). Mortalities caused by the project decrease as the proposed dam height increases from 6.5 to 18.5 feet (Tables 11-7 and 11-8). When removing nonoperations-related mortality, leaving mortality due to operations-related activities, only eggs and fry were affected (Table 11-8).

Critical water years under CP3 had mortality to eggs due to unsuitable water temperatures as the primary cause of operations-related mortalities, followed by mortality to prespawned eggs and during incubation caused by dewatering the

redds, and then to fry from forced movement to downstream habitats. Attachments 4C and 5C contain tables of mortality to spring-run sorted by water-year type, and Table 11-9 outlines the rankings classified under each Comprehensive Plan for each water-year type.

In dry, below-normal, and above-normal water years, CP3 was dominated by egg temperature mortality, followed by mortality resulting from redd dewatering. Mortality to prespawned eggs occurred in only two dry years but not in any below-normal water years. Mortality to fry from forced movement was relatively low in only several more years (Table 11-9).

In wet water years, spring-run eggs under conditions created by CP3 were more affected by redd dewatering than by unsuitable water temperatures (Table 11-9).

Years with the highest operations-related mortality were the same for all the Comprehensive Plans: 1924, 1931, 1932, 1933, 1934, 1977, and 1992. Except 1932 (a dry water year), each of these years was a critical water-year type and was preceded by either a below-normal, dry, or (predominantly) a critical water year. However, years with the lowest mortality varied between all water-year types. Years in which the project had the greatest impact on spring-run Chinook salmon were also years in which the lowest production occurred, with nearly all of the mortality occurring in the egg incubation life stage (Attachments 4C and 5C).

When the spawning population equaled the AFRP goal, spring-run Chinook salmon mortality caused by operations-related activities decreased under CP3 compared to No-Action Alternative conditions (Attachment 6B). Under CP3, mortality caused by operations-related activities would decrease from non-operations related mortality by over 35 percent. Under CP3, the greatest mortality to spring-run Chinook salmon occurred to the egg incubation life stage, followed by presmolts, then fry, and lastly to immature smolts. Nonoperational conditions were the primary causes of mortality for all life stages under all alternatives.

Because spring-run Chinook salmon have, overall, a reduced mortality, spring-run Chinook salmon would benefit from actions taken in CP3. Mitigation for this impact is not needed, and thus not proposed.

Fall-Run Chinook Salmon

Production

Based on the 1999 through 2006 population average, overall average fall-run Chinook salmon production for the 82-year period was similar between CP3 and the No-Action Alternative and the Existing Condition (Attachments 7A and 8A). The maximum increase in production relative to the No-Action Alternative was 148 percent for CP3 while the largest decrease in production relative to the No-Action Alternative was 9 percent (Attachment 7A). The maximum increase in production relative to the Existing Condition was 59

percent for CP3. The largest decrease in production relative to the Existing Condition was 69 percent for CP3 (Attachment 8A).

In critical, dry, and below-normal water years, when production was lowest over the simulation period, the increase in production resulting from operations-related activities was greatest. In above-normal and wet water years, however, the lowest production years typically had a slight decrease in production under CP1 conditions relative to the No-Action Alternative.

Under CP3, critical water years 1931, 1933, 1934, and 1977 had increases in production relative to the No-Action Alternative, ranging from 8 to 148 percent. Dry water years 1926, 1932, 1939, 1955, and 1964, and below-normal water years 1937 and 1945 had an 8 to 76 percent increase in production compared to the No-Action Alternative. Above-normal water years 1957 and 1945, and 1999, a wet water year had decreases in overall production relative to the No-Action Alternative, from 6 to 17 percent.

Under CP3, critical water years 1924 and 1934 had increases in production relative to the Existing Condition, ranging from 14 to 37 percent. Five dry water years (1926, 1939, 1955, 1964, and 1985) increased production by 7 to 57 percent compared to the Existing Condition. Three below-normal water years, 1937, 1945, and 1950, had increases in production relative to the Existing Condition, from 5 to 60 percent. Critical water years 1931 and 1977 had decreased production relative to the Existing Condition from 27 to 69 percent. One below-normal (1979) and one above-normal (1957) and four wet (1941, 1942, 1969, and 1999) water years resulted in a substantial decrease in production relative to the Existing Condition ranging from 5 to 17 percent.

When the spawning population equaled the AFRP goal, overall average fall-run Chinook salmon production was similar for CP3 relative to the No-Action Alternative (Attachment 9A). The maximum increase in production relative to the No-Action Alternative was 150 percent for CP3. The largest decrease in production relative to the No-Action Alternative was 9 percent for CP3. In critical, dry, and below-normal water years, years with the lowest production under the No-Action Alternative typically had the greatest percent increase in production under CP3. In above-normal and wet water years, however, the lowest production years typically remained similar or had a slight decrease in production under CP3 conditions relative to the No-Action Alternative.

Mortality

Based on the 1999 through 2006 population average, the greatest mortality to fall-run Chinook salmon under CP3 occurs to the egg incubation life stage, followed by presmolts, then fry, and lastly to immature smolts. Nonoperational conditions were the primary causes of mortality for all life stages under all Comprehensive Plans. Table 11-10 displays the overall mortalities for each alternative that were caused by nonoperational factors versus those caused by operations (i.e., water temperature and flow) (Attachments 7B and 8B).

Mortalities caused by the operations-related activities were greatest under the No-Action Alternative and lowest under CP3, but CP1 had a slightly lower mortality than CP2 (Tables 11-10 and 11-11).

When removing nonoperations-related mortality, allowing comparison of mortality for operations-related activities only, egg incubation was still the primary life stage affected, but operations-related activities had a greater effect on fry than on presmolts and an even lesser effect on immature smolts. The same trends for each Comprehensive Plan were observed, with the bulk of the mortality affecting the egg incubation life stage, and flow triggering more of the mortality (Table 11-11).

In all water-year types, under all Comprehensive Plans, the greatest portion of mortality occurred to fry caused by forced movement to downstream habitats. Prespawn, incubation, and superimposition mortality were greater than mortality to eggs caused by unsuitable water temperatures and presmolt habitat movement.

In critical water years, mortality to eggs during the prespawn phase was the primary cause of operations-related mortalities for CP3, followed by mortality to eggs prior to spawning, and then to fry caused by forced movement. Least affected were presmolts and then immature smolts by both water temperatures and forced movement. Attachments 7C and 8C contain tables of mortality to fall-run sorted by water-year type, and Table 11-12 outlines the ranks classified under each Comprehensive Plan for each water-year type.

As with critical water years, dry water years were dominated by mortality to fry due to forced movement downstream, followed by redd dewatering or scouring and redd superimposition. Additional mortality occurred to fall-run Chinook salmon presmolts and immature smolts from both forced movement and unsuitable water temperatures (Table 11-12).

Below-normal and above-normal water years were relatively similar for all Comprehensive Plans. The mortality factors were dominated by mortality to fry due to forced movement downstream, followed by redd superimposition, dewatering or scouring. Mortality to presmolts caused by forced downstream movement was a greater factor affecting fall-run Chinook salmon populations than was egg mortality caused by unsuitable water temperatures or to immature smolts and fry due to unsuitable water temperatures (Table 11-12).

As with the water-year types discussed above, under wet water year conditions, the majority of the mortality also occurred to fry due to forced downstream movement, followed by redd superimposition, and redd dewatering or scouring. Mortality to presmolts and immature smolts from downstream movement was the lowest mortality rates resulting from operations-related activities. Least affected were eggs due to unsuitable water temperatures, both pre- and post-spawn.

Years with the highest mortality were the same for the No-Action Alternative, CP1, CP2, and CP3: 1934, 1935, 1970, 1978, and 1993. With the exception of 1970, each of these years was preceded by a critical water year. Overall, years with the lowest mortality tended to be dry or critical water years.

Years with the highest mortality were the same for the Existing Condition, CP1, CP2, and CP3: 1957, 1982, 1985, 1994, and 1997. Overall, years with the lowest mortality tended to be dry or critical water years.

When the spawning population equaled the AFRP goal, fall-run Chinook salmon mortality caused by operations-related activities decreased under CP3 compared to No-Action Alternative conditions (Attachment 9B). Under CP3, mortality caused by operations-related activities would decrease from non-operations related mortality by over 15 percent. Under CP3, the greatest mortality to fall-run Chinook salmon occurred to the egg incubation life stage, followed by fry, then presmolts, and lastly to immature smolts. Nonoperational conditions were the primary causes of mortality for all life stages under all alternatives.

Because fall-run Chinook salmon have, overall, a reduced mortality, fall-run Chinook salmon would benefit from actions taken in CP3. Mitigation for this impact is not needed, and thus not proposed.

Late Fall-Run Chinook Salmon

Production

Based on the 1999 through 2006 population average, overall average late fall-run Chinook salmon production for the 82-year period was similar to CP3 and the No-Action Alternative and the Existing Condition (Attachments 10A and 11A). The maximum increase in production relative to the No-Action Alternative was 11 percent for CP3, while the largest decrease in production relative to the No-Action Alternative was 5 percent for CP3 (Attachment 10A). The maximum increase in production relative to the Existing Condition was 18 percent for CP3, while the largest decrease in production relative to the Existing Condition was 7 percent for CP3 (Attachment 11A).

Under CP3, dry water years 1926, 1930, 1932, and 1985 had greater than 7 to 11 percent increases in production compared to the No-Action Alternative. No decreases in production greater than 5 percent occurred.

Under CP3, three dry (1926, 1955, and 1985), had greater than 5 percent increases in production compared to the Existing Condition. One wet water year (1983) had a 6 percent increase relative to the Existing Condition. One critical water year (1976), and one wet water year (1984) had substantial decreases in production over the Existing Condition by 5 to 7 percent.

When the spawning population equaled the AFRP goal, overall average late fall-run Chinook salmon production was similar for CP3 relative to the No-

Action Alternative (Attachment 12A). The maximum increase in production relative to the No-Action Alternative was 27 percent for CP3. The largest decrease in production relative to the No-Action Alternative was 5 percent for CP3. In critical, dry, below-normal, and above-normal water years, years with the lowest production under the No-Action Alternative typically had the greatest percent increase in production under CP3, with two exceptions – 1994 and 1937 (1 percent decrease for both). In wet water years, however, the lowest production years typically remained similar or had a slight decrease in production under CP3 conditions relative to the No-Action Alternative.

Mortality

Based on the 1999 through 2006 population average, the greatest mortality to late fall-run under CP3 occurred to the egg incubation life stage, followed by fry, then presmolts and lastly to immature smolts. Nonoperational conditions were the primary causes of mortality for all life stages under all Comprehensive Plans. Table 11-13 displays the overall mortalities for each Comprehensive Plans that were caused by nonoperational factors versus those caused by operations (i.e., water temperature and flow) (Attachments 10 B and 11B). Mortalities caused by the project decreased for all Comprehensive Plans relative to the No-Action Alternative.

When removing nonoperations-related mortality, allowing comparison of mortality for operations-related activities only, fry became the primary life stage affected, and operations-related activities had a greater effect on eggs than on presmolts and an even lesser effect on immature smolts. Most of the mortality occurred as a result of flow conditions rather than water temperature (Table 11-14).

Under all Comprehensive Plans, mortality to fry resulting from unsuitable water temperatures only occurred at low levels to late fall-run Chinook salmon during critical, dry and below-normal water years only. In all water-year types, under all Comprehensive Plans, mortality to fry during forced movement to downstream habitats was the primary cause of operations-related mortality.

In critical, dry, and below-normal water years, the causes of operations-related mortality follow similar trends for all Comprehensive Plans, with a few exceptions. In general, the effects of flow (and density) had the greatest effect on mortality. Forced movement of fry resulted in the greatest mortality, followed by flow effects on eggs via scouring, dewatering, or superimposition. Next affected were presmolts and immature smolts by unsuitable water temperatures, and lastly temperature effects on eggs and flow effects on presmolts and immature smolts and fry (Table 11-15).

Wet and above-normal water years were overall similar to critical, dry, and below-normal water years except that mortality to fry due to unsuitable water temperatures disappear.

Years with the highest mortality were the same for all the Comprehensive Plans and were 1937, 1957, 1973, 1982, 1994, and 1997. All water-year types were covered. Two years were preceded by a wet water year, one preceded by an above-normal water year, and two by a below-normal water year (Attachments 10C and 11C).

When the spawning population equaled the AFRP goal, late fall-run Chinook salmon mortality caused by operations-related activities was slightly less under CP3 than under No-Action Alternative (Attachment 12B). Under CP3, mortality caused by operations-related activities would decrease from non-operations related mortality by 29 percent. Under CP3, the greatest mortality to late fall-run Chinook salmon occurred to the egg incubation life stage, followed by presmolts, then fry, and lastly to immature smolts. Nonoperational conditions were the primary causes of mortality for all life stages under all alternatives.

Because late fall-run Chinook salmon have, overall, a reduced mortality, late fall-run Chinook salmon would benefit from actions taken in CP3. Mitigation for this impact is not needed, and thus not proposed.

Impact Aqua-13 (CP3): Changes in Flow and Water Temperatures in the Upper Sacramento River Resulting from Project Operation—Steelhead, Green Sturgeon, Sacramento Splittail, American Shad, and Striped Bass CP3 operation would result in slightly improved flow and water temperature conditions in the upper Sacramento River for steelhead, green sturgeon, Sacramento splittail, American shad, and striped bass. This impact would be less than significant.

This impact would be similar to Impact Aqua-13 (CP1). The impact could be greater because of the increased reservoir capacity associated with an 18.5-foot raise compared to a 6.5-foot raise.

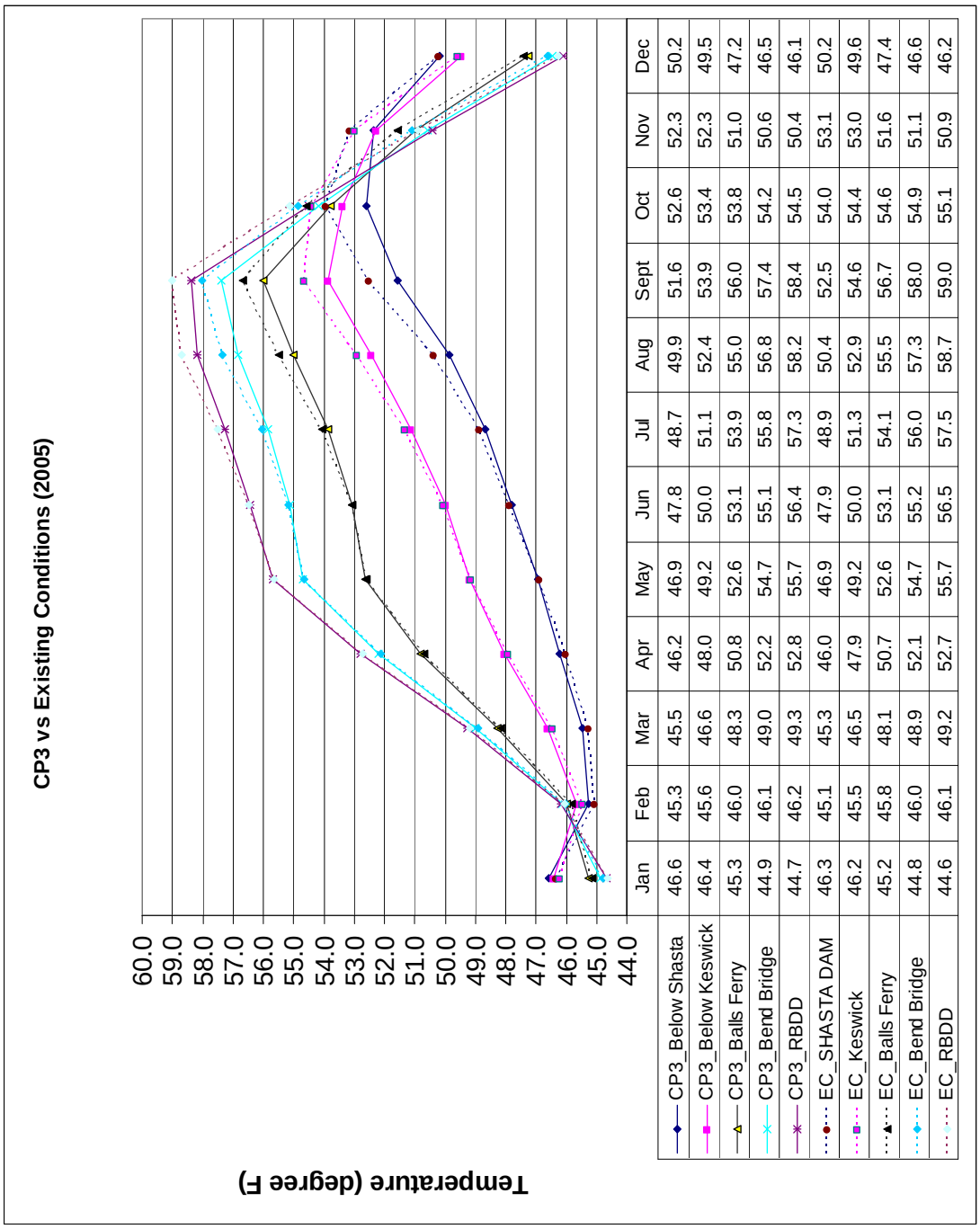
Flow-Related Effects Similar to CP1, monthly mean flows at all model locations (i.e., below Shasta Dam, below Keswick Dam, above Bend Bridge, and above RBDD) within the upper Sacramento River under CP3 would be essentially equivalent to flows (less than 4 percent) under the Existing Condition and No-Action Alternative conditions simulated for all months (see the *Hydrology, Hydraulics, and Water Management Technical Report* for complete modeling results). Potential flow-related effects on fish species of management concern in the upper Sacramento River would be minimal. All potential changes in flows and stages would diminish rapidly downstream from RBDD because of increasing effect of inflows from tributaries, and of diversions and flood bypasses.

There would be no discernable flow-related effects on steelhead, green sturgeon, Sacramento splittail, American shad, or striped bass in the upper Sacramento River related to changes in monthly mean flows under CP3, relative

to the Existing Condition and No-Action Alternative. Functional flows for migration, attraction, spawning, egg incubation, and rearing/emigration for all these fish species would be unchanged. Flow-related effects on these fish species would be less than significant.

Water Temperature-Related Effects Similar to CP1, monthly mean water temperatures at all model locations (i.e., below Shasta Dam, below Keswick Dam, above Bend Bridge, and above RBDD) within the upper Sacramento River under CP3 would be the same or fractionally lower than those under the Existing Condition and No-Action Alternative simulated for all months (Figures 11-23 and 11-24) (see also the *Hydrology, Hydraulics, and Water Management Technical Report* for complete modeling results). As discussed above, the modeling simulations may not fully account for real-time management of the cold-water pool and TCD (through the SRTTG) to achieve maximum cold-water benefits. Therefore, the modeled changes in water temperature (i.e., small benefits) are likely conservative and understated to some degree. Nevertheless, potential water temperature-related effects on fish species of management concern in the upper Sacramento River from CP3 would be minimal. During most years, annual releases from Shasta Dam would be unchanged. On average, the greatest cooling effect (less than 1°F) occurs during critical years and during the late summer (i.e., July to September), because of the increased cold-water pool volume within Shasta Lake, even following an extended dry period. All potential changes in flows and stages would diminish downstream from RBDD because of the increasing effect of inflows from tributaries, and of diversions and flood bypasses.

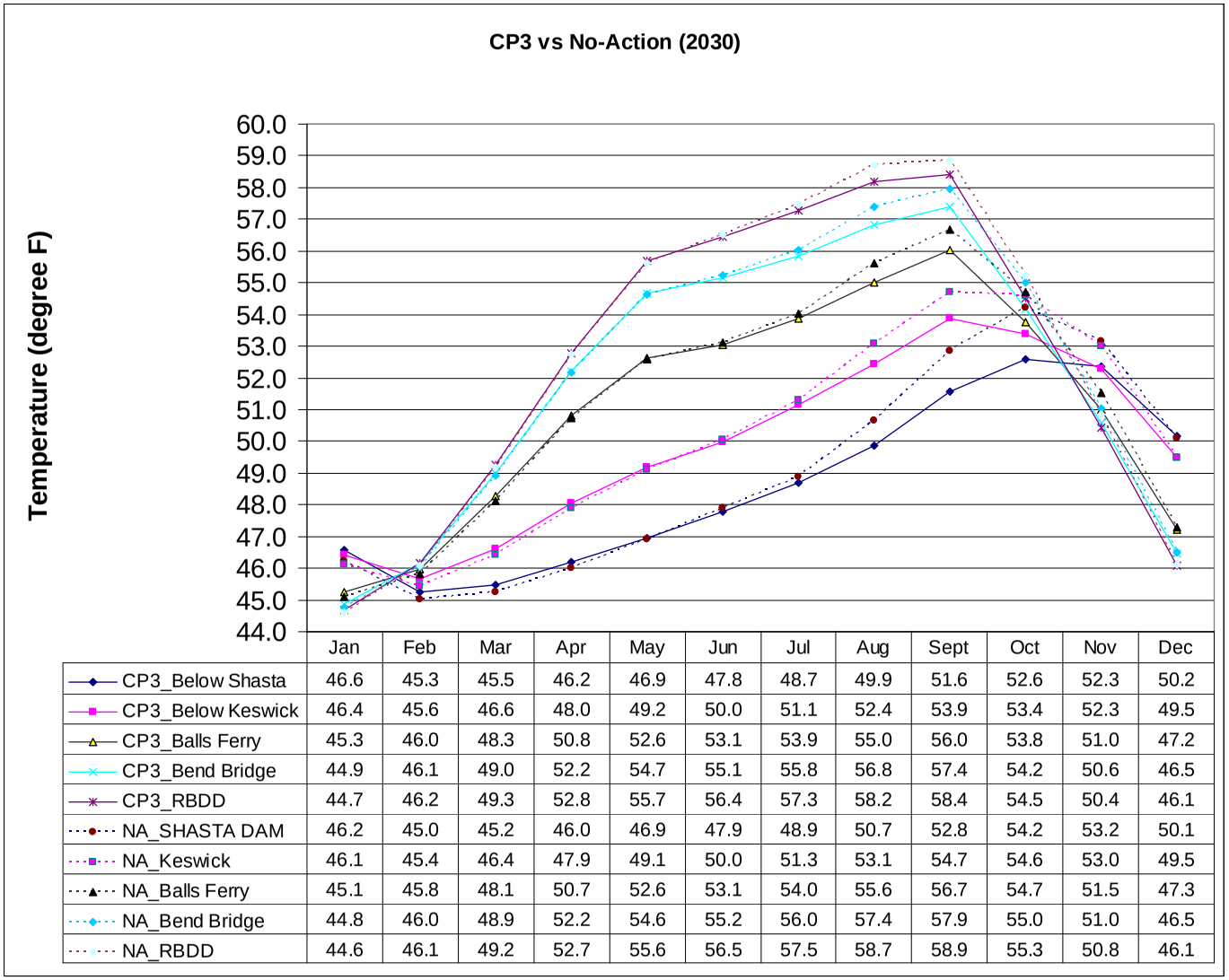
There would be very small water temperature–related effects on steelhead, green sturgeon, Sacramento splittail, American shad, or striped bass in the upper Sacramento River related to slightly cooler monthly mean water temperatures under CP3, relative to the Existing Condition and No-Action Alternative. Mean monthly water temperatures would not rise above important thermal tolerances for the species life stages relevant to the upper Sacramento River. Water temperature-related effects on these fish species would be less than significant. Mitigation for this impact is not needed, and thus not proposed.



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
CP3_Below Shasta	46.6	45.3	45.5	46.2	46.9	47.8	48.7	49.9	51.6	52.6	52.3	50.2
CP3_Below Keswick	46.4	45.6	46.6	48.0	49.2	50.0	51.1	52.4	53.9	53.4	52.3	49.5
CP3_Balls Ferry	45.3	46.0	48.3	50.8	52.6	53.1	53.9	55.0	56.0	53.8	51.0	47.2
CP3_Bend Bridge	44.9	46.1	49.0	52.2	54.7	55.1	55.8	56.8	57.4	54.2	50.6	46.5
CP3_RBDD	44.7	46.2	49.3	52.8	55.7	56.4	57.3	58.2	58.4	54.5	50.4	46.1
EC_SHASTA DAM	46.3	45.1	45.3	46.0	46.9	47.9	48.9	50.4	52.5	54.0	53.1	50.2
EC_Keswick	46.2	45.5	46.5	47.9	49.2	50.0	51.3	52.9	54.6	54.4	53.0	49.6
EC_Balls Ferry	45.2	45.8	48.1	50.7	52.6	53.1	54.1	55.5	56.7	54.6	51.6	47.4
EC_Bend Bridge	44.8	46.0	48.9	52.1	54.7	55.2	56.0	57.3	58.0	54.9	51.1	46.6
EC_RBDD	44.6	46.1	49.2	52.7	55.7	56.5	57.5	58.7	59.0	55.1	50.9	46.2

Key:
CP = Comprehensive Plan
EC = Existing Condition
RBDD = Red Bluff Diversion Dam

Figure 11-23. Changes in Mean Monthly Water Temperature at Modeled Locations in the Sacramento River Within the Primary Study Area (Existing Condition)



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
CP3_Below Shasta	46.6	45.3	45.5	46.2	46.9	47.8	48.7	49.9	51.6	52.6	52.3	50.2
CP3_Below Keswick	46.4	45.6	46.6	48.0	49.2	50.0	51.1	52.4	53.9	53.4	52.3	49.5
CP3_Balls Ferry	45.3	46.0	48.3	50.8	52.6	53.1	53.9	55.0	56.0	53.8	51.0	47.2
CP3_Bend Bridge	44.9	46.1	49.0	52.2	54.7	55.1	55.8	56.8	57.4	54.2	50.6	46.5
CP3_RBDD	44.7	46.2	49.3	52.8	55.7	56.4	57.3	58.2	58.4	54.5	50.4	46.1
NA_SHASTA DAM	46.2	45.0	45.2	46.0	46.9	47.9	48.9	50.7	52.8	54.2	53.2	50.1
NA_Keswick	46.1	45.4	46.4	47.9	49.1	50.0	51.3	53.1	54.7	54.6	53.0	49.5
NA_Balls Ferry	45.1	45.8	48.1	50.7	52.6	53.1	54.0	55.6	56.7	54.7	51.5	47.3
NA_Bend Bridge	44.8	46.0	48.9	52.2	54.6	55.2	56.0	57.4	57.9	55.0	51.0	46.5
NA_RBDD	44.6	46.1	49.2	52.7	55.6	56.5	57.5	58.7	58.9	55.3	50.8	46.1

Key:
CP = Comprehensive Plan
EC = Existing Condition
RBDD = Red Bluff Diversion Dam

Figure 11-24. Changes in Mean Monthly Water Temperature at Modeled Locations in the Sacramento River Within the Primary Study Area (No-Action Alternative)

Impact Aqua-14 (CP3): Reduction in Ecologically Important Geomorphic Processes in the Upper Sacramento River Resulting from Reduced Frequency and Magnitude of Intermediate to High Flows CP3 operations could result in reduced intermediate to large flows that are necessary for channel forming and maintenance, meander migration, and the creation of seasonally inundated floodplains, all of which are processes necessary for the maintenance of important aquatic habitat functions and values for the fish and macroinvertebrate community. A reduction in these ecologically important geomorphic processes and related aquatic habitat functions and values in the Sacramento River and lowermost (confluence) areas of tributaries would be a potentially significant impact.

This impact would be similar to Impact Aqua-14 (CP1). The impact could be greater because the increased reservoir capacity associated with an 18.5-foot raise compared to a 6.5-foot raise would allow additional water volume (and flows) to be stored behind the raised dam. Sediment transport, deposition, and scour regulate the formation of key habitat features such as point bars, gravel deposits, and SRA habitat. Intermediate to high flows and associated stage elevation of water surface also provide a backwater effect on the lowermost segment of tributaries, which reduces the potential for downcutting. These processes are regulated by the magnitude and frequency of flow, with relatively large flows providing the energy required to mobilize sediment from the river bed, produce meander migration, increase stage elevation, and create seasonally inundated floodplains. Project operation could result in reduced intermediate to large flows that are necessary for channel forming and maintenance, meander migration, and the creation of seasonally inundated floodplains.

CP3 would lead to a further reduction in the magnitude, duration, and frequency of intermediate to large flows. Overall, the project would increase the existing, ongoing impacts on geomorphic processes resulting from operation of Shasta Dam that are necessary for channel forming and maintenance, meander migration, and the creation of seasonally inundated floodplains.

These effects would likely occur along the upper Sacramento River, downstream from Shasta Dam, throughout the primary study area. Reductions in the magnitude of high flows would likely be sufficient to reduce ecologically important processes along the upper Sacramento River, downstream from Shasta Dam, throughout the primary study area. These impacts would be potentially significant within the primary study area. Mitigation for this impact is proposed in Section 11.3.4.

Lower Sacramento River and Delta

Impact Aqua-15 (CP3): Changes in Flow and Water Temperatures in the Lower Sacramento River and Tributaries and Trinity River Resulting from Project Operation – Fish Species of Primary Management Concern CP3 operation would result in no discernable change in mean monthly flow or water temperature conditions in the lower Sacramento River; however, predicted

changes in flow in the Feather River, American River, and Trinity River could result in an adverse effect on Chinook salmon, steelhead, coho salmon, green sturgeon, Sacramento splittail, American shad, and striped bass if they were to occur. This impact would be potentially significant.

This impact would be similar to Impact Aqua-15 (CP1). The impact could be greater because the increased reservoir capacity associated with an 18.5-foot raise compared to a 6.5-foot raise would allow additional water volume (and increased cold-water pool) to be stored behind the raised dam.

Similar to CP1, monthly mean flows at model locations (i.e., Verona, Freeport) within the lower Sacramento River under CP3 would be essentially equivalent (less than 2 percent difference) to flows under the Existing Condition and No-Action Alternative conditions simulated for all months (see the *Hydrology, Hydraulics, and Water Management Technical Report* for complete modeling results). All potential changes in flows diminished rapidly downstream from RBDD because of the increasing effect of inflows from tributaries, and of diversions and flood bypasses. Potential flow-related effects on fish species of management concern in the lower Sacramento River from this alternative would be minimal. Differences in mean monthly flow are generally small (less than 2 percent) and within the existing range of variability. All potential changes in water temperatures in the lower Sacramento River due to small changes in releases would diminish rapidly downstream because of increasing effect of inflows, atmospheric influences, and groundwater. Therefore, flow- and temperature-related impacts on fish species in the lower Sacramento River would be less than significant.

Also similar to CP1, monthly mean flows at all model locations within the lower Feather River, the American River, and Trinity River under CP2 would be essentially equivalent (less than 2 percent difference) to flows under the Existing Condition and No-Action Alternative simulated for most months; however, there are several months within the modeling record showed substantial changes (based on model simulations) to flows in tributaries (see the *Hydrology, Hydraulics, and Water Management Technical Report* for complete CalSim-II modeling results). All potential changes in flows could be diminished in these areas per existing operational rules and because of operation of upstream reservoirs (i.e., Lake Oroville, Folsom Lake, and Trinity Lake) and increasing effects of inflows from tributaries and of diversions and flood bypasses. Nevertheless, based on predicted changes in flow and associated flow-habitat relationships, potential flow-related impacts to species of management concern in the American, Feather, and Trinity rivers could occur and would be a potentially significant impact.

Monthly mean flows at all model locations within the lower Feather River (i.e., below Thermalito Afterbay) and the American River (i.e., near the H Street Bridge in Sacramento) under CP1 would also be essentially equivalent (less than 2 percent difference) to flows under the Existing Condition and No-Action

Alternative simulated for all months. All potential changes in flows were diminished in these areas because of operation of upstream CVP and SWP reservoirs (i.e., Lake Oroville and Folsom Lake) and increasing effect of inflows from tributaries, and of diversions and flood bypasses. Potential flow-related effects on fish species of management concern in the Feather River and American River from this alternative would be minimal and within the range of existing variability.

All potential changes in water temperatures in the lower Sacramento River and primary tributaries (i.e., Feather River and American River) due to altered releases from reservoirs diminished downstream from RBDD because of increasing effect of inflows, and atmospheric and groundwater influences.

As under CP1, effects of altered flow regimes resulting from implementation of CP3 are unlikely to extend into the lower Sacramento River and Delta because the Central Valley's reservoirs and diversions are managed as a single integrated system (consisting of the SWP and the CVP). The guidelines for this management, which are described in the CVP/SWP OCAP, have been designed to maintain standards for flow to the lower Sacramento River and Delta. CVP and SWP operations must be consistent with OCAP to allow coverage by OCAP permits and BOs. Thus, under CP3, this project is not anticipated to cause an alteration in flow to the Delta nor cause an alteration to water temperatures in the lower Sacramento River and primary tributaries within the extended study area sufficient to cause discernable effects on Chinook salmon, steelhead, green sturgeon, Sacramento splittail, American shad, or striped bass, relative to the Existing Condition and No-Action Alternative. Functional flows for fish migration, attraction, spawning, egg incubation, and rearing/emigration for all these fish species would be unchanged. Therefore, flow- and temperature-related effects on these fish species would be less than significant. Mitigation for this impact is proposed in Section 11.3.4.

Impact Aqua-16 (CP3): Reduction in Ecologically Important Geomorphic Processes in the Lower Sacramento River Resulting from Reduced Frequency and Magnitude of Intermediate to High Flows Project operation could result in reduced intermediate to large flows that are necessary for channel forming and maintenance, meander migration, and the creation of seasonally inundated floodplains, all of which are processes necessary for the maintenance of important aquatic habitat functions and values for the fish and macroinvertebrate community. A reduction in these ecologically important geomorphic processes and related aquatic habitat functions and values in the lower Sacramento River and lowermost (confluence) areas of tributaries would be a potentially significant impact.

This impact would be similar to Impact Aqua-16 (CP1). The impact could be greater because the increased reservoir capacity associated with an 18.5-foot raise compared to a 6.5-foot raise would allow additional water volume (and flows) to be stored behind the raised dam. Sediment transport, deposition, and

scour regulate the formation of key habitat features such as point bars, gravel deposits, and SRA habitat. Intermediate to high flows and associated stage elevation of water surface also provide a backwater effect on the lowermost segment of tributaries, which the reduces potential for downcutting. These processes are regulated by the magnitude and frequency of flow, with relatively large floods providing the energy required to mobilize sediment from the river bed, produce meander migration, increase stage elevation, create seasonally inundated floodplains, and inundate floodplain bypasses. Project operation could result in reduced intermediate to large flows that are necessary for channel forming and maintenance, meander migration, and creation of seasonally inundated floodplains.

CP3 would lead to a further reduction in the magnitude, duration, and frequency of intermediate to large flows, relative to the Existing Condition and No-Action Alternative. Overall, the project would increase the existing, ongoing impacts on geomorphic processes resulting from the operation of Shasta Dam that are necessary for channel forming and maintenance, meander migration, the creation of seasonally inundated floodplains, and the inundation of floodplain bypasses. These effects would likely occur along upper reaches of the lower Sacramento River. Reductions in the magnitude of high flows would likely be sufficient to reduce ecologically important processes along the upper Sacramento River and its floodplain bypasses. These impacts would be potentially significant. Mitigation for this impact is proposed in Section 11.3.4.

Impact Aqua-17 (CP3): Effects to Delta Fishery Habitat Resulting from Changes to Delta Outflow Based on the results of hydrologic modeling comparing Delta outflow under CP3 relative to the Existing Condition and No-Action Alternative, CP3 would have a less than significant effect on Delta fisheries and hydrologic transport processed within the Bay-Delta.

Results of the comparison of Delta outflows under CP3 compared with the Existing Condition and No-Action Alternative are summarized by month and water-year type in Table 11-30. The comparison includes the estimated average monthly outflow, the average monthly flow under CP3, and the percentage change between base flows and CP3 operations. Results of the analysis (Table 11-30) showed that Delta outflows were observed to be slightly lower under many of the CP3 operations as well as slightly higher than basis-of-comparison conditions depending on month and water-year type. However, none of the changes were larger than 5 percent. Based on the results of this comparison, it was concluded that CP3 would have a less than significant impact on Delta fisheries and hydrologic transport processed within the Bay-Delta as a consequence of changes in Delta outflow under existing conditions. Mitigation for this impact is not needed, and thus not proposed.

Table 11-30. Delta Outflow Under Existing Conditions, No-Action Alternative, and CP3

		Existing Condition	CP3 (Existing Condition)		No-Action Alternative	CP3 (Future Condition)	
Month	**Water Year**	**Base Flow (cfs)**	**Flow (cfs)**	**Percent Change**	**Base Flow (cfs)**	**Flow (cfs)**	**Percent Change**
January	Average	40,954	40,591	-0.9	40,167	39,890	0.7
	W	84,978	84,518	-0.5	83,595	83,313	0.3
	AN	47,101	46,194	-1.9	46,322	45,248	2.3
	BN	19,833	19,935	0.5	19,369	19,455	-0.4
	D	11,374	11,034	-3.0	10,881	10,620	2.4
	C	8,434	8,243	-2.3	8,111	8,195	-1.0
February	Average	52,699	51,986	-1.4	52,341	51,870	0.9
	W	98,900	97,867	-1.0	98,330	97,505	0.8
	AN	61,653	60,375	-2.1	60,800	59,710	1.8
	BN	35,173	35,171	0.0	35,441	35,087	1.0
	D	20,356	19,808	-2.7	19,894	20,141	-1.2
	C	12,605	12,074	-4.2	12,628	12,326	2.4
March	Average	42,610	42,422	-0.4	42,117	41,916	0.5
	W	79,254	79,240	0.0	78,370	78,405	0.0
	AN	53,361	52,713	-1.2	52,361	51,787	1.1
	BN	23,126	23,033	-0.4	23,136	23,093	0.2
	D	18,943	18,567	-2.0	18,596	18,062	2.9
	C	10,697	10,764	0.6	10,749	10,729	0.2
April	Average	27,104	27,095	0.0	27,096	27,047	0.2
	W	49,818	49,783	-0.1	49,806	49,743	0.1
	AN	27,420	27,336	-0.3	27,778	27,471	1.1
	BN	19,001	19,062	0.3	18,938	18,958	-0.1
	D	12,735	12,712	-0.2	12,516	12,552	-0.3
	C	8,586	8,645	0.7	8,600	8,628	-0.3
May	Average	20,470	20,427	-0.2	20,288	20,184	0.5
	W	37,736	37,694	-0.1	37,173	37,153	0.1
	AN	22,276	21,909	-1.6	22,205	21,662	2.4
	BN	14,200	14,217	0.1	14,080	13,940	1.0
	D	9,422	9,519	1.0	9,436	9,465	-0.3
	C	5,141	5,141	0.0	5,306	5,303	0.1
June	Average	13,104	13,058	-0.4	13,055	13,050	0.0
	W	23,675	23,682	0.0	23,303	23,342	-0.2
	AN	12,563	12,297	-2.1	12,587	12,395	1.5
	BN	8,735	8,589	-1.7	9,027	8,747	3.1
	D	6,611	6,662	0.8	6,656	6,869	-3.2
	C	5,580	5,608	0.5	5,615	5,697	-1.5
July	Average	7,927	7,969	0.5	8,291	8,312	-0.3
	W	11,228	11,241	0.1	11,501	11,469	0.3
	AN	9,085	9,169	0.9	10,040	10,098	-0.6
	BN	7,314	7,396	1.1	7,897	7,992	-1.2
	D	5,330	5,409	1.5	5,477	5,545	-1.3
	C	4,229	4,191	-0.9	4,271	4,213	1.4

Table 11-30. Delta Outflow Under Existing Conditions, No-Action Alternative, and CP3 (contd.)

		Existing Condition	CP3 (Existing Condition)		No-Action Alternative	CP3 (Future Condition)	
Month	**Water Year**	**Base Flow (cfs)**	**Flow (cfs)**	**Percent Change**	**Base Flow (cfs)**	**Flow (cfs)**	**Percent Change**
August	Average	4,501	4,549	1.1	4,458	4,482	-0.6
	W	5,233	5,220	-0.3	4,961	4,952	0.2
	AN	4,000	4,000	0.0	4,039	4,037	0.0
	BN	4,000	4,000	0.0	4,144	4,140	0.1
	D	4,491	4,677	4.1	4,547	4,617	-1.5
	C	4,017	4,097	2.0	4,017	4,108	-2.3
September	Average	5,595	5,553	-0.7	5,262	5,261	0.0
	W	10,498	10,432	-0.6	9,510	9,419	1.0
	AN	3,781	3,761	-0.5	3,464	3,511	-1.4
	BN	3,516	3,428	-2.5	3,405	3,431	-0.8
	D	3,050	3,048	-0.1	3,277	3,344	-2.1
	C	3,025	3,009	-0.5	3,000	3,011	-0.4
October	Average	5,313	5,275	-0.7	5,023	5,022	0.0
	W	7,040	6,960	-1.1	6,464	6,447	0.3
	AN	4,540	4,534	-0.1	4,335	4,258	1.8
	BN	4,624	4,587	-0.8	4,427	4,457	-0.7
	D	4,388	4,364	-0.6	4,257	4,280	-0.6
	C	4,534	4,532	0.0	4,434	4,473	-0.9
November	Average	9,688	9,551	-1.4	9,238	9,154	0.9
	W	15,113	15,208	0.6	14,412	14,256	1.1
	AN	11,060	10,316	-6.7	10,265	10,071	1.9
	BN	6,529	6,236	-4.5	6,248	6,148	1.6
	D	6,755	6,667	-1.3	6,474	6,526	-0.8
	C	4,648	4,724	1.6	4,631	4,631	0.0
December	Average	22,933	22,581	-1.5	22,289	21,858	1.9
	W	47,953	46,947	-2.1	46,800	45,738	2.3
	AN	18,119	17,981	-0.8	17,859	17,392	2.6
	BN	13,712	13,312	-2.9	12,890	12,366	4.1
	D	8,645	8,793	1.7	8,366	8,534	-2.0
	C	5,728	5,882	2.7	5,460	5,645	-3.4

Key:
AN = above-normal
BN = below-normal
C = critical
CP = Comprehensive Plan
cfs = cubic feet per second
D = dry
W = wet

Impact Aqua-18 (CP3): Effects to Delta Fishery Habitat Resulting from Changes to Delta Inflow Changes in upstream reservoir storage have the potential to affect Delta inflow. Delta inflow may affect hydrologic conditions within Delta channels, hydraulic residence times, salinity gradients, and the transport and movement of various life stages of fish, invertebrates, phytoplankton, and nutrients into and through the Delta. Delta inflow serves as a surrogate metric for a variety of habitat conditions within the Delta that directly, or indirectly, affects fish and other aquatic resources. Based on the results of hydrologic modeling comparing Delta inflow under CP3 to Existing

Condition and No-Action Alternative, CP3 would have a less than significant effect on Delta fisheries and hydrologic transport processed within the Bay-Delta.

Results of the comparison of Delta inflows are summarized by month and water-year type in Table 11-31. The comparison includes the estimated average monthly inflow under the basis-of-comparison conditions, the average monthly flow under CP3, and the percentage change between base flows and CP3 operations. Delta inflows were observed to be slightly lower under many of the CP3 operations and slightly higher than basis-of-comparison conditions depending on month and water-year type. None of the comparisons exceeded 5 percent difference between the No-Action Alternative, Existing Condition and CP3. Based on the results of this comparison, it was concluded that CP3 would have a less than significant effect on Delta fisheries and hydrologic transport processed within the Bay-Delta as a consequence of changes in Delta inflow. Mitigation for this impact is not needed, and thus not proposed.

Table 11-31. Delta Inflow Under Existing Conditions, No-Action Alternative, and CP3

		Existing Condition	CP3 (Existing Condition)		No-Action Alternative	CP3 (Future Condition)	
Month		**Base Flow (cfs)**	**Flow (cfs)**	**Percent Change**	**Base Flow (cfs)**	**Flow (cfs)**	**Percent Change**
January	Average	50,193	49,878	-0.6	49,674	49,363	-0.6
	W	93,590	93,128	-0.5	92,710	92,441	-0.3
	AN	56,641	55,754	-1.6	55,935	54,823	-2.0
	BN	30,176	30,244	0.2	29,939	29,961	0.1
	D	21,201	20,955	-1.2	20,927	20,617	-1.5
	C	16,560	16,582	0.1	16,312	16,320	0.0
February	Average	61,147	60,567	-0.9	60,691	60,370	-0.5
	W	108,058	107,146	-0.8	107,699	106,984	-0.7
	AN	70,137	69,112	-1.5	69,901	68,791	-1.6
	BN	44,310	44,208	-0.2	43,831	43,604	-0.5
	D	28,791	28,237	-1.9	28,157	28,235	0.3
	C	18,694	18,678	-0.1	18,099	18,716	3.4
March	Average	50,938	50,790	-0.3	50,576	50,367	-0.4
	W	88,045	88,073	0.0	87,612	87,608	0.0
	AN	63,252	62,440	-1.3	62,667	61,943	-1.2
	BN	32,287	32,276	0.0	31,760	31,790	0.1
	D	26,931	26,735	-0.7	26,504	26,045	-1.7
	C	15,999	16,043	0.3	16,299	16,260	-0.2
April	Average	33,715	33,694	-0.1	33,832	33,817	0.0
	W	57,897	57,872	0.0	58,185	58,137	-0.1
	AN	35,063	34,892	-0.5	35,403	35,127	-0.8
	BN	26,022	26,028	0.0	25,955	25,965	0.0
	D	17,991	17,976	-0.1	17,853	18,012	0.9
	C	12,534	12,630	0.8	12,653	12,683	0.2

Table 11-31. Delta Inflow Under Existing Conditions, No-Action Alternative, and CP3 (contd.)

		Existing Condition	CP3 (Existing Condition)		No-Action Alternative	CP3 (Future Condition)	
Month		**Base Flow (cfs)**	**Flow (cfs)**	**Percent Change**	**Base Flow (cfs)**	**Flow (cfs)**	**Percent Change**
May	Average	27,783	27,726	-0.2	27,762	27,661	-0.4
	W	47,155	47,092	-0.1	46,817	46,783	-0.1
	AN	30,016	29,594	-1.4	30,446	29,774	-2.2
	BN	21,135	21,171	0.2	21,177	21,089	-0.4
	D	15,555	15,666	0.7	15,529	15,605	0.5
	C	9,671	9,638	-0.3	9,827	9,866	0.4
June	Average	23,254	23,318	0.3	23,559	23,589	0.1
	W	35,726	35,775	0.1	35,503	35,570	0.2
	AN	23,868	23,637	-1.0	24,400	24,102	-1.2
	BN	18,814	18,636	-0.9	20,111	19,838	-1.4
	D	15,726	16,025	1.9	15,789	16,174	2.4
	C	12,089	12,409	2.6	12,516	12,619	0.8
July	Average	18,889	19,210	1.7	20,470	20,748	1.4
	W	23,568	23,745	0.8	24,661	24,797	0.5
	AN	19,796	20,029	1.2	22,429	22,697	1.2
	BN	18,549	18,979	2.3	21,709	21,822	0.5
	D	16,344	16,943	3.7	17,176	17,995	4.8
	C	12,058	12,235	1.5	12,928	12,904	-0.2
August	Average	18,889	19,210	1.7	16,281	16,378	0.6
	W	23,568	23,745	0.8	17,995	17,952	-0.2
	AN	19,796	20,029	1.2	17,543	17,689	0.8
	BN	18,549	18,979	2.3	17,273	17,239	-0.2
	D	16,344	16,943	3.7	15,167	15,651	3.2
	C	12,058	12,235	1.5	11,816	11,743	-0.6
September	Average	16,480	16,475	0.0	16,625	16,758	0.8
	W	23,176	23,134	-0.2	22,459	22,376	-0.4
	AN	15,742	15,737	0.0	15,814	15,951	0.9
	BN	14,961	14,778	-1.2	15,198	15,263	0.4
	D	12,749	12,882	1.0	14,118	14,610	3.5
	C	10,076	10,156	0.8	10,220	10,360	1.4
October	Average	15,542	15,545	0.0	14,833	14,888	0.4
	W	18,176	18,130	-0.3	17,270	17,297	0.2
	AN	14,399	14,446	0.3	13,708	13,717	0.1
	BN	15,010	15,022	0.1	14,436	14,479	0.3
	D	13,980	14,035	0.4	13,490	13,510	0.1
	C	13,942	13,917	-0.2	13,153	13,382	1.7
November	Average	19,409	19,400	0.0	19,043	19,041	0.0
	W	26,007	26,117	0.4	25,720	25,527	-0.8
	AN	20,432	19,805	-3.1	19,604	19,560	-0.2
	BN	16,833	16,513	-1.9	16,510	16,451	-0.4
	D	15,836	15,972	0.9	15,453	15,679	1.5
	C	12,458	12,955	4.0	12,354	12,535	1.5

Table 11-31. Delta Inflow Under Existing Conditions, No-Action Alternative, and CP3 (contd.)

		Existing Condition	CP3 (Existing Condition)		No-Action Alternative	CP3 (Future Condition)	
Month		**Base Flow (cfs)**	**Flow (cfs)**	**Percent Change**	**Base Flow (cfs)**	**Flow (cfs)**	**Percent Change**
December	Average	33,195	32,934	-0.8	32,657	32,310	-1.1
	W	58,863	57,858	-1.7	58,092	57,003	-1.9
	AN	28,400	28,495	0.3	28,098	27,769	-1.2
	BN	23,545	23,181	-1.5	22,831	22,296	-2.3
	D	19,116	19,386	1.4	19,010	19,285	1.4
	C	14,756	15,069	2.1	14,041	14,573	3.8

Key:
AN = above-normal
BN = below-normal
C = critical
cfs = cubic feet per second
CP = Comprehensive Plan
D = dry
W = wet

Impact Aqua-19 (CP3): Effects to Delta Fisheries Resulting from Changes in Sacramento River Inflow Project operation would result in a variable response in Sacramento River flow, resulting in both increases and decreases in river flow above basis-of-comparison conditions depending on month and water-year type. This impact would be less than significant.

Results of hydrologic modeling, by month and year type, comparing basis-of-comparison Sacramento River flow, are presented in Table 11-32. Results of these analyses show a variable response in Sacramento River flow with CP3 operations resulting in both increases and decreases in river flow above basis-of-comparison conditions, depending on month and water year. All differences in Sacramento River flow between the No-Action Alternative, Existing Condition and CP3 operations were less than 5 percent. Based on these results, it was concluded that the effect of CP3 on fish habitat and transport mechanisms within the lower Sacramento River and Delta would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Table 11-32. Sacramento River Inflow Under Existing Conditions, No-Action Alternative, and CP3

		Existing Condition	CP3 (Existing Condition)		No-Action Alternative	CP3 (Future Condition)	
Month	**Water Year**	**Base Flow (cfs)**	**Flow (cfs)**	**Percent Change**	**Base Flow (cfs)**	**Flow (cfs)**	**Percent Change**
January	Average	34,680	34,497	-0.5	34,363	34,196	-0.5
	W	56,231	56,100	-0.2	55,714	55,726	0.0
	AN	44,117	43,408	-1.6	44,049	43,308	-1.7
	BN	25,272	25,339	0.3	25,024	25,046	0.1
	D	18,166	17,924	-1.3	17,888	17,579	-1.7
	C	14,298	14,321	0.2	14,028	14,039	0.1
February	Average	40,650	40,306	-0.8	40,345	40,230	-0.3
	W	61,746	61,682	-0.1	61,676	61,609	-0.1
	AN	51,527	50,504	-2.0	51,346	50,234	-2.2
	BN	34,676	34,575	-0.3	34,309	34,083	-0.7
	D	24,116	23,408	-2.9	23,562	23,641	0.3
	C	15,834	15,826	-0.1	15,345	15,962	4.0
March	Average	35,093	34,978	-0.3	35,018	34,839	-0.5
	W	52,808	52,870	0.1	52,720	52,715	0.0
	AN	47,679	46,932	-1.6	47,821	47,194	-1.3
	BN	25,629	25,606	-0.1	25,210	25,240	0.1
	D	22,908	22,780	-0.6	22,615	22,226	-1.7
	C	13,443	13,487	0.3	13,907	13,869	-0.3
April	Average	24,190	24,157	-0.1	24,317	24,307	0.0
	W	39,645	39,580	-0.2	39,901	39,869	-0.1
	AN	26,322	26,152	-0.6	26,721	26,444	-1.0
	BN	18,746	18,752	0.0	18,673	18,682	0.1
	D	13,900	13,884	-0.1	13,782	13,940	1.1
	C	10,362	10,458	0.9	10,534	10,563	0.3
May	Average	20,098	20,042	-0.3	20,119	20,018	-0.5
	W	32,904	32,842	-0.2	32,639	32,607	-0.1
	AN	22,928	22,506	-1.8	23,355	22,684	-2.9
	BN	14,923	14,958	0.2	14,997	14,910	-0.6
	D	12,055	12,165	0.9	12,060	12,135	0.6
	C	7,622	7,590	-0.4	7,821	7,860	0.5
June	Average	17,718	17,782	0.4	18,092	18,122	0.2
	W	24,331	24,382	0.2	24,141	24,210	0.3
	AN	17,986	17,755	-1.3	18,678	18,379	-1.6
	BN	15,806	15,628	-1.1	17,160	16,887	-1.6
	D	14,015	14,312	2.1	14,146	14,528	2.7
	C	10,907	11,226	2.9	11,406	11,508	0.9

Table 11-32. Sacramento River Inflow Under Existing Conditions, No-Action Alternative, and CP3 (contd.)

		Existing Condition	CP3 (Existing Condition)		No-Action Alternative	CP3 (Future Condition)	
Month	**Water Year**	**Base Flow (cfs)**	**Flow (cfs)**	**Percent Change**	**Base Flow (cfs)**	**Flow (cfs)**	**Percent Change**
July	Average	15,270	15,591	2.1	16,870	17,146	1.6
	W	16,088	16,264	1.1	17,160	17,295	0.8
	AN	16,682	16,914	1.4	19,335	19,602	1.4
	BN	16,500	16,931	2.6	19,698	19,811	0.6
	D	14,988	15,584	4.0	15,871	16,687	5.1
	C	11,077	11,253	1.6	11,974	11,950	-0.2
August	Average	12,649	12,940	2.3	13,790	13,886	0.7
	W	13,724	13,650	-0.5	13,840	13,797	-0.3
	AN	12,721	12,986	2.1	15,183	15,329	1.0
	BN	12,319	12,723	3.3	15,145	15,111	-0.2
	D	13,162	13,964	6.1	13,769	14,249	3.5
	C	9,865	10,070	2.1	10,738	10,664	-0.7
September	Average	13,697	13,692	0.0	13,863	13,996	1.0
	W	18,936	18,894	-0.2	18,242	18,159	-0.5
	AN	13,088	13,083	0.0	13,160	13,296	1.0
	BN	12,543	12,360	-1.5	12,817	12,882	0.5
	D	10,847	10,979	1.2	12,238	12,728	4.0
	C	8,577	8,652	0.9	8,737	8,877	1.6
October	Average	12,719	12,773	0.4	12,068	12,124	0.5
	W	14,766	14,884	0.8	14,040	14,071	0.2
	AN	12,049	12,096	0.4	11,379	11,389	0.1
	BN	12,322	12,334	0.1	11,758	11,801	0.4
	D	11,249	11,304	0.5	10,747	10,768	0.2
	C	11,619	11,593	-0.2	10,823	11,052	2.1
November	Average	15,858	15,847	-0.1	15,501	15,505	0.0
	W	21,159	21,229	0.3	20,878	20,687	-0.9
	AN	17,210	16,583	-3.6	16,355	16,340	-0.1
	BN	13,687	13,367	-2.3	13,377	13,322	-0.4
	D	12,805	12,992	1.5	12,475	12,701	1.8
	C	10,129	10,626	4.9	10,012	10,192	1.8
December	Average	26,148	26,014	-0.5	25,710	25,510	-0.8
	W	44,908	44,313	-1.3	44,459	43,709	-1.7
	AN	22,225	22,302	0.3	21,941	21,870	-0.3
	BN	19,129	18,762	-1.9	18,434	17,899	-2.9
	D	16,164	16,440	1.7	16,042	16,323	1.8
	C	12,587	12,900	2.5	11,848	12,380	4.5

Key:
AN = above-normal
BN = below-normal
C = critical
cfs = cubic feet per second
CP = Comprehensive Plan
D = dry
W = wet

Impact Aqua-20 (CP3): Effects to Delta Fisheries Resulting from Changes in San Joaquin River Flow at Vernalis CP3 operations would result in no discernable change in San Joaquin River flows at Vernalis, and therefore no effects on fish habitat or transport mechanisms within the lower San Joaquin River and Delta compared with the Existing Condition and No-Action Alternative. This impact would be less than significant.

Results of the comparative analysis of model results, by month and water-year type, for basis-of-comparison conditions and CP3 for San Joaquin River flow are summarized in Table 11-33. Results of these analyses show that CP3 would have no effect on seasonal flows under existing conditions within the San Joaquin River. Similarly, modeling results showed that CP3 would have no effect on flows or fish habitat compared with the No-Action Alternative. Based on these results, it was concluded that CP3 would have no effect on Delta fisheries or transport mechanisms within the lower San Joaquin River and Delta. Mitigation for this impact is not needed, and thus not proposed.

Table 11-33. San Joaquin River Flow at Vernalis Under Existing Conditions, and CP3

		Existing Condition	Existing Condition With Project	
Month	**Water Year**	**Base Flow (cfs)**	**Flow (cfs)**	**Percent Change**
January	Average	4,772	4,772	0.0
	W	9,255	9,255	0.0
	AN	4,339	4,339	0.0
	BN	2,971	2,971	0.0
	D	2,084	2,084	0.0
	C	1,624	1,624	0.0
February	Average	6,434	6,433	0.0
	W	11,637	11,637	0.0
	AN	6,271	6,271	0.0
	BN	5,742	5,741	0.0
	D	2,506	2,506	0.0
	C	2,020	2,021	0.0
March	Average	6,339	6,338	0.0
	W	12,420	12,419	0.0
	AN	5,792	5,790	0.0
	BN	4,539	4,538	0.0
	D	2,372	2,372	0.0
	C	1,760	1,760	0.0
April	Average	6,006	6,006	0.0
	W	10,455	10,455	0.0
	AN	5,976	5,976	0.0
	BN	5,241	5,242	0.0
	D	3,050	3,050	0.0
	C	1,722	1,722	0.0
May	Average	6,022	6,022	0.0
	W	10,991	10,990	0.0
	AN	5,420	5,420	0.0
	BN	4,987	4,988	0.0
	D	2,895	2,896	0.0
	C	1,752	1,752	0.0

Table 11-33. San Joaquin River Flow at Vernalis Under Existing Conditions, and CP3 (contd.)

		Existing Condition	Existing Condition With Project	
Month	**Water Year**	**Base Flow (cfs)**	**Flow (cfs)**	**Percent Change**
June	Average	4,631	4,631	0.0
	W	9,577	9,575	0.0
	AN	4,946	4,946	0.0
	BN	2,320	2,321	0.0
	D	1,478	1,480	0.1
	C	1,022	1,022	0.1
July	Average	3,221	3,222	0.0
	W	6,646	6,646	0.0
	AN	2,779	2,779	0.0
	BN	1,755	1,755	0.0
	D	1,260	1,262	0.2
	C	895	896	0.0
August	Average	2,113	2,114	0.0
	W	3,350	3,350	0.0
	AN	2,010	2,010	0.0
	BN	1,827	1,827	0.0
	D	1,347	1,349	0.1
	C	1,021	1,022	0.1
September	Average	2,366	2,366	0.0
	W	3,433	3,434	0.0
	AN	2,293	2,293	0.0
	BN	2,077	2,077	0.0
	D	1,764	1,764	0.0
	C	1,368	1,368	0.0
October	Average	2,486	2,486	0.0
	W	2,915	2,915	0.0
	AN	2,099	2,099	0.0
	BN	2,428	2,428	0.0
	D	2,417	2,417	0.0
	C	2,113	2,113	0.0
November	Average	2,561	2,561	0.0
	W	3,311	3,311	0.0
	AN	2,104	2,104	0.0
	BN	2,334	2,334	0.0
	D	2,315	2,315	0.0
	C	2,026	2,026	0.0
December	Average	2,561	2,561	0.0
	W	3,311	3,311	0.0
	AN	2,104	2,104	0.0
	BN	2,334	2,334	0.0
	D	2,315	2,315	0.0
	C	2,026	2,026	0.0

Key:
AN = above-normal
BN = below-normal
C = critical
cfs = cubic feet per second
CP = Comprehensive Plan
D = dry
W = wet

Impact Aqua-21 (CP3): Reduction in Low Salinity Habitat Conditions Resulting from an Upstream Shift in X2 *Location* CP3 operation would result in less than 0.5 km movement upstream or downstream from the X2 location. This impact would be less than significant.

The 1 km X2 criterion was applied to a comparison of hydrologic model results for basis-of-comparison conditions and CP3, by month and water-year type, for the months from February through May. Results of the comparisons are summarized in Table 11-34. These results showed that changes in X2 location under CP3 were less than 1 km (all were less than 0.4 km) with both variable upstream and downstream movement of the X2 location depending on month and water-year type. These results are consistent with model results for Delta outflow that showed a less than significant change in flows.

Table 11-34. Difference in X2 Under Existing Conditions, No-Action Alternative, and CP3

		Existing Condition	CP3 (Existing Condition)		No-Action Alternative	CP3 (Future Condition)	
Month	**Water Year**	**Base Flow (cfs)**	**Flow (cfs)**	**Percent Change**	**Base Flow (cfs)**	**Flow (cfs)**	**Percent Change**
February	Average	65	66	20.0	66	66	10.0
	W	55	55	10.0	55	55	10.0
	AN	61	61	20.0	61	61	20.0
	BN	68	68	0.0	68	68	0.0
	D	73	74	40.0	73	73	0.0
	C	77	78	40.0	77	77	0.0
March	Average	65	65	10.0	65	65	10.0
	W	56	56	0.0	56	56	0.0
	AN	60	60	20.0	60	60	10.0
	BN	68	68	0.0	68	68	0.0
	D	72	72	30.0	72	72	20.0
	C	77	77	10.0	77	77	0.0
April	Average	68	68	0.0	68	68	0.0
	W	59	59	0.0	59	59	0.0
	AN	64	64	10.0	64	64	10.0
	BN	70	70	0.0	70	70	0.0
	D	74	74	10.0	74	74	0.0
	C	78	78	0.0	78	78	0.0

Table 11-34. Difference in X2 Under Existing Conditions, No-Action Alternative, and CP3 (contd.)

		Existing Condition	CP3 (Existing Condition)		No-Action Alternative	CP3 (Future Condition)	
Month	Water Year	Base Flow (cfs)	Flow (cfs)	Percent Change	Base Flow (cfs)	Flow (cfs)	Percent Change
May	Average	71	71	0.0	71	71	0.0
	W	62	62	0.0	62	62	0.0
	AN	67	67	10.0	67	68	0.0
	BN	72	72	0.0	72	72	0.0
	D	76	76	-10.0	76	76	0.0
	C	83	83	0.0	82	82	0.0

Key:
AN = above-normal
BN = below-normal
C = critical
cfs = cubic feet per second
CP = Comprehensive Plan
D = dry
W = wet

Results of a comparative analysis of changes in X2 location between the basis-of-comparison and CP3, assuming future operating conditions, are also summarized in Table 11-34. Results of these comparisons showed very little difference (less than 0.2 km) in the X2 location between CP3 and the No-Action Alternative. Based on these results, it was concluded that CP3 would have a less than significant effect on low salinity habitat conditions within the Bay-Delta. Mitigation for this impact is not needed, and thus not proposed.

Impact Aqua-22 (CP3): Increase in Mortality of Species of Primary Management Concern as a Result of Increased Reverse Flows in Old and Middle Rivers Project operation would result in an increase of reverse flows in Old and Middle rivers. The increase in reverse flows would be expected to contribute to a small increase in the vulnerability of juvenile striped bass, threadfin shad, and other resident warm-water fish to increased salvage and potential losses. This impact would be potentially significant.

Results of the analysis showed several occurrences when reverse flows within Old and Middle rivers were greater than basis-of-comparison conditions by more than 5 percent. These events occurred typically in dry and critical water years, which would be expected as a result of greater export operations under CP3. During February (Table 11-35), operations under CP3 resulted in an increase in reverse flow of greater than 5 percent during critical years. Based on results of the delta smelt analysis of the relationship between reverse flows and delta smelt salvage, the increase from approximately 4,300 cfs under the basis-of-comparison in a critical water year to approximately 4,700 cfs would not be expected to result in a significant increase in adverse effects to delta smelt. Juvenile Chinook salmon and steelhead are migrating through the Delta during February, and an increase in average monthly reverse flows of 300 to 400 cfs would be expected to increase the potential risk of increased mortality.

However given the tidal volumes and hydrodynamics of the Old and Middle rivers region, it is not expected that the change in reverse flows in February in a critical year would result in a detectable change in fish survival. The majority of juvenile Chinook salmon emigrating from the San Joaquin River typically migrate downstream later in dry years and would not be expected to occur in high numbers within Old and Middle rivers in February.

Table 11-35. Reverse Flows Under Existing Conditions, No-Action Alternative, and CP3

		Existing Condition	CP3 (Existing Condition)		No-Action Alternative	CP3 (Future Condition)	
Month	**Water Year**	**Base Flow (cfs)**	**Flow (cfs)**	**Percent Change**	**Base Flow (cfs)**	**Flow (cfs)**	**Percent Change**
January	Average	-6,592	-6,625	-0.5	-6,968	-6,942	0.4
	W	-5,026	-5,021	0.1	-5,624	-5,634	-0.2
	AN	-7,598	-7,610	-0.2	-7,828	-7,795	0.4
	BN	-7,717	-7,688	0.4	-8,042	-7,993	0.6
	D	-7,540	-7,606	-0.9	-7,880	-7,842	0.5
	C	-6,243	-6,405	-2.6	-6,402	-6,345	0.9
February	Average	-4,930	-5,029	-2.0	-4,996	-5,113	-2.3
	W	-3,582	-3,673	-2.5	-3,857	-3,942	-2.2
	AN	-5,663	-5,855	-3.4	-6,276	-6,263	0.2
	BN	-5,723	-5,644	1.4	-5,301	-5,399	-1.9
	D	-6,175	-6,164	0.2	-6,211	-6,081	2.1
	C	-4,326	-4,719	-9.1	-4,004	-4,713	-17.7
March	Average	-3,975	-4,004	-0.7	-4,148	-4,141	0.2
	W	-2,052	-2,081	-1.4	-2,394	-2,364	1.2
	AN	-5,528	-5,402	2.3	-5,933	-5,817	2.0
	BN	-5,264	-5,327	-1.2	-4,948	-5,003	-1.1
	D	-5,245	-5,380	-2.6	-5,313	-5,371	-1.1
	C	-3,181	-3,163	0.6	-3,479	-3,465	0.4
April	Average	-1,984	-1,975	0.5	-2,049	-2,074	-1.2
	W	-1,525	-1,531	-0.4	-1,709	-1,722	-0.7
	AN	-2,825	-2,758	2.4	-2,791	-2,814	-0.8
	BN	-2,488	-2,446	1.7	-2,460	-2,451	0.4
	D	-2,098	-2,102	-0.2	-2,128	-2,214	-4.1
	C	-1,382	-1,411	-2.1	-1,447	-1,445	0.2
May	Average	-1,649	-1,638	0.6	-1,729	-1,729	0.0
	W	-1,147	-1,130	1.4	-1,265	-1,255	0.8
	AN	-2,312	-2,270	1.8	-2,627	-2,528	3.8
	BN	-1,693	-1,706	-0.8	-1,755	-1,794	-2.2
	D	-2,088	-2,098	-0.5	-2,026	-2,057	-1.5
	C	-1,364	-1,340	1.8	-1,361	-1,391	-2.2

Table 11-35. Reverse Flows Under Existing Conditions, No-Action Alternative, and CP3 (contd.)

		Existing Condition	CP3 (Existing Condition)		No-Action Alternative	CP3 (Future Condition)	
Month	Water Year	Base Flow (cfs)	Flow (cfs)	Percent Change	Base Flow (cfs)	Flow (cfs)	Percent Change
June	Average	-2,858	-2,942	-2.9	-3,210	-3,236	-0.8
	W	-2,219	-2,252	-1.5	-2,387	-2,409	-0.9
	AN	-3,532	-3,558	-0.7	-4,011	-3,930	2.0
	BN	-3,752	-3,726	0.7	-4,578	-4,583	-0.1
	D	-3,341	-3,531	-5.7	-3,476	-3,606	-3.7
	C	-1,801	-2,024	-12.4	-2,194	-2,209	-0.7
July	Average	-3,942	-4,155	-5.4	-4,813	-5,010	-4.1
	W	-3,493	-3,619	-3.6	-4,027	-4,155	-3.2
	AN	-3,967	-4,080	-2.9	-5,167	-5,328	-3.1
	BN	-4,733	-4,999	-5.6	-6,665	-6,679	-0.2
	D	-4,859	-5,258	-8.2	-5,378	-5,954	-10.7
	C	-2,592	-2,754	-6.3	-3,154	-3,181	-0.8

Key:
AN = above-normal
BN = below-normal
C = critical
cfs = cubic feet per second
CP = Comprehensive Plan
D = dry
W = wet

The increase in reverse flows estimated to occur under CP3 in critical and dry years in June, and under critical, dry, and below-normal years in July, exceeded 5 percent compared with the Existing Condition. The increased reverse flows in June of critical and dry years occur at a time of year when water temperatures in the Delta are elevated and juvenile Chinook salmon or steelhead would not be expected to occur in the area. Juvenile delta smelt may occur in the area in June; however, a change in Old and Middle river flows of approximately 100 to 200 cfs may result in a small increase in their vulnerability to CVP and SWP salvage, but this increase is expected to be less than significant. As water temperatures increase in the Delta during June and July, the majority of delta smelt are located farther downstream in Suisun Bay where temperatures are more suitable. The increase in reverse flows estimated from the modeling in June of a critical year and in July of below-normal, dry, and critical years, would be expected to contribute to a small increase in the vulnerability of juvenile striped bass, threadfin shad, and other resident warm-water fish to increased salvage and potential losses as a result of increased reverse flows. The increased reverse flows in low-flow years would be expected to result in a low, but potentially significant, increase in mortality for resident warm-water fish inhabiting the south Delta.

Results of the comparison of Old and Middle rivers reverse flows are summarized in Table 11-35. Results of the analysis show that in the majority of years and months, reverse flows under CP3 did not exceed basis-of-comparison conditions by more than 5 percent. CP3 exceeded basis-of-comparison conditions during February of a critical year by approximately 700 cfs. The increase in reverse flows would be expected, particularly in a critical year, to contribute to an increase in the potential for losses of adult delta smelt and other species, which is considered to be potentially significant. During June in a critical water year, under CP3 the magnitude of reverse flows was reduced more than 5 percent but would be expected to contribute to a less than significant biological benefit based on both the low reverse flow under the basis-of-comparison and under CP3. An increase in reverse flow above the basis-of-comparison of approximately 300 to 600 cfs during dry years in July would be expected to contribute to an increase in the risk of losses to resident warm-water fish species. Increased reverse flows in July would not be expected to adversely affect delta or longfin smelt, juvenile Chinook salmon, or steelhead based on their seasonal migration patterns and geographic distribution. The potential increase in losses during February and July under CP3 is considered to be potentially significant. Mitigation for this impact is not proposed because operations will be guided by RPAs established by NMFS and USFWS BOs.

Impact Aqua-23 (CP3): Increase in the Risk of Entrainment or Salvage of Species of Primary Management Concern at CVP and SWP Export Facilities Due to Changes in CVP and SWP Exports CP3 operations may result in an increase in CVP and SWP exports, which is assumed to result in a direct proportional increase in the risk of fish being entrained and salvaged at the facilities. This is a considered a less than significant impact to Chinook salmon, steelhead, and longfin smelt. This is considered a potentially significant impact to delta smelt, striped bass, and splittail. Future operations of the SWP and CVP export facilities would continue to be managed and regulated in accordance with incidental take limits established for each of the protected fish by USFWS, NMFS, and DFG.

Results of the entrainment loss modeling at the CVP and SWP export facilities are presented in Table 11-36 for CP3. The initial modeling was conducted using average fish densities developed from past fish salvage monitoring at the SWP and CVP export facilities. Average monthly water exports were used in the analysis based on hydrologic simulation modeling. The indices of the potential risk of entrainment for some species, such as Chinook salmon, were not estimated separately for each species (e.g., winter-run Chinook) in these initial analyses. If the proposed project is developed in the future a more detailed species-specific analysis of potential changes in fish salvage losses, in addition to an assessment of the population-level effects on each species, would be required for use as a basis for developing a biological assessment and Section 7 BOs and incidental take permits for project operations. These indices were calculated for wet, above-normal, below-normal, dry, and critical water-year types, and for an average across all years (no water-year type specified).

The total numbers of fish lost annually, by species, are presented in Attachment 13. The difference between the non-operations related and operations related fish mortality is represented as the entrainment index, shown in the tables, to represent the effect of project operations on each fish species at the CVP and SWP facilities.

Table 11-36. Entrainment at the CVP and SWP Facilities Comparing Existing Conditions, No-Action Alternative, and CP3

Species	Water Year	CP3 minus Existing Condition	Percent Change	CP3 Minus Future Condition	Percent Change
Delta Smelt	Average	227	0.3	159	0.2
	W	-65	-0.1	-33	0.0
	AN	-422	-0.5	-1,582	-1.8
	BN	144	0.2	566	0.8
	D	903	1.6	970	1.7
	C	590	1.9	623	1.9
Chinook Salmon	Average	410	0.4	374	0.4
	W	139	0.1	112	0.1
	AN	-440	-0.4	-1,529	-1.2
	BN	-63	-0.1	643	0.6
	D	1,100	1.3	1,058	1.3
	C	1,363	2.8	1,506	3.0
Longfin Smelt	Average	-38	-0.2	15	0.1
	W	-53	-0.2	-32	-0.1
	AN	-187	-1.0	-343	-1.8
	BN	24	0.2	135	0.9
	D	51	0.4	167	1.4
	C	-59	-0.9	106	1.6
Steelhead	Average	40	0.8	36	0.7
	W	29	0.5	930	16.5
	AN	57	1.1	-18	-0.3
	BN	-31	-0.6	26	0.5
	D	17	0.4	-37	-0.8
	C	164	5.2	225	7.4
Striped Bass	Average	27,650	2.1	17,643	1.3
	W	10,968	0.7	9,537	0.6
	AN	14,544	1.0	436	0.0
	BN	16,514	1.3	2,955	0.2
	D	57,660	5.1	57,274	4.8
	C	44,881	6.8	10,098	1.4
Splittail	Average	5,759	2.1	3,377	1.1
	W	2,539	0.7	2,186	0.6
	AN	1,955	0.6	-2,349	-0.7
	BN	2,172	0.8	775	0.2
	D	12,446	5.4	12,268	5.1
	C	10,692	9.2	1,383	1.0

Key:
AN = above-normal
BN = below-normal
C = critical
cfs = cubic feet per second
CP = Comprehensive Plan
D = dry
W = wet

Results of the entrainment risk calculations for delta smelt showed a change of less than 1 percent in wet, above-normal, and below-normal water years and an increase in risk ranging from approximately 1 to 4 percent during dry and critical water years under CP3 relative to the Existing Condition (Table 11-36). The risk of increased losses of delta smelt under CP3 compared to the No-Action Alternative (Table 11-36) was greatest in the dry years. Although the incremental change in the risk of delta smelt losses resulting from CVP and SWP export operations is small, delta smelt population abundance is currently at such critically low levels that even a small increase in the risk of losses is considered to be potentially significant. The increase in risk is also expected to contribute to cumulative factors affecting the survival of delta smelt.

The estimated change in the risk of losses for salmon follows a pattern similar to that described for delta smelt (Table 11-36). Overall, CP3 would result in a small increase in the risk of losses. The loss index for salmon also showed increased risk in wet, below-normal, dry, and critical years relative to the No-Action Alternative. Given the numbers of juvenile Chinook salmon produced each year in the Central Valley, the relatively small incremental increase in the risk of entrainment/salvage at the CVP and SWP export facilities is considered to be a less than significant direct effect but would contribute incrementally to the overall cumulative factors affecting juvenile Chinook salmon survival within the Delta, and population dynamics of the stocks.

The change in the risk of longfin smelt entrainment/salvage under CP3 compared to the No-Action Alternative and to the Existing Condition shows small positive and negative changes depending on water-year type and alternative (Table 11-36). These small changes in the risk of entrainment are considered to be less than significant.

The change in the risk to steelhead of entrainment/salvage at the CVP and SWP export facilities are summarized in Table 11-36, respectively. The small positive and negative changes in risk under wet, above-normal, below-normal, and dry water years are considered to be less than significant. The increase in risk of steelhead losses in critical water years are considered to be less than significant based on the abundance of juvenile steelhead migrating through the Delta, but would contribute directly to cumulative factors affecting the survival and population dynamics of Central Valley steelhead. The predicted increase in potential entrainment risk for steelhead under critically dry water years represents an initial estimate of the change (percentage) between the proposed project operations and the existing conditions and no-project alternatives and does not allow the predicted losses to be evaluated at the population-level. As noted above, more detailed modeling and analysis of potential steelhead losses would be required as part of preparing a project-specific analysis of entrainment losses for use in the Section 7 biological assessment and BOs for future project operations and incidental take of steelhead. As part of this more detailed analysis additional actions may be identified to further reduce and avoid potential adverse effects to steelhead.

The change in risk to juvenile striped bass for entrainment/salvage at the CVP and SWP export facilities are summarized in Table 11-36. The change in risk in wet, above-normal, and below-normal water years are considered to be less than significant based on the abundance of striped bass, but would contribute to the cumulative factors affecting striped bass survival and population dynamics in the Delta. The losses of juvenile striped bass increased substantially under dry and critical water years, which would be expected with an increase in exports during the summer months. The risk of increased losses ranged from 3.8 to 7.6 percent (approximately 30,000 to 60,000 fish) under CP3, compared to the Existing Condition, which is considered to be potentially significant. The increased losses under CP3, particularly in drier water years when juvenile striped bass production is lower, would be expected to contribute to the cumulative effects of factors affecting juvenile striped bass survival in the Delta.

Results of the risk estimates for juvenile splittail losses under CP3 compared with the No-Action Alternative and Existing Condition show a pattern similar to other species (Table 11-36). The increased risk index was 1.3 percent or less in wet, above-normal, and below-normal water years, and was considered to be a less than significant affect. The loss index increased during dry and critically dry water years, with the greatest increase for CP3. Higher risk of entrainment/salvage losses in drier water years has a potentially greater effect of abundance of juvenile splittail since reproductive success and overall juvenile abundance is typically lower within the Delta in dry years. The increased risk of losses in drier years was considered to be potentially significant. The increased losses would also contribute to cumulative factors affecting survival of juvenile splittail within the Delta.

Impact Aqua-23 (CP1) is considered to be less than significant for Chinook salmon, steelhead, and longfin smelt, but potentially significant for delta smelt, striped bass, and splittail. Mitigation for this impact is not proposed because operations will be guided by RPAs established by NMFS and USFWS BOs.

CVP/SWP Service Areas

Impact Aqua-24 (CP3): Impacts on Aquatic Habitats and Fish Populations in the CVP and SWP Service Areas Resulting from Modifications to Existing Flow Regimes. Project implementation would result in modified flow regimes that would reduce the frequency and magnitude of high winter flows along the Sacramento River; however, the hydrologic effects in tributaries and reservoirs (e.g., New Melones and San Luis) with CVP and SWP dams are expected to be less than impacts on the lower Sacramento River. The change in hydrology could affect aquatic habitats that provide habitat for the fish community. These changes are unlikely to result in substantial effects on the distribution or abundance of these species in the CVP and SWP service areas. Therefore, this impact would be less than significant.

This impact would be similar to Impact Aqua-24 (CP1). The impact could be greater because the increased reservoir capacity associated with an 18.5-foot raise compared to a 6.5-foot raise would allow for additional water volume (and flows) to be stored behind the raised dam. However, these changes are unlikely to result in substantial effects on the distribution or abundance of these species in the CVP and SWP service areas. The effects from CP3 on CVP and SWP reservoir elevations, filling, spilling, and planned releases, and resulting flows downstream from those reservoirs, would be small and well within the range of variability that commonly occurs in these reservoirs and downstream. Therefore, this impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

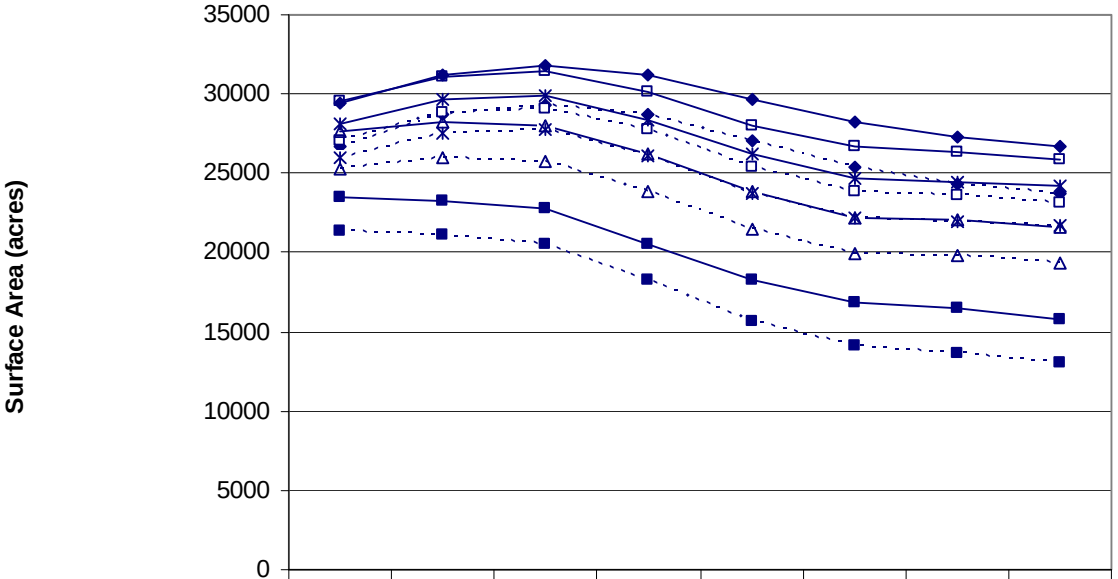
CP4 – 18.5-Foot Dam Raise, Anadromous Fish Focus with Water Supply Reliability

The primary function of CP4 is to address survival of anadromous fish, while still improving water supply reliability. It focuses on increasing the volume of cold water available to the TCD through reservoir reoperations, and on raising Shasta Dam by 18.5 feet. CP4 also includes a 10-year spawning gravel augmentation program as an additional environmental commitment. As with CP3 and the common features above, this raise would increase the full pool by 20.5 feet and enlarge total reservoir storage space by 634,000 acre-feet. This additional storage space would expand Shasta Lake's cold-water supply available to the TCD by 378,000 acre-feet, a feature that would help reduce water temperatures in the upper Sacramento River.

Shasta Lake and Vicinity

Impact Aqua-1 (CP4): Effects on Nearshore, Warm-Water Habitat in Shasta Lake from Project Operations Under CP4, project operations would contribute to an increase in the surface area and WSEL of Shasta Lake, which would in turn increase the area and productivity of nearshore, warm-water habitat. CP2 operations would also result in reduced monthly fluctuations in WSEL, which would contribute to increased reproductive success, young-of-the-year production, and the juvenile growth rate of warm-water fish species. Similar to CP-1 the value of existing structural habitat improvements would be diminished to varying degrees, large areas of the shoreline would not be cleared, and the vegetation along these sections will be inundated periodically. In the short term, this vegetation will provide warm-water lacustrine habitat, with decay expected to occur over several decades. This impact would be less than significant.

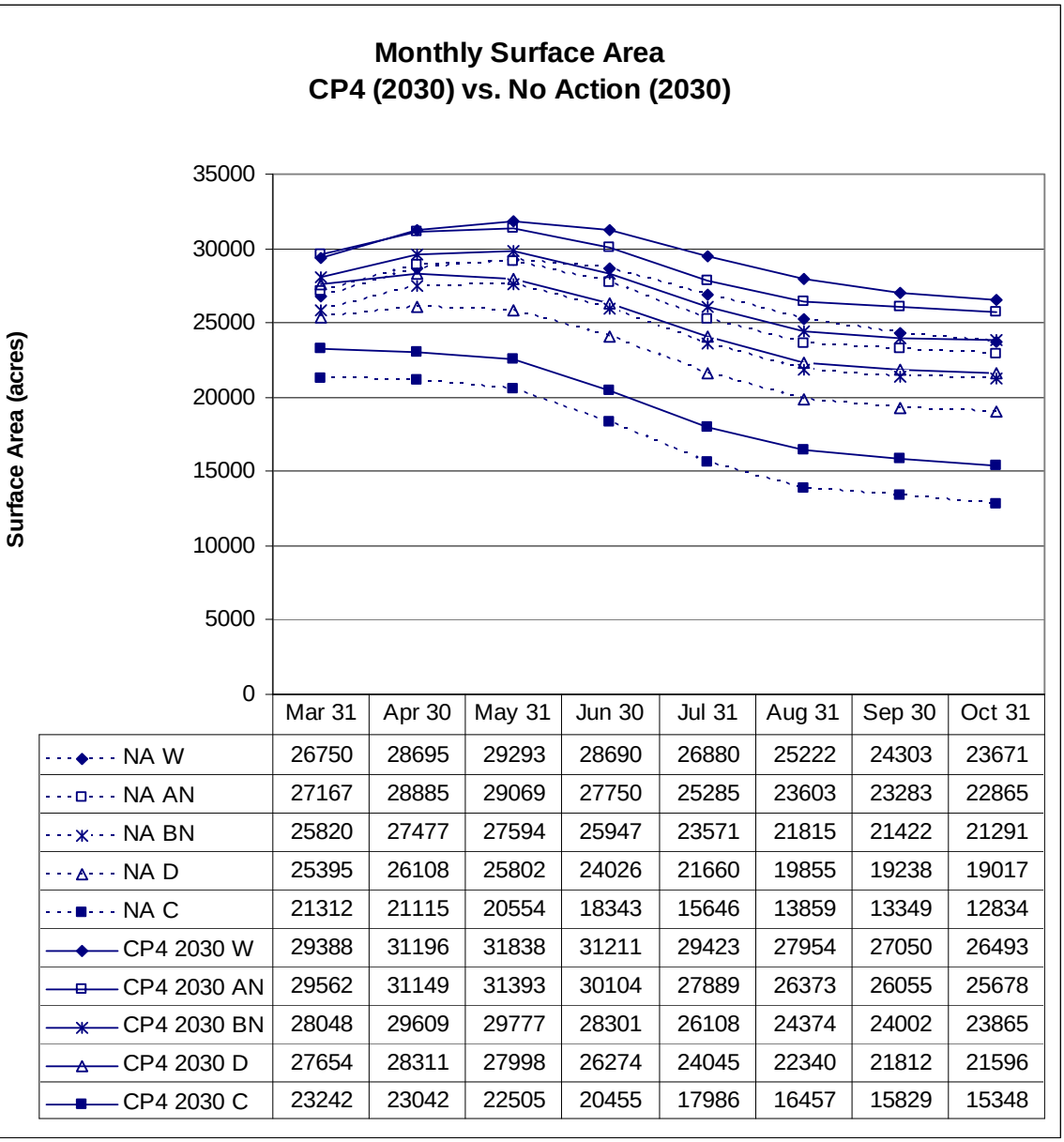
This impact would be similar to Impact Aqua-1 (CP1, CP2, and CP3), but the surface area would be larger under the 18.5-foot dam raise than under CP1 and CP2. CalSim-II modeling shows that the surface area of Shasta Lake would be larger under CP4 for both a 2005 and 2030 water supply demand than under the Existing Condition or the No-Action Alternative in all five water-year types (Figures 11-25 and 11-26).



	Mar 31	Apr 30	May 31	Jun 30	Jul 31	Aug 31	Sep 30	Oct 31
EC W	26726	28711	29305	28720	27042	25351	24380	23709
EC AN	27096	28851	29102	27792	25377	23881	23648	23105
EC BN	25942	27562	27715	26098	23740	22177	21932	21732
EC D	25311	26013	25724	23891	21531	19954	19778	19310
EC C	21336	21121	20583	18251	15644	14079	13655	12992
CP4 2005 W	29373	31194	31841	31249	29672	28201	27248	26661
CP4 2005 AN	29516	31136	31449	30168	27990	26638	26315	25818
CP4 2005 BN	28177	29712	29868	28370	26189	24694	24456	24243
CP4 2005 D	27605	28256	27958	26164	23871	22221	22070	21636
CP4 2005 C	23499	23277	22761	20582	18222	16813	16433	15832

Key:
AN = above-normal water
BN= below-normal water years
C = critical water years
CP = Comprehensive Plan
D = dry water years
EC = Existing Condition
W = wet water years

Figure 11-25. Monthly Surface Area for Each Water-Year Type Within the Shasta Lake Vicinity of the Primary Study Area, CP4 vs. Existing Condition (2005)



	Mar 31	Apr 30	May 31	Jun 30	Jul 31	Aug 31	Sep 30	Oct 31
NA W	26750	28695	29293	28690	26880	25222	24303	23671
NA AN	27167	28885	29069	27750	25285	23603	23283	22865
NA BN	25820	27477	27594	25947	23571	21815	21422	21291
NA D	25395	26108	25802	24026	21660	19855	19238	19017
NA C	21312	21115	20554	18343	15646	13859	13349	12834
CP4 2030 W	29388	31196	31838	31211	29423	27954	27050	26493
CP4 2030 AN	29562	31149	31393	30104	27889	26373	26055	25678
CP4 2030 BN	28048	29609	29777	28301	26108	24374	24002	23865
CP4 2030 D	27654	28311	27998	26274	24045	22340	21812	21596
CP4 2030 C	23242	23042	22505	20455	17986	16457	15829	15348

Key:
AN = above-normal water
BN= below-normal water years
C = critical water years
CP = Comprehensive Plan
D = dry water years
EC = Existing Condition
W = wet water years

Figure 11-26. Monthly Surface Area for Each Water-Year Type Within the Shasta Lake Vicinity of the Primary Study Area, CP4 vs. No-Action Alternative

Monthly WSEL fluctuations were compared to projections for water supply demand. For CP4, with a 2005 water supply demand, 20 percent of monthly changes in projected WSELs (i.e., 5 of the 25 total projections made for the 5 months from March through July for all five water-year types) showed increased monthly WSEL fluctuations relative to the Existing Condition and 80 percent showed reduced monthly WSEL fluctuations (Figure 11-27). For CP3, with a projected 2030 water supply demand, 36 percent of monthly changes in projected WSELs showed increased WSEL fluctuations relative to the No-Action Alternative and 64 percent showed reduced monthly WSEL fluctuations (Figure 11-28). Under CP4, none of the changes in monthly WSEL fluctuation are different enough from the Existing Condition to warrant the investigation of daily WSEL fluctuation.

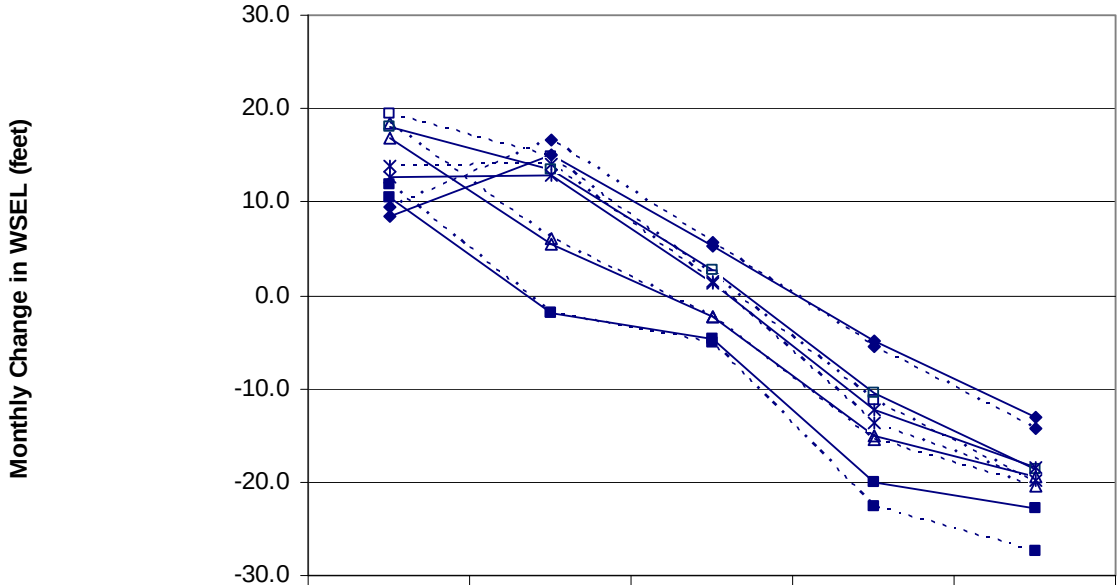
Increases in the overall surface area and WSEL under CP4 would increase the area of available warm-water habitat and stimulate biological productivity, including fish production, of the entire lake for a period of time, possibly for several decades. Furthermore, reductions in the magnitude of monthly WSEL fluctuations could contribute to increased reproductive success, young-of-the-year production, and juvenile growth rate of warm-water fish species. Therefore, this impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact Aqua-2 (CP4): Effects on Nearshore, Warm-Water Habitat in Shasta Lake from Project Construction This impact would be similar to CP3. This impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed

Impact Aqua-3 (CP4): Effects on Cold-Water Habitat in Shasta Lake
Operations-related changes in the ratio of cold-water storage to surface area would affect the availability of suitable cold-water fisheries habitat in Shasta Lake, including rainbow trout. This impact would be beneficial.

This impact would be similar to Impact Aqua-3 (CP1, CP2, and CP3) but would be of lower magnitude than Aqua-1 (CP3) owing to its focus on increasing the volume of cold-water available to the TCD to benefit anadromous fish downstream from Shasta Dam.

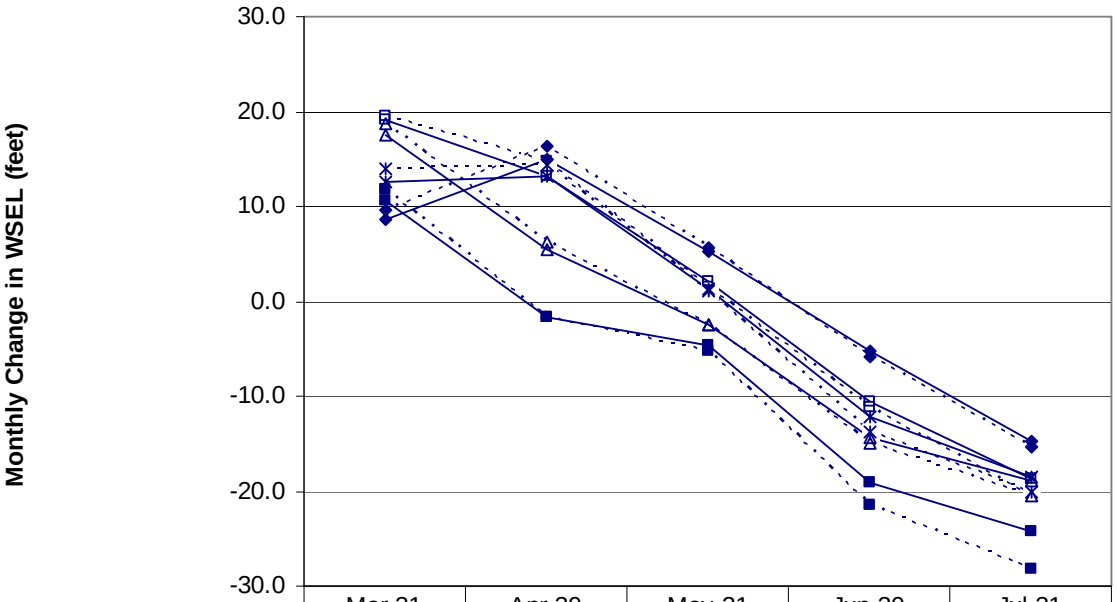
CalSim-II modeling shows that under CP4, with a 2030 water supply demand, the ratio of cold-water storage to surface area is higher than under the No-Action Alternative in all water years and during all months modeled. The greatest projected increases over the No-Action Alternative occurred between June 30 and August 31, which is the critical holding and rearing period for cold-water fishes in reservoirs, and are greatest during critical water years (Figure 11-29). Therefore, this impact would be beneficial. Mitigation for this impact is not needed, and thus not proposed.



	Mar 31	Apr 30	May 31	Jun 30	Jul 31
EC W	9.5	16.7	5.7	-5.6	-14.3
EC AN	19.5	14.9	2.1	-11.2	-20.1
EC BN	13.9	14.0	1.4	-13.6	-19.9
EC D	18.4	6.1	-2.3	-15.5	-20.5
EC C	11.8	-1.9	-5.0	-22.7	-27.5
CP4 (2005) W	8.5	15.1	5.3	-5.0	-13.1
CP4 (2005) AN	18.0	13.4	2.6	-10.5	-18.5
CP4 (2004) BN	12.6	12.9	1.3	-12.3	-18.5
CP4 (2005) D	16.8	5.4	-2.4	-15.0	-19.4
CP4 (2005) C	10.4	-1.9	-4.6	-20.0	-22.9

Key:
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BN= below-normal water years
C = critical water years
CP = Comprehensive Plan
D = dry water years
EC = Existing Condition
W = wet water years

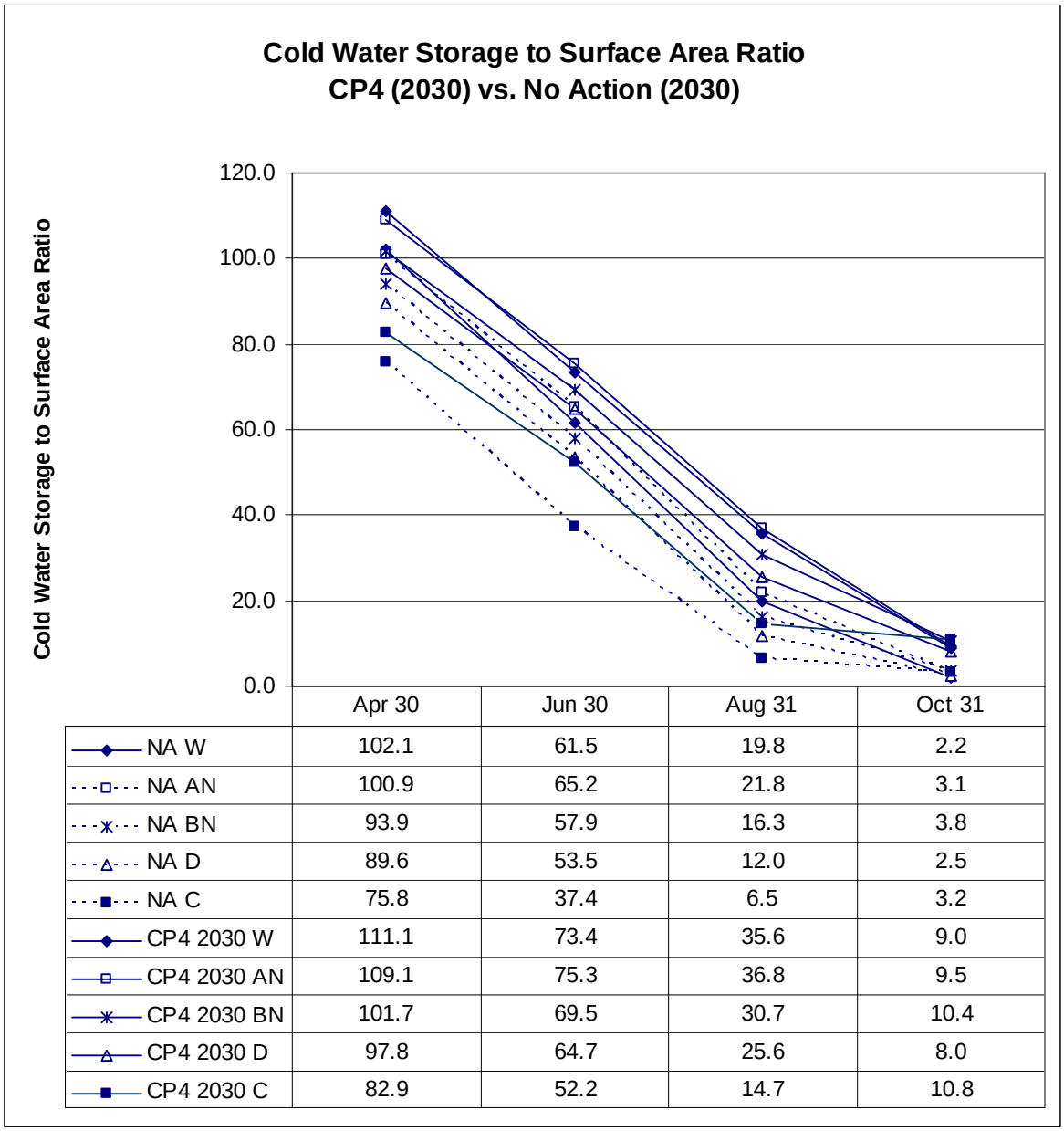
Figure 11-27. Monthly Change in WSEL for Each Water-Year Type Within the Shasta Lake Vicinity of the Primary Study Area, CP4 vs. Existing Condition (2005)



	Mar 31	Apr 30	May 31	Jun 30	Jul 31
NA W	9.7	16.3	5.7	-5.8	-15.3
NA AN	19.4	14.7	1.5	-11.3	-20.5
NA BN	13.9	14.4	1.1	-13.8	-20.1
NA D	18.8	6.2	-2.4	-15.0	-20.5
NA C	11.9	-1.7	-5.3	-21.5	-28.3
CP4 (2030) W	8.7	14.9	5.3	-5.3	-14.8
CP4 (2030) AN	19.0	13.1	2.0	-10.6	-18.8
CP4 (2030) BN	12.7	13.2	1.3	-12.1	-18.5
CP4 (2030) D	17.5	5.4	-2.4	-14.3	-18.9
CP4 (2300) C	10.7	-1.7	-4.7	-19.1	-24.2

Key:
AN = above-normal water
BN= below-normal water years
C = critical water years
CP = Comprehensive Plan
D = dry water years
NA = No-Action
W = wet water years

Figure 11-28. Monthly Change in WSEL for Each Water-Year Type Within the Shasta Lake Vicinity of the Primary Study Area, CP4 vs. No-Action Alternative



	Apr 30	Jun 30	Aug 31	Oct 31
NA W	102.1	61.5	19.8	2.2
NA AN	100.9	65.2	21.8	3.1
NA BN	93.9	57.9	16.3	3.8
NA D	89.6	53.5	12.0	2.5
NA C	75.8	37.4	6.5	3.2
CP4 2030 W	111.1	73.4	35.6	9.0
CP4 2030 AN	109.1	75.3	36.8	9.5
CP4 2030 BN	101.7	69.5	30.7	10.4
CP4 2030 D	97.8	64.7	25.6	8.0
CP4 2030 C	82.9	52.2	14.7	10.8

Key:
AN = above-normal water
BN= below-normal water years
C = critical water years
CP = Comprehensive Plan
D = dry water years
NA = No-Action
W = wet water years

Figure 11-29. Monthly Cold-water Storage to Surface Area Ratio for Each Water-Year Type Within the Shasta Lake Vicinity of the Primary Study Area, CP4 vs. Existing Condition

Impact Aqua-4 (CP4): Effects on Special-Status Aquatic Mollusks Under CP4, habitat for special-status mollusks could be inundated. Seasonal fluctuations in the surface area and WSEL of Shasta Lake could also adversely affect special-status aquatic mollusks that could occupy habitat in or near Shasta Lake and its tributaries. Tributary investigations are ongoing and will provide additional information and analysis for inclusion in the FEIS. This impact would be potentially significant. Mitigation for this impact is proposed in Section 11.3.4.

Impact Aqua-5 (CP4): Effects on Special-Status Fish Species That Occupy Habitat Provided by Shasta Lake and Its Tributaries The expansion of the surface area of Shasta Lake and the inundation of additional tributary habitat under CP4 could affect one species designated as sensitive by the USFS, the hardhead. Tributary investigations are ongoing and will provide additional information and analysis for inclusion in the FEIS. This impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact Aqua-6 (CP4): Creation or Removal of Barriers to Fish Between Tributaries and Shasta Lake Under CP4, project implementation would result in the periodic inundation of steep and low-gradient tributaries to Shasta Lake up to the 1,090-foot contour, the maximum inundation level under this alternative. Tributary investigations are ongoing and will provide additional information and analysis for inclusion in the FEIS. However, based on digital topographic data and stream channel data generated from field inventories, there do not appear to be any substantial barriers between the 1,070-foot and 1,090-foot contours that would be inundated under this alternative. This impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact Aqua-7 (CP4): Effects on Spawning and Rearing Habitat of Adfluvial Salmonids in Low-Gradient Tributaries to Shasta Lake CP4 would result in additional periodic inundation of potentially suitable spawning and rearing habitat for adfluvial salmonids in the Sacramento River, McCloud River, Pit River, Big Backbone Creek, and Squaw Creek upstream from Shasta Lake. A total of 11 miles of low-gradient reaches that could potentially provide some spawning and rearing habitat for adfluvial salmonids would be affected by CP4, which is only about 2.8 percent of the low-gradient habitat upstream from Shasta Lake. Tributary investigations are ongoing and will provide additional information and analysis for inclusion in the FEIS. This impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact Aqua-8 (CP4): Effects on Aquatic Connectivity in Non-Fish-Bearing Tributaries to Shasta Lake CP4 would result in periodic inundation of the lower reaches of high-gradient, non-fish-bearing tributaries to Shasta Lake. About 24 miles of non-fish-bearing tributary habitat would be affected by CP4, which is only about 1 percent of the lengths of non-fish-bearing tributaries upstream from Shasta Lake. Tributary investigations are ongoing and will provide additional information and analysis for inclusion in the FEIS. This

impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact Aqua-9 (CP4): Effects on Water Quality at Livingston Stone Hatchery Reclamation provides the water supply to the Livingston Stone Hatchery from a pipeline emanating from Shasta Dam. This supply would not be interrupted by any activity associated with CP4. There would be no impact. Mitigation for this impact is not needed, and thus not proposed.

Upper Sacramento River (Shasta Dam to RBDD)

Impact Aqua-10 (CP4): Loss or Degradation of Aquatic Habitat in the Upper Sacramento River During Construction Activities Construction activities have the potential to increase sediments and turbidity, and release and exposure of contaminants. With environmental commitments in place, this would be a less than significant impact.

This impact would be similar to Impact Aqua-10 (CP1). The impact could be greater because of the increased activity associated with an 18.5-foot dam raise compared to a 6.5-foot dam raise. Additionally, CP4 also includes a 10-year gravel augmentation program as an additional environmental commitment. The placement of gravel along the Sacramento River channel and bank on an annual basis would result in an additional source of fine sediment being released and exposed to the river and aquatic communities. However, the gravel augmentation activities would only occur during pre-specified in-water work windows, which would minimize the potential for impacts associated with this activity.

Lastly, CP4 also includes riparian, floodplain, and side channel habitat restoration in the upper Sacramento River at Reading Island. The Reading Island riparian, floodplain, and side channel restoration could result in additional disturbed surfaces, but most of this construction is expected to occur away from the wetted channel, and all disturbed areas would be revegetated.

However, the environmental commitments for all action would result in less than significant impacts. Mitigation for this impact is not needed, and thus not proposed. *Impact Aqua-11 (CP4): Release and Exposure of Contaminants in the Upper Sacramento River During Construction Activities* Construction-related activities have the potential to result in the release and exposure of contaminants, resulting in adverse effects on aquatic habitats, the aquatic food web, and fish populations, including special-status species, within the primary study area downstream from project construction activities. This impact would be less than significant with all environmental commitments in place.

This impact would be similar to Impact Aqua-11 (CP1). The impact could be greater because of the increased activity associated with an 18.5-foot raise compared to a 6.5-foot raise. Additionally, as discussed above, CP4 also includes a 10-year gravel augmentation program and restoration of riparian,

floodplain, and side channel habitat as additional environmental commitments. Both of these construction activities could result in additional sources of equipment-related contaminants potentially being released and exposed to the river and aquatic communities. However, additional environmental commitments that call for in-water work windows and specific best management practices (BMP) would minimize and/or avoid the potential for impacts associated with this activity.

However, the environmental commitments for all action would result in less than significant impacts. Mitigation for this impact is not needed, and thus not proposed *Impact Aqua-12 (CP4): Improved Flow and Water Temperature in the Upper Sacramento River Resulting from Project Operation – Chinook Salmon* Project operation would result in improved flow and water temperature conditions in the upper Sacramento River for fish species of management concern. This impact would be beneficial.

Winter-Run Chinook Salmon

Production

Based on the 1999 through 2006 population average, overall average winter-run production for the 82-year period was greater under CP4 conditions relative to the No-Action Alternative and Existing Condition (Attachments 1A and 2A). The maximum increase in production relative to the No-Action Alternative was 233 percent, while the largest decrease in production under CP4 relative to the No-Action Alternative was less than 5 percent (Attachment 1A). The maximum increase in production relative to the Existing Condition was 233 percent in 1934 for CP4, while the largest decrease in production relative to the Existing Condition was 5 percent CP4 in 1976 (Attachment 2A).

All years with the lowest production over the simulation period show the largest increase in production under CP4 conditions.

Under CP4, critical water years 1924, 1931, 1933, 1934, 1977, 1988, and 1992, and dry water year 1932 had increases in production compared to the No-Action Alternative, ranging from 7 percent to 233 percent. No water years had a decrease in production compared with the No-Action Alternative greater than 5 percent.

Under CP4, critical water years 1924, 1931, 1933, 1934, 1977, 1988, 1992 and 1994 had substantial increases in production compared to the Existing Condition, ranging from 5 percent to 233 percent. Three dry (1932, 1944, and 1947) water years had increases over the Existing Condition ranging from 4 to 10 percent. No water years had a decrease in production greater than 5 percent relative to the Existing Condition.

When the spawning population equaled AFRP goal, the overall average winter-run Chinook salmon production was similar for CP4 relative to the No-Action Alternative (Attachment 3A). The maximum increase in production relative to

the No-Action Alternative was 166 percent for CP4. The largest decrease in production relative to the No-Action Alternative was 15 percent for CP4. In all years, the lowest production under the No-Action Alternative typically had the greatest percent increase in production under CP4.

Mortality

Based on the 1999 through 2006 population average, the greatest mortality to winter-run Chinook salmon under CP4 occurred to the egg incubation life stage, followed by presmolts, then fry, and lastly to immature smolts. Nonoperational conditions were the primary causes of mortality for all life stages under all Comprehensive Plans. Table 11-4 displays the overall mortalities for each Comprehensive Plan that were caused by nonoperational factors versus those caused by the operations (i.e., water temperature and flow) (Attachments 2B and 3B). Mortalities caused by the project decrease as the proposed dam height increases from 6.5 to 18.5 feet.

When removing nonoperations-related mortality, allowing comparison of mortality for operations-related activities only, fry were the primary life stage affected, but operations-related activities had a greater effect on eggs than on presmolts and no effect on immature smolts. The same trends for each Comprehensive Plan were observed, with the bulk of the mortality affecting the fry and egg incubation life stages, and both water temperature and flow causing the mortality (Table 11-5).

In critical water years, mortality under CP4 conditions was dominated by forced movement of fry, then by superimposition and mortality to eggs due to unsuitable water temperatures. Attachments 1C and 2C contain tables of mortality to winter-run sorted by water-year type, and Table 11-6 outlines the ranks classified under each Comprehensive Plan for each water-year type.

In dry water years, mortality to fry when moving to new habitats was the primary cause of operations-related mortalities for CP4, followed by mortality to eggs due to redd superimposition. Third was the mortality to eggs due to redd scouring and/or dewatering, followed by mortality to presmolts while moving to new habitats.

Below-normal, above-normal, and wet water years also had the greatest number of winter-run Chinook salmon perish as fry caused by forced movement to habitat downstream, followed by mortality to eggs due to redd superimposition, then the loss of eggs from unsuitable water temperatures, and forced movement of presmolts to downstream habitats.

Under CP4, years with the highest mortality were 1924, 1932, 1934, 1963, 1970 and 1982, and included two critical water years, one dry water year, and three wet water years. These years were preceded by two critical, one dry, two below-normal, and one wet water year. Years with the lowest mortality varied between all water-year types. Years in which the project had the greatest

impact on winter-run were also the years in which the lowest production occurred (Attachments 1C and 2C).

When the spawning population equaled the AFRP goal, winter-run Chinook salmon mortality caused by the operations-related activities decreased under CP4 compared to No-Action Alternative conditions. Under CP4, mortality caused by operations-related activities would decrease from non-operations related mortality by more than 12 percent. Under CP4, the greatest mortality to winter-run Chinook salmon occurred to the egg incubation life stage, followed by presmolts, then fry, and lastly to immature smolts. Nonoperational conditions were the primary causes of mortality for all life stages under all alternatives (Attachment 3B).

Because winter-run Chinook salmon have, overall, a reduced mortality, winter-run Chinook salmon would benefit from water temperature and flow conditions under in CP4. Additionally, winter-run Chinook salmon will likely benefit from the 10-year gravel augmentation program, although this was not modeled with SALMOD. Mitigation for this impact is not needed, and thus not proposed.

Spring-Run Chinook Salmon

Production

Based on the 1999 through 2006 population average, overall average spring-run Chinook salmon production increased for the 82-year period under CP4 compared to the No-Action Alternative and the Existing Condition (Attachments 4A and 5A). The maximum increase in production relative to the No-Action Alternative was 5,321 percent for CP4. The largest decrease in production relative to the No-Action Alternative was 9 percent for CP4 (Attachment 4A). The maximum increase in production relative to the Existing Condition was 5,586 percent for CP4. The largest decrease in production relative to the Existing Condition was 9 percent for CP4 (Attachment 5A).

Under CP4, critical water years 1924, 1931, 1933, 1934, 1977, 1988, 1991, 1992, and 1994, dry water years 1925, 1926 and 1932, below-normal water years 1935 and 1959, and above-normal water year 2000, had increases in production compared to the No-Action Alternative, ranging from 6 to 5,321 percent. In 1955 (dry water year, 1923 (below-normal water year) and 1969 and 1997 (wet water years), production decreased between 6 and 10 percent.

Under CP4, critical water years 1924, 1931, 1933, 1934, 1977, 1988, 1991, 1992, 1994, and 2001 had increases in production compared to the Existing Condition, ranging from 11 to 5,586 percent. Dry water years 1932 and 2002 resulted in substantial increases over the Existing Condition ranging between 8 and 3,081 percent. Two below-normal water years (1935 and 1959), and one above-normal water year (2000) had substantial increases relative to the Existing Condition, from 9 to 23 percent. One above-normal water years (1978), and two wet water years (1969, 1997) had decreases in production relative to the Existing Condition ranging from 5 to 9 percent.

The overall average spring-run Chinook salmon production was slightly higher for CP4 relative to the No-Action Alternative (Attachment 6A). The maximum increase in production relative to the No-Action Alternative was 10,446 percent for CP4. The largest decrease in production relative to the No-Action Alternative was 5 percent for CP4. Years with the lowest production under the No-Action Alternative typically had the greatest percent increase in production under CP4.

Mortality

Based on the 1999 through 2006 population average, the greatest mortality to spring-run Chinook salmon under CP4 occurred to the eggs, followed by presmolts, then fry. Nonoperational conditions were the primary causes of mortality for all life stages under all Comprehensive Plans. Table 11-7 displays the overall mortalities for each Comprehensive Plan that were caused by nonoperational factors versus those caused by the operations (i.e., water temperature and flow) (Attachments 4B and 5B). Mortalities caused by the project decrease as the proposed dam height increases from 6.5 to 18.5 feet (Tables 11-7 and 11-8).

When removing nonoperations-related mortality, leaving mortality due to operations-related activities, only eggs and fry were affected (Table 11-8).

Critical water years under all Comprehensive Plans follow the same trends, with mortality to eggs due to unsuitable water temperatures as the primary cause of operations-related mortalities, followed by mortality to prespawned eggs and during incubation caused by dewatering the redds, then mortality to fry from forced movement to downstream habitats. Attachments 4C and 5C contains tables of mortality to spring-run Chinook salmon sorted by water-year type, and Table 11-9 outlines the rankings classified under each Comprehensive Plan for each water-year type.

In dry, below-normal and above-normal water years, all Comprehensive Plans were dominated by egg temperature mortality, followed by mortality resulting from redd dewatering. Mortality to prespawned eggs occurred in only two dry years but no below-normal water years. Mortality to fry from forced movement was relatively low in only several more years (Table 11-9).

In wet water years, the primary cause of mortality to spring-run Chinook salmon were to eggs due to redd dewatering and/or scouring, followed by mortality to eggs due to unsuitable water temperatures, then to fry resulting from forced movement and prespawn mortality (Table 11-9).

Years with the highest operations-related mortality were the same for all the Comprehensive Plans: 1924, 1931, 1932, 1933, 1934, 1977, and 1992. Except for 1932 (a dry water year), each of these years was a critical water-year type and was preceded by either a below, dry, or (predominantly) a critical water year. However, years with the lowest mortality varied between all water-year

types. Years in which the project had the greatest impact on spring-run Chinook salmon were also the years in which the lowest production occurred, with nearly all of the mortality occurring in the egg incubation life stage (Attachments 4C and 5C).

When the spawning population equaled AFRP goals, spring-run Chinook salmon mortality caused by the operations-related activities decreased under CP4 compared to No-Action Alternative conditions. Under CP4, mortality caused by operations-related activities would decrease from non-operations related mortality by over 43 percent. Under CP4, the greatest mortality to spring-run occurs to the egg incubation life stage, followed by presmolts, then fry, and lastly to immature smolts. Nonoperational conditions were the primary causes of mortality for all life stages under all alternatives (Attachment 6B).

Because spring-run Chinook salmon have, overall, a reduced mortality, spring-run Chinook salmon would benefit from actions taken in CP4. Additionally, spring-run Chinook salmon will benefit from the 10-year gravel augmentation program, although this was not modeled with SALMOD. Mitigation for this impact is not needed, and thus not proposed.

Fall-Run Chinook Salmon

Production

Based on the 1999 through 2006 population average, overall average fall-run Chinook salmon production increased for the 82-year period compared with the No-Action Alternative and Existing Condition (Attachments 7A and 8A). The maximum increase in production relative to the No-Action Alternative was 350 percent. The largest decrease in production relative to the No-Action Alternative was 9 percent for CP4 (Attachment 7A). The maximum increase in production relative to the Existing Condition was 607 percent in 1934. The largest decrease in production relative to the Existing Condition was 11 percent for CP4 in 1969 (Attachment 8A).

In critical, dry, and below-normal water years, when production was lowest over the simulation period, the increase in production resulting from operations-related activities was greatest. In above-normal and wet water years, however, the lowest production years typically had a slight decrease in production under CP1 conditions relative to the No-Action Alternative.

Under CP4, critical water years 1924, 1931, 1933, 1934, 1977, 1992, and 1994, dry water year 1932, and below-normal water years 1937 and 1945 had increases in production relative to the No-Action Alternative, ranging from 6 to 351 percent. A wet water year (1999) had a production decrease of approximately 10 percent.

Under CP4, six critical water years (1924, 1931, 1933, 1934, 1977, 1992) had increases in production relative to the Existing Condition, ranging from 10 to 607 percent. Two dry water years, 1932 and 1955, had a 16 and 5 percent

increase in production compared to the Existing Condition, respectively. Two below-normal water years, 1937 and 1945, had an increase in production relative to the Existing Condition of 9 and 7 percent, respectively. One dry water year (1985), one above-normal water year (1957) and two wet water years (1969 and 1999), resulted in a decrease in production relative to the Existing Condition, ranging from 5 to 11 percent.

When the spawning population equaled the AFRP goal, overall average fall-run Chinook salmon production was similar for CP4 relative to the No-Action Alternative (Attachment 9A). The maximum increase in production relative to the No-Action Alternative was 310 percent for CP4. The largest decrease in production relative to the No-Action Alternative was 9 percent for CP4. In critical, dry, and below-normal water years, years with the lowest production under the No-Action Alternative typically had the greatest percent increase in production under CP4. In above-normal and wet water years, however, the lowest production years typically remained similar or slightly decreased in production under CP4 conditions relative to the No-Action Alternative.

Mortality

Based on the 1999 through 2006 population average, the greatest mortality to fall-run Chinook salmon occurred to the egg incubation life stage, followed by presmolts, then fry, and lastly to immature smolts. Nonoperational conditions were the primary causes of mortality for all life stages under all Comprehensive Plans. Table 11-10 displays the overall mortalities for each alternative that were caused by nonoperational factors versus those caused by operations (i.e., water temperature and flow) (Attachments 7B and 8B).

When removing nonoperations-related mortality, allowing comparison of mortality for operations-related activities only, egg incubation was still the primary life stage affected, but operations-related activities had a greater effect on fry than on presmolts and an even lesser effect on immature smolts. The same trends for each Comprehensive Plan were observed, with the bulk of the mortality affecting the egg incubation life stage, with flow triggering more of the mortality (Table 11-11).

In all water-year types, under all Comprehensive Plans, the greatest portion of mortality occurred to fry caused by forced movement to downstream habitats. Prespawn, incubation, and superimposition mortality were greater than mortality to eggs caused by unsuitable water temperatures and presmolt habitat movement.

In critical water years, all Comprehensive Plans showed the same general trend in mortality factors. Mortality to fry due to forced movement downstream was the primary cause of operations-related mortalities for the No-Action Alternative and CP4, followed by mortality to eggs prior to spawning, and then to eggs from redd dewatering or scouring. Least affected were presmolts and then immature smolts by both water temperatures and forced movement.

Attachments 7C and 8C contain tables of mortality to fall-run Chinook salmon sorted by water-year type, and Table 11-12 outlines the rankings classified under each Comprehensive Plan for each water-year type.

As with critical water years, dry water years were dominated by mortality to fry due to forced movement downstream, followed by redd dewatering or scouring and redd superimposition. Additional mortality occurred to fall-run Chinook salmon presmolts and immature smolts from both forced movement and unsuitable water temperatures (Table 11-12).

Below-normal and above-normal water years were relatively similar for all Comprehensive Plans. The mortality factors were dominated by mortality to fry due to forced movement downstream, followed by redd superimposition, dewatering, or scouring. Mortality to presmolts caused by forced downstream movement was a greater factor affecting fall-run populations than was egg mortality caused by unsuitable water temperatures or to immature smolts and fry due to unsuitable water temperatures (Table 11-12).

As with the water-year types discussed above, under wet water year conditions, the majority of the mortality also occurred to fry due to forced downstream movement, followed by redd superimposition, and redd dewatering or scouring. Mortality to presmolts and immature smolts from downstream movement had the lowest mortality rates resulting from operations-related activities. Least affected were eggs due to unsuitable water temperatures, both pre- and post-spawn.

Under conditions created by CP4 compared with the No-Action Alternative, the years with the highest mortality tended to shift to all wet water years – 1956, 1958, 1970, 1978, and 1984 – which were preceded by wet, above-normal and dry water years (Attachment 7C).

Under conditions created by CP4 compared with the Existing Condition, the years with the highest mortality rates were 1955, 1957, 1969, 1973, 1981,1983, and 1996 (Attachment 8C).

When the spawning population equaled the AFRP goal, fall-run Chinook salmon mortality caused by operations-related activities decreased under CP4 compared to No-Action Alternative conditions (Attachment 9B). Under CP4, mortality caused by operations-related activities would decrease from non-operations related mortality by over 17 percent. Under CP4, the greatest mortality to fall-run occurred to the egg incubation life stage, followed by fry, then presmolts, and lastly to immature smolts. Nonoperational conditions were the primary causes of mortality for all life stages under all alternatives.

Because fall-run Chinook salmon have, overall, a reduced mortality, fall-run Chinook salmon would benefit from actions taken in CP4. Additionally, fall-run Chinook salmon will benefit from the 10-year gravel augmentation

program, although this was not modeled with SALMOD. Mitigation for this impact is not needed, and thus not proposed.

Late Fall-Run Chinook Salmon

Production

Based on the 1999 through 2006 population average, overall average late fall-run Chinook salmon production for the 82-year period under CP4 conditions was slightly greater than the No-Action Alternative and the Existing Condition (Attachments 10A and 11A). The maximum increase in production relative to the No-Action Alternative was 27 percent, while the largest decrease in production relative to the No-Action Alternative was 6 percent for CP4 (Attachment 10A). The maximum increase in production relative to the Existing Condition was 28 percent, while the largest decrease in production relative to the Existing Condition was 7 percent for CP4 (Attachment 11A).

Under CP4, critical water years 1924, 1929, 1931, 1933, 1976, and 1991, dry water years 1930 and 1932, and below-normal water year 1923 had increases in production compared to the No-Action Alternative, ranging from 6 to 28 percent. No water years had a decrease greater than 5 percent.

Under CP4, five critical water years (1931, 1933, 1976, 1988, and 1991) had substantial increases in production compared to the Existing Condition, ranging from 5 to 28 percent. Five dry water years (1926, 1930, 1932, 1939, and 1985), and one below-normal water year (1923), had increases in production relative to the Existing Condition, ranging from 5 to 19 percent. One wet water year (1969) and one dry water year (1949) had a decrease in production over the Existing Condition by 5 percent to 7 percent.

When the spawning population equaled the AFRP goal, overall average late fall-run Chinook salmon production was similar for CP4 relative to the No-Action Alternative (Attachment 12A). The maximum increase in production relative to the No-Action Alternative was 28 percent for CP4. The largest decrease in production relative to the No-Action Alternative was 3 percent for CP4. In critical, dry, and below-normal water years, years with the lowest production under the No-Action Alternative typically had the greatest percent increase in production under CP4. In above-normal and wet water years, however, the lowest production years typically remained similar to, or had a slight decrease in production under CP4 conditions relative to the No-Action Alternative.

Mortality

Based on the 1999 through 2006 population average, the greatest mortality to late fall-run Chinook salmon under CP4 occurred to the egg incubation life stage, followed by fry, then presmolts, and lastly to immature smolts. Nonoperational conditions were the primary causes of mortality for all life stages under all Comprehensive Plans. Table 11-13 displays the overall mortalities for each Comprehensive Plan that was caused by nonoperational

factors versus those caused by the operations (i.e., water temperature and flow) (Attachments 10B and 11B). Mortalities caused by the project decreased for all Comprehensive Plans relative to the No-Action Alternative.

When removing nonoperations-related mortality, allowing comparison of mortality for operations-related activities only, fry became the primary life stage affected, and operations-related activities had a greater effect on eggs than on presmolts and even less effect on immature smolts. Most of the mortality occurred as a result of flow conditions rather than water temperature (Table 11-14).

Under all Comprehensive Plans, mortality to fry resulting from unsuitable water temperatures only occurred at low levels to late fall-run Chinook salmon during critical, dry, and below-normal water years. In all water-year types, under all Comprehensive Plans, mortality to fry during forced movement to downstream habitats was the primary cause of operations-related mortality.

In critical, dry and below-normal water years, the causes of operations-related mortality followed similar trends for all Comprehensive Plans, with a few exceptions. In general, the effects of flow (and density) had the greatest effect on mortality. Forced movement of fry resulted in the greatest mortality, followed by flow effects on eggs via scouring, dewatering, or superimposition. Next affected were presmolts and immature smolts, by unsuitable water temperatures, and lastly temperature effects on eggs and flow effects on presmolts and immature smolts and fry (Table 11-15).

Wet and above-normal water years were overall similar to critical, dry, and below-normal water years except that mortality to fry due to unsuitable water temperatures disappeared and CP4 in wet years had no mortality due to redd scouring and/or dewatering.

Years with the highest mortality were the same for CP4 and the No-Action Alternative and the Existing Condition: 1937, 1957, 1982, 1985, 1994 and 1997. All water-year types were covered. Three of these with the highest mortality years were preceded by a wet water year, one preceded by an above-normal water year, and at least one below-normal water year (Attachments 10C and 11C).

When the spawning population equaled the AFRP goal, late fall-run Chinook salmon mortality caused by operations-related activities was slightly less under CP4 than under No-Action Alternative conditions. Under CP4, mortality caused by operations-related activities would decrease from non-operations related mortality by over 28 percent. Under CP4, the greatest mortality to late fall-run Chinook salmon occurred to the egg incubation life stage, followed by presmolts, then fry, and lastly to immature smolts. Nonoperational conditions were the primary causes of mortality for all life stages under all alternatives (Attachment 12B).

Because late fall-run Chinook salmon have, overall, a reduced mortality, late fall-run Chinook salmon would benefit from actions taken in CP4. Additionally, late fall-run Chinook salmon will benefit from the 10-year gravel augmentation program, although this was not modeled with SALMOD. Mitigation for this impact is not needed, and thus not proposed.

Impact Aqua-13 (CP4): Changes in Flow and Water Temperatures in the Upper Sacramento River Resulting from Project Operation – Steelhead, Green Sturgeon, Sacramento Splittail, American Shad, and Striped Bass CP4 operations would result in slightly improved flow and, sometimes, improved water temperature conditions in the upper Sacramento River for steelhead, green sturgeon, Sacramento splittail, American shad, and striped bass, particularly in critical water years. Overall, potential flow changes resulting from the implementation of CP4 would not be of sufficient frequency or magnitude to beneficially or adversely affect steelhead, green sturgeon, Sacramento splittail, American shad, or striped bass, in the upper Sacramento River. However, potential water temperature changes (reductions) resulting from the implementation of CP4 would result in beneficial impacts on steelhead, green sturgeon, Sacramento splittail, American shad, and striped bass in the upper Sacramento River especially during critical water years. Flow- and water temperature-related effects on these fish species would be less than significant (flow) and beneficial (water temperature), relative to the Existing Condition and No-Action Alternative. The benefits of the water temperature decrease outweigh the minimal effects of flow changes. Therefore, this impact would be beneficial.

This impact would be similar to Impact Aqua-13 (CP1); however, the impact could be greater (beneficial) during certain years because of the increased reservoir capacity associated with an 18.5-foot raise compared to a 6.5-foot raise and the additional volume of cold-water that would be available for anadromous fish.

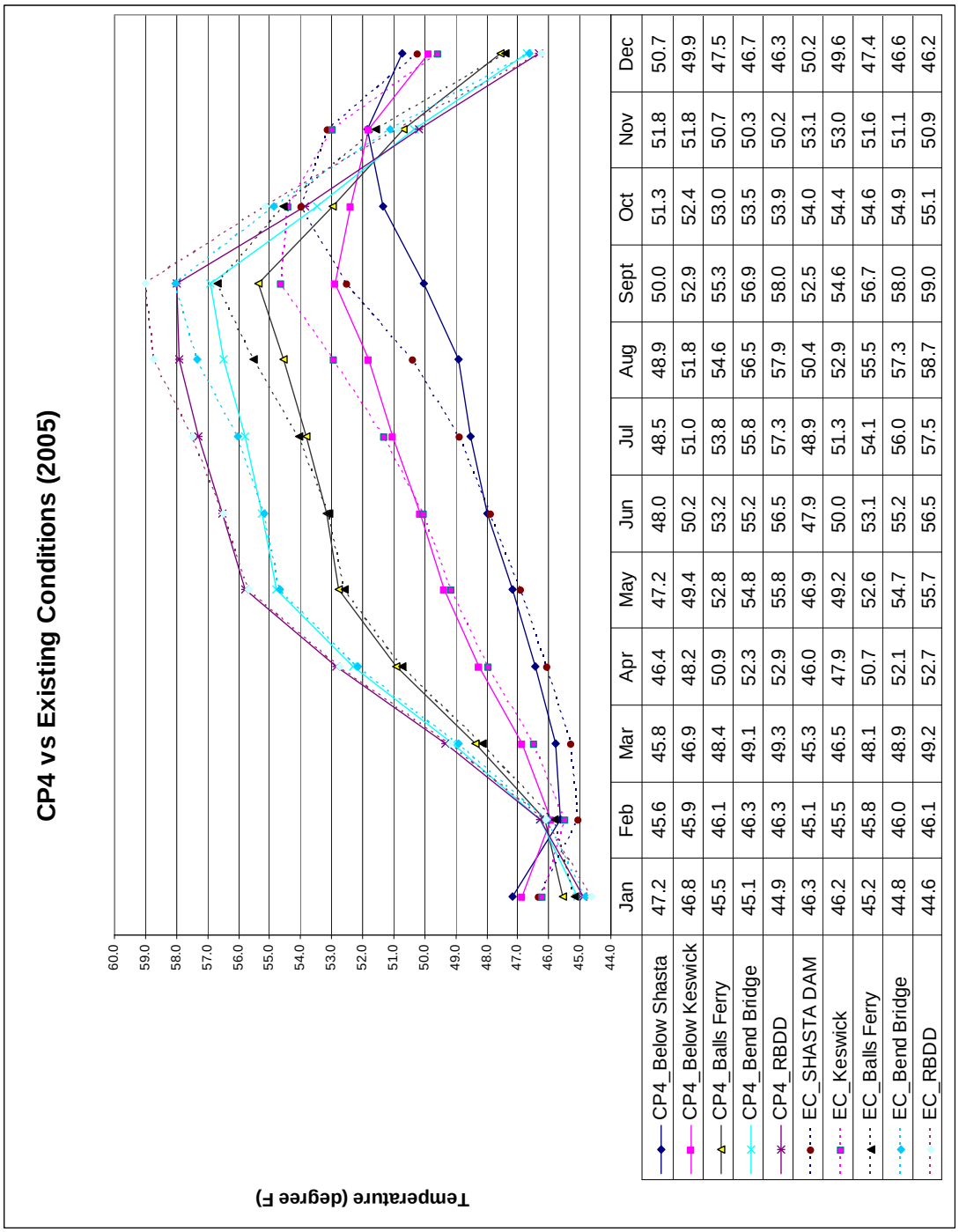
Flow-Related Effects Similar to CP1, monthly mean flows at all model locations (i.e., below Shasta Dam, below Keswick Dam, above Bend Bridge, and above RBDD) within the upper Sacramento River under CP4 would be similar to flows (less than 4 percent) under the Existing Condition and No-Action Alternative simulated for all months (see the *Hydrology, Hydraulics, and Water Management Technical Report* for complete modeling results). Potential flow-related effects on fish species of management concern in the upper Sacramento River from this alternative would be minimal. All potential changes in flows and stages would diminish rapidly downstream from RBDD because of the increasing effect of inflows from tributaries, and of diversions and flood bypasses.

There would be no discernable flow-related effects on steelhead, green sturgeon, Sacramento splittail, American shad, or striped bass in the upper Sacramento River related to changes in monthly mean flows under CP4, relative

to the Existing Condition and No-Action Alternative. Functional flows for migration, attraction, spawning, egg incubation, and rearing/emigration for all these fish species would be unchanged. Flow-related effects on these fish species would be less than significant.

Water Temperature-Related Effects Similar to CP1, monthly mean water temperatures at all model locations (i.e., below Shasta Dam, below Keswick Dam, above Bend Bridge, and above RBDD) within the upper Sacramento River under CP4 would be slightly less than those under the Existing Condition and No-Action Alternative conditions simulated for all months (Figures 11-30 and 11-31) (see also the *Hydrology, Hydraulics, and Water Management Technical Report* for complete modeling results). As discussed above, modeling simulations may not fully account for real-time management of the cold-water pool and TCD (through the SRTTG) to achieve maximum cold-water benefits. Therefore, the modeled changes in water temperature (i.e., small benefits) are likely conservative and understated to some varying degree. During most years, flow releases from Shasta Dam would be unchanged. On average, the greatest cooling effect (more than a 4°F reduction) occurred during critical years and during the late summer (i.e., July through September) (Figures 11-32 and 11-33), because of the increased cold-water pool volume within Shasta Lake, even following an extended dry period. All potential changes in flows and stages would diminish rapidly downstream from RBDD because of the increasing effect of inflows from tributaries, and of diversions and flood bypasses.

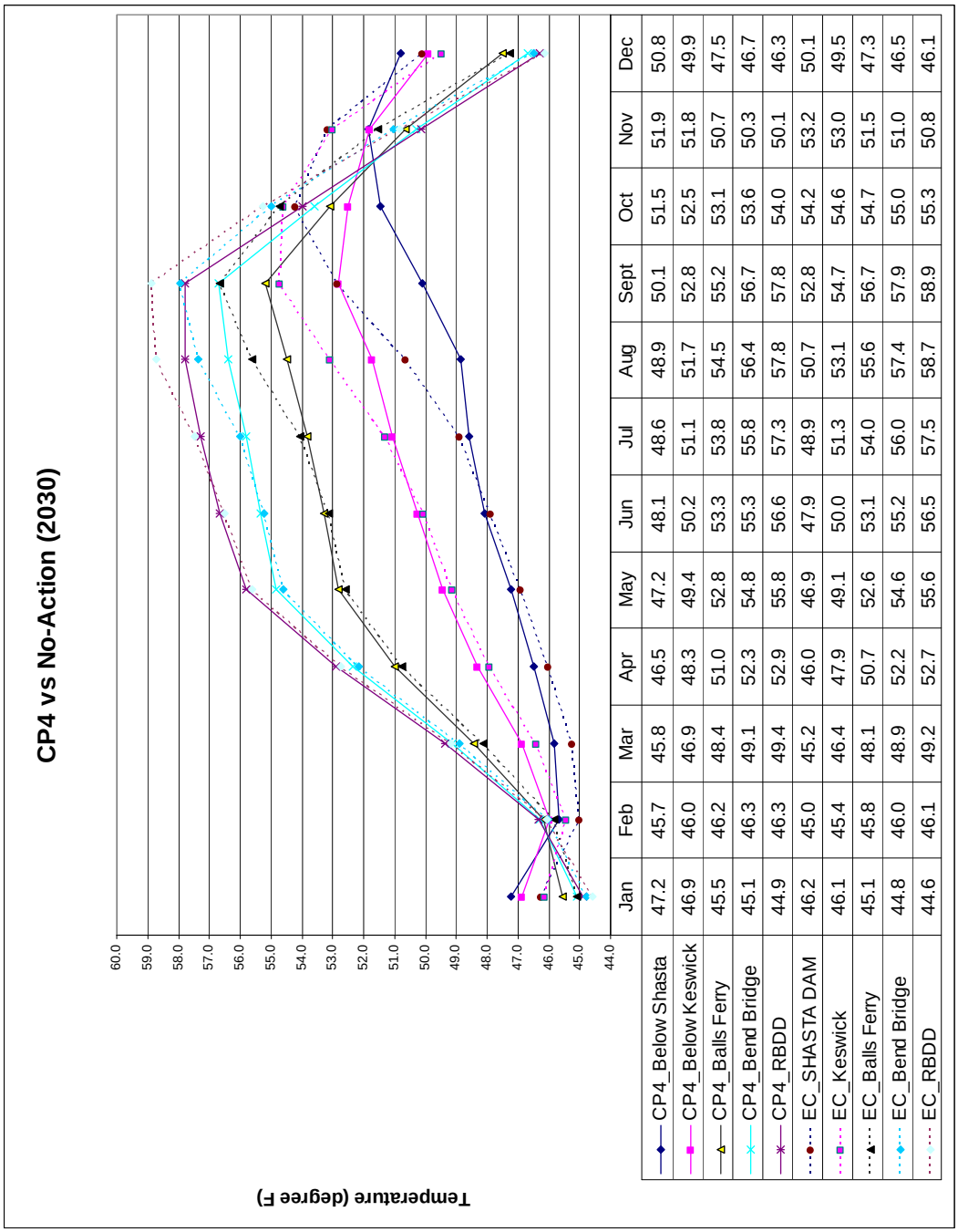
There would be water temperature-related effects on steelhead, green sturgeon, Sacramento splittail, American shad, or striped bass in the upper Sacramento River related to cooler monthly mean water temperatures under CP4, relative to the Existing Condition and No-Action Alternative. Mean monthly water temperatures would not rise above important thermal tolerances for the species life stages relevant to the upper Sacramento River, and would actually create more suitable conditions. Water temperature-related effects on these fish species would be beneficial. Mitigation for this impact is not needed, and thus not proposed.



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
CP4_Below Shasta	47.2	45.6	45.8	46.4	47.2	48.0	48.5	48.9	50.0	51.3	51.8	50.7
CP4_Below Keswick	46.8	45.9	46.9	48.2	49.4	50.2	51.0	51.8	52.9	52.4	51.8	49.9
CP4_Balls Ferry	45.5	46.1	48.4	50.9	52.8	53.2	53.8	54.6	55.3	53.0	50.7	47.5
CP4_Bend Bridge	45.1	46.3	49.1	52.3	54.8	55.2	55.8	56.5	56.9	53.5	50.3	46.7
CP4_RBDD	44.9	46.3	49.3	52.9	55.8	56.5	57.3	57.9	58.0	53.9	50.2	46.3
EC_SHASTA DAM	46.3	45.1	45.3	46.0	46.9	47.9	48.9	50.4	52.5	54.0	53.1	50.2
EC_Keswick	46.2	45.5	46.5	47.9	49.2	50.0	51.3	52.9	54.6	54.4	53.0	49.6
EC_Balls Ferry	45.2	45.8	48.1	50.7	52.6	53.1	54.1	55.5	56.7	54.6	51.6	47.4
EC_Bend Bridge	44.8	46.0	48.9	52.1	54.7	55.2	56.0	57.3	58.0	54.9	51.1	46.6
EC_RBDD	44.6	46.1	49.2	52.7	55.7	56.5	57.5	58.7	59.0	55.1	50.9	46.2

Key:
CP = Comprehensive Plan
EC = Existing Condition
RBDD = Red Bluff Diversion Dam

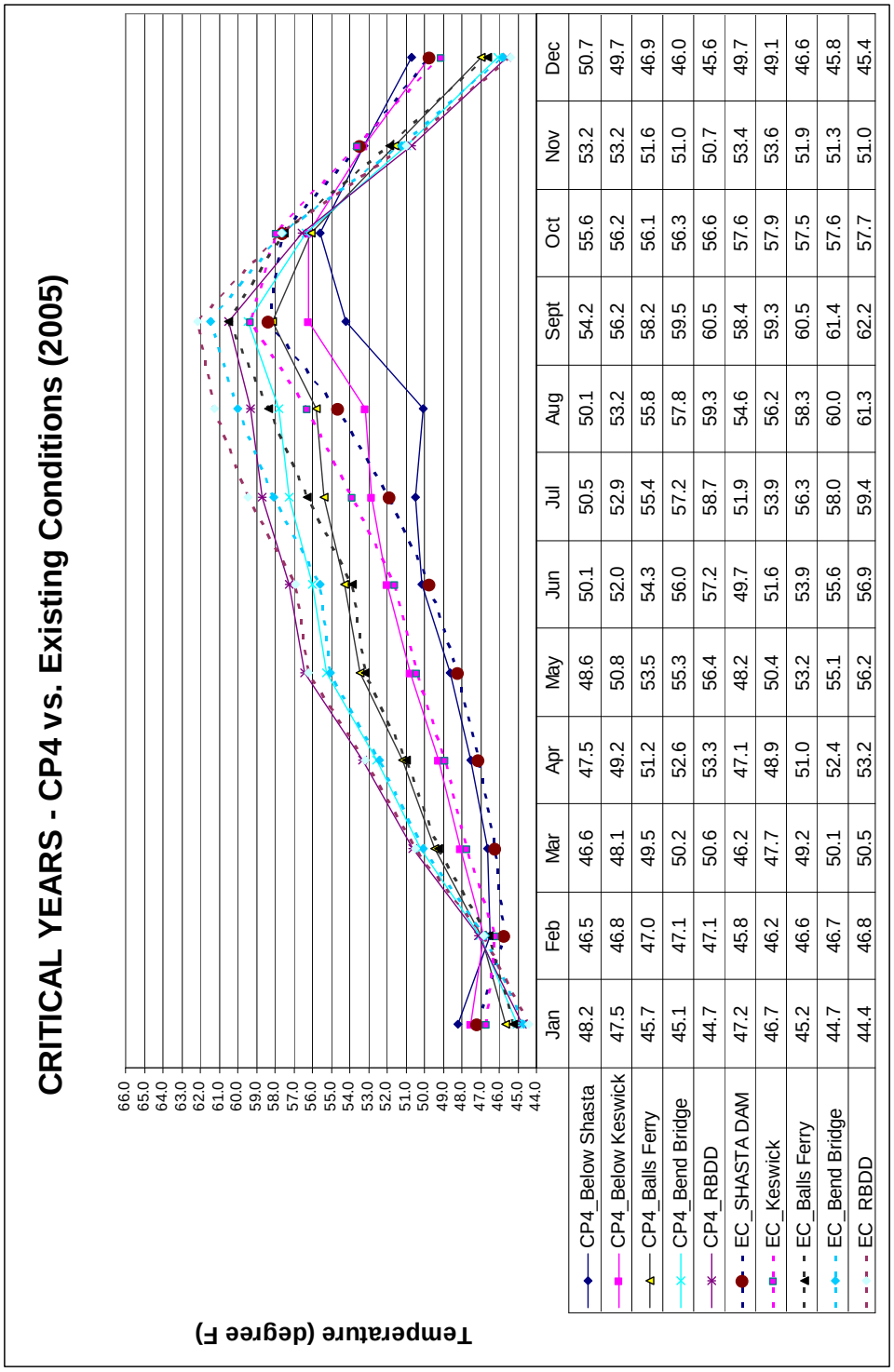
Figure 11-30. Changes in Mean Monthly Water Temperature at Modeled Locations in the Sacramento River Within the Primary Study Area (Existing Condition)



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
CP4_Below Shasta	47.2	45.7	45.8	46.5	47.2	48.1	48.6	48.9	50.1	51.5	51.9	50.8
CP4_Below Keswick	46.9	46.0	46.9	48.3	49.4	50.2	51.1	51.7	52.8	52.5	51.8	49.9
CP4_Balls Ferry	45.5	46.2	48.4	51.0	52.8	53.3	53.8	54.5	55.2	53.1	50.7	47.5
CP4_Bend Bridge	45.1	46.3	49.1	52.3	54.8	55.3	55.8	56.4	56.7	53.6	50.3	46.7
CP4_RBDD	44.9	46.3	49.4	52.9	55.8	56.6	57.3	57.8	57.8	54.0	50.1	46.3
EC_SHASTA DAM	46.2	45.0	45.2	46.0	46.9	47.9	48.9	50.7	52.8	54.2	53.2	50.1
EC_Keswick	46.1	45.4	46.4	47.9	49.1	50.0	51.3	53.1	54.7	54.6	53.0	49.5
EC_Balls Ferry	45.1	45.8	48.1	50.7	52.6	53.1	54.0	55.6	56.7	54.7	51.5	47.3
EC_Bend Bridge	44.8	46.0	48.9	52.2	54.6	55.2	56.0	57.4	57.9	55.0	51.0	46.5
EC_RBDD	44.6	46.1	49.2	52.7	55.6	56.5	57.5	58.7	58.9	55.3	50.8	46.1

Key:
EC = Existing Condition
CP = Comprehensive Plan
RBDD = Red Bluff Diversion Dam

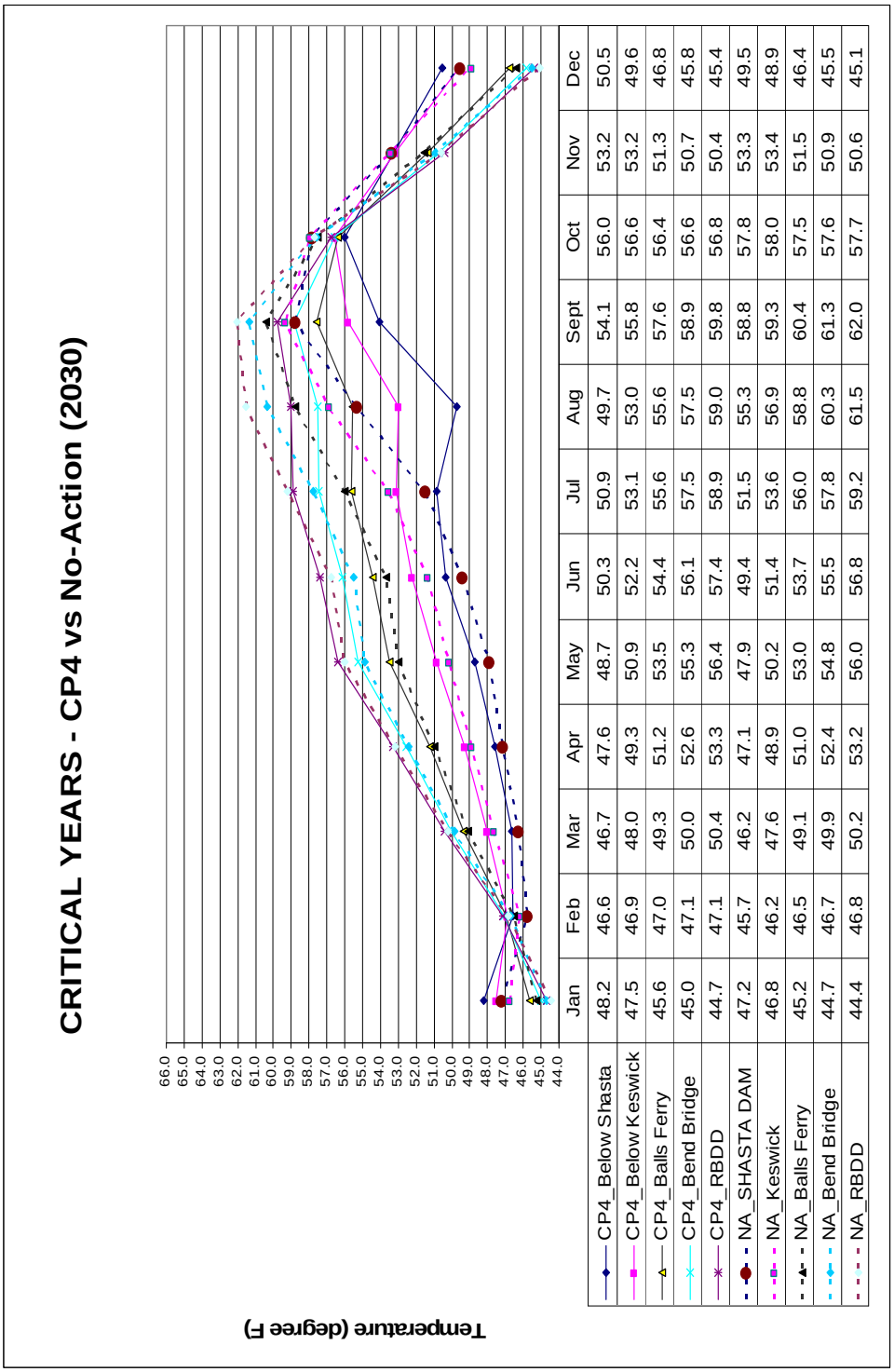
Figure 11-31. Changes in Mean Monthly Water Temperature at Modeled Locations in the Sacramento River Within the Primary Study Area (No-Action Alternative)



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
CP4_Below Shasta	48.2	46.5	46.6	47.5	48.6	50.1	50.5	50.1	54.2	55.6	53.2	50.7
CP4_Below Keswick	47.5	46.8	48.1	49.2	50.8	52.0	52.9	53.2	56.2	56.2	53.2	49.7
CP4_Balls Ferry	45.7	47.0	49.5	51.2	53.5	54.3	55.4	55.8	58.2	56.1	51.6	46.9
CP4_Bend Bridge	45.1	47.1	50.2	52.6	55.3	56.0	57.2	57.8	59.5	56.3	51.0	46.0
CP4_RBDD	44.7	47.1	50.6	53.3	56.4	57.2	58.7	59.3	60.5	56.6	50.7	45.6
EC_SHASTA DAM	47.2	45.8	46.2	47.1	48.2	49.7	51.9	54.6	58.4	57.6	53.4	49.7
EC_Keswick	46.7	46.2	47.7	48.9	50.4	51.6	53.9	56.2	59.3	57.9	53.6	49.1
EC_Balls Ferry	45.2	46.6	49.2	51.0	53.2	53.9	56.3	58.3	60.5	57.5	51.9	46.6
EC_Bend Bridge	44.7	46.7	50.1	52.4	55.1	55.6	58.0	60.0	61.4	57.6	51.3	45.8
EC_RBDD	44.4	46.8	50.5	53.2	56.2	56.9	59.4	61.3	62.2	57.7	51.0	45.4

Key:
EC = Existing Condition
CP = Comprehensive Plan
RBDD = Red Bluff Diversion Dam

Figure 11-32. Changes in Mean Monthly Water Temperature at Modeled Locations in the Sacramento River Within the Primary Study Area for Critical Years (Existing Condition)



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
CP4_Below Shasta	48.2	46.6	46.7	47.6	48.7	50.3	50.9	49.7	54.1	56.0	53.2	50.5
CP4_Below Keswick	47.5	46.9	48.0	49.3	50.9	52.2	53.1	53.0	55.8	56.6	53.2	49.6
CP4_Balls Ferry	45.6	47.0	49.3	51.2	53.5	54.4	55.6	55.6	57.6	56.4	51.3	46.8
CP4_Bend Bridge	45.0	47.1	50.0	52.6	55.3	56.1	57.5	57.5	58.9	56.6	50.7	45.8
CP4_RBDD	44.7	47.1	50.4	53.3	56.4	57.4	58.9	59.0	59.8	56.8	50.4	45.4
NA_SHASTA DAM	47.2	45.7	46.2	47.1	47.9	49.4	51.5	55.3	58.8	57.8	53.3	49.5
NA_Keswick	46.8	46.2	47.6	48.9	50.2	51.4	53.6	56.9	59.3	58.0	53.4	48.9
NA_Balls Ferry	45.2	46.5	49.1	51.0	53.0	53.7	56.0	58.8	60.4	57.5	51.5	46.4
NA_Bend Bridge	44.7	46.7	49.9	52.4	54.8	55.5	57.8	60.3	61.3	57.6	50.9	45.5
NA_RBDD	44.4	46.8	50.2	53.2	56.0	56.8	59.2	61.5	62.0	57.7	50.6	45.1

Key:
EC = Existing Condition
CP = Comprehensive Plan
RBDD = Red Bluff Diversion Dam

Figure 11-33. Changes in Mean Monthly Water Temperature at Modeled Locations in the Sacramento River Within the Primary Study Area for Critical Years (No-Action Alternative)

Impact Aqua-14 (CP4): Reduction in Ecologically Important Geomorphic Processes in the Upper Sacramento River Resulting from Reduced Frequency and Magnitude of Intermediate to High Flows CP4 operations could result in reduced intermediate to large flows that are necessary for channel forming and maintenance, meander migration, and the creation of seasonally inundated floodplains, all of which are processes necessary for the maintenance of important aquatic habitat functions and values for the fish and macroinvertebrate community. A reduction in these ecologically important geomorphic processes and related aquatic habitat functions and values in the Sacramento River and lowermost (confluence) areas of tributaries would be a potentially significant impact.

This impact would be similar to Impact Aqua-14 (CP1). The impact could be greater because the increased reservoir capacity associated with an 18.5-foot raise compared to a 6.5-foot raise would allow for additional water volume (and flows) to be stored behind the raised dam. Sediment transport, deposition, and scour regulate the formation of key habitat features such as point bars, gravel deposits, and SRA habitat. Intermediate to high flows and associated stage elevation of water surface also provide a backwater effect on the lowermost segment of tributaries, which reduces the potential for downcutting. These processes are regulated by the magnitude and frequency of flow, with relatively large floods providing the energy required to mobilize sediment from the river bed, produce meander migration, increase stage elevation, and create seasonally inundated floodplains. CP4 operations could result in reduced intermediate to large flows that are necessary for channel forming and maintenance, meander migration, and the creation of seasonally inundated floodplains.

CP4 would lead to a further reduction in the magnitude, duration, and frequency of intermediate to large flows. Overall, the project would increase the existing, ongoing impacts on geomorphic processes resulting from the operation of Shasta Dam that are necessary for channel forming and maintenance, meander migration, and the creation of seasonally inundated floodplains.

These effects would likely occur along the upper Sacramento River, downstream from Shasta Dam, throughout the primary study area. As discussed above, CP4 also includes a 10-year gravel augmentation program and the restoration of riparian, floodplain, and side channel habitat at Reading Island as additional environmental commitments. The placement of gravel along the Sacramento River channel and bank on an annual basis and restoration of riparian, floodplain, and side channel habitat at Reading Island would result in ecological process (e.g., sediment transport and deposition, floodplain inundation) benefits that would partially offset the impacts described above. Nevertheless, reductions in the magnitude of high flows would likely be sufficient to reduce ecologically important processes along the upper Sacramento River, downstream from Shasta Dam, throughout the primary study area. These impacts would be potentially significant within the primary study area. Mitigation for this impact is proposed in Section 11.3.4.

Lower Sacramento River and Delta

Impact Aqua-15 (CP4): Changes in Flow and Water Temperatures in the Lower Sacramento River and Tributaries and Trinity River Resulting from Project Operation – Fish Species of Primary Management Concern Project operation would result in no discernable change in mean monthly flow or water temperature conditions in the lower Sacramento River; however, predicted changes in flow in the Feather River, American River, and Trinity River could result in an adverse effect on Chinook salmon, steelhead, coho salmon, green sturgeon, Sacramento splittail, American shad, and striped bass if they were to occur. This impact would be potentially significant.

This impact would be similar to Impact Aqua-15 (CP1). The impact could be greater because the increased reservoir capacity associated with an 18.5-foot raise compared to a 6.5-foot raise would allow for additional water volume (and increased cold-water pool) to be stored behind the raised dam.

Similar to CP1, monthly mean flows at model locations (i.e., Verona, Freeport) within the lower Sacramento River under CP4 would be essentially equivalent (less than 2 percent difference) to flows under the Existing Condition and No-Action Alternative simulated for all months (see the *Hydrology, Hydraulics, and Water Management Technical Report* for complete modeling results). All potential changes in flows diminish rapidly downstream from RBDD because of the increasing effect of inflows from tributaries and of diversions and flood bypasses. Potential flow-related effects on fish species of management concern in the lower Sacramento River from this alternative would be minimal. Differences in mean monthly flow are generally small (less than 2 percent) and within the existing range of variability. All potential changes in water temperatures in the lower Sacramento River due to small changes in releases would diminish rapidly downstream because of the increasing effects of inflows, atmospheric influences, and groundwater. Therefore, flow- and temperature-related impacts on fish species in the lower Sacramento River would be less than significant.

Also similar to CP1, monthly mean flows at all model locations within the lower Feather River, the American River, and Trinity River under CP4 would be essentially equivalent (less than 2 percent difference) to flows under the Existing Condition and No-Action Alternative simulated for most months. However, there were several months within the modeling record that showed substantial changes (based on model simulations) to flows in tributaries (see the *Hydrology, Hydraulics, and Water Management Technical Report* for complete CalSim-II modeling results). All potential changes in flows could be diminished in these areas per existing operational rules and because of operation of upstream reservoirs (i.e., Lake Oroville, Folsom Lake, and Trinity Lake), and increasing effects of inflows from tributaries, and of diversions and flood bypasses. Nevertheless, based on predicted changes in flow and associated flow-habitat relationships, potential flow-related impacts on species of

management concern in the American, Feather, and Trinity rivers could occur and would be a potentially significant impact.

Monthly mean flows at all model locations within the lower Feather River (i.e., below Thermalito Afterbay) and the American River (i.e., near the H Street Bridge in Sacramento) under CP4 would also be essentially equivalent (less than 2 percent difference) to flows under the Existing Condition and No-Action Alternative simulated for all months. All potential changes in flows were diminished in these areas because of operation of upstream CVP and SWP reservoirs (i.e., Lake Oroville and Folsom Lake), and the increasing effect of inflows from tributaries, and of diversions and flood bypasses. Potential flow-related effects on fish species of management concern in the Feather River and American River from this alternative would be minimal and within the range of existing variability.

All potential changes in water temperatures in the lower Sacramento River and primary tributaries (i.e., Feather and American rivers) due to altered releases from reservoirs diminished downstream from RBDD because of increasing effect of inflows, and atmospheric and groundwater influences.

As under CP1, effects of altered flow regimes resulting from implementation of CP4 are unlikely to extend into the lower Sacramento River and Delta because the Central Valley's reservoirs and diversions are managed as a single integrated system (consisting of the SWP and the CVP). The guidelines for this management, which are described in the CVP/SWP OCAP, have been designed to maintain standards for flow to the lower Sacramento River and Delta. CVP and SWP operations must be consistent with the OCAP to allow coverage by the OCAP permits and BOs. Thus, under CP4, this project is not anticipated to cause an alteration in flow to the Delta nor cause an alteration to water temperatures in the lower Sacramento River and primary tributaries within the extended study area sufficient to cause discernable effects on Chinook salmon steelhead, green sturgeon, Sacramento splittail, American Shad, or striped bass relative to the Existing Condition and No-Action Alternative. Functional flows for fish migration, attraction, spawning, egg incubation, and rearing/emigration for all these fish species would be unchanged. Therefore, flow- and temperature-related effects on these fish species would be less than significant. Mitigation for this impact is proposed in Section 11.3.4.

Impact Aqua-16 (CP4): Reduction in Ecologically Important Geomorphic Processes in the Lower Sacramento River Resulting from Reduced Frequency and Magnitude of Intermediate to High Flows CP4 operations could result in reduced intermediate to large flows that are necessary for channel forming and maintenance, meander migration, and the creation of seasonally inundated floodplains, all of which are processes necessary for the maintenance of important aquatic habitat functions and values for the fish and macroinvertebrate community. A reduction in these ecologically important geomorphic processes and related aquatic habitat functions and values in the

lower Sacramento River and lowermost (confluence) areas of tributaries would be a potentially significant impact.

This impact would be similar to Impact Aqua-16 (CP1). The impact could be greater because the increased reservoir capacity associated with an 18.5-foot raise compared to a 6.5-foot raise would allow for additional water volume (and flows) to be stored behind the raised dam. Sediment transport, deposition, and scour regulate the formation of key habitat features such as point bars, gravel deposits, and SRA habitat. Intermediate to high flows and associated stage elevation of water surface also provide a backwater effect on the lowermost segment of tributaries, which reduces the potential for downcutting. These processes are regulated by the magnitude and frequency of flow, with relatively large floods providing the energy required to mobilize sediment from the bed, produce meander migration, increase stage elevation, create seasonally inundated floodplains, and inundate floodplain bypasses. Project operation could result in reduced intermediate to large flows that are necessary for channel forming and maintenance, meander migration, and the creation of seasonally inundated floodplains.

CP4 would lead to a further reduction in the magnitude, duration, and frequency of intermediate to large flows, relative to the Existing Condition and No-Action Alternative. Overall, the project would increase the existing, ongoing impacts on geomorphic processes resulting from the operation of Shasta Dam that are necessary for channel forming and maintenance, meander migration, the creation of seasonally inundated floodplains, and the inundation of floodplain bypasses. These effects would likely occur along the upper reaches of the lower Sacramento River. Reductions in the magnitude of high flows would likely be sufficient to reduce ecologically important processes along the upper Sacramento River and its floodplain bypasses. These impacts would be potentially significant. Mitigation for this impact is proposed in Section 11.3.4.

Impact Aqua-17 (CP4): Effects to Delta Fishery Habitat Resulting from Changes to Delta Outflow Delta outflow conditions under CP4 would be the same as those under CP1. Therefore, CP4 would have a less than significant effect on Delta fisheries and hydrologic transport processed within the Bay-Delta. Mitigation for this impact is not needed, and thus not proposed.

Impact Aqua-18 (CP4): Effects to Delta Fishery Habitat Resulting from Changes to Delta Inflow Changes in upstream reservoir storage have the potential to affect Delta inflow. Delta inflow may affect hydrologic conditions within Delta channels, hydraulic residence times, salinity gradients, and the transport and movement of various life stages of fish, invertebrates, phytoplankton, and nutrients into and through the Delta. Delta inflow serves as a surrogate metric for a variety of habitat conditions within the Delta that directly, or indirectly, affects fish and other aquatic resources. Delta inflow conditions under CP4 would be the same as those under CP1; therefore, CP4 would have a less than significant effect on Delta fisheries and hydrologic

transport processed within the Bay-Delta compared with the Existing Condition and No-Action Alternative. Mitigation for this impact is not needed, and thus not proposed.

Impact Aqua-19 (CP4): Effects to Delta Fisheries Resulting from Changes in Sacramento River Inflow CP4 operations would be the same as those under CP1 and would result in a variable response in Sacramento River flow, in turn, resulting in both increases and decreases in river flow above the Existing Condition and No-Action Alternative depending on month and water-year type. This impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact Aqua-20 (CP4): Effects to Delta Fisheries Resulting from Changes in San Joaquin River Flow at Vernalis CP4 operation would be the same as under CP1 and would result in no discernable change in San Joaquin River flows at Vernalis. Therefore, CP4 would have no effect on Delta fisheries or transport mechanisms within the lower San Joaquin River and Delta relative to either the No-Action Alternative of Existing Condition. This impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact Aqua-21 (CP4): Reduction in Low Salinity Habitat Conditions Resulting from an Upstream Shift in X2 Location CP4 operations, the same as CP1 operations, would result in a less than 0.5 km movement upstream or downstream from the X2 location. This impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact Aqua-22 (CP4): Increase in Mortality of Species of Primary Management Concern as a Result of Increased Reverse Flows in Old and Middle Rivers CP4 operations, the same as CP1 operations, would result in an increase of reverse flows in Old and Middle rivers. The increase in reverse flows would be expected to contribute to a small increase in the vulnerability of juvenile striped bass, threadfin shad, and other resident warm-water fish to increased salvage and potential losses. This impact would be potentially significant. Mitigation for this impact is not proposed because operations will be guided by RPAs established by NMFS and USFWS BOs.

Impact Aqua-23 (CP4): Increase in the Risk of Entrainment or Salvage of Species of Primary Management Concern at CVP and SWP Export Facilities Due to Changes in CVP and SWP Exports CP4 operations, which are the same as CP1 operations, may result in an increase of CVP and SWP exports, which is assumed to result in a direct proportional increase or decrease in the risk of fish being entrained and salvaged at the facilities. This is considered a less than significant impact to Chinook salmon, steelhead, and longfin smelt. This is considered a potentially significant impact to delta smelt, striped bass, and splittail. Mitigation for this impact is not proposed because operations will be guided by RPAs established by NMFS and USFWS BOs.

CVP/SWP Service Areas

Impact Aqua-24 (CP4): Impacts on Aquatic Habitats and Fish Populations in the CVP and SWP Service Areas Resulting from Modifications to Existing Flow Regimes CP4 implementation could result in modified flow regimes that would reduce the frequency and magnitude of high winter flows along the Sacramento River; however, the hydrologic effects in tributaries and reservoirs (e.g., New Melones and San Luis) with CVP and SWP dams are expected to be less than impacts on the lower Sacramento River. The change in hydrology could affect aquatic habitats that provide habitat for the fish community. These changes are unlikely to result in substantial effects on the distribution or abundance of these species in the CVP and SWP service areas. Therefore, this impact would be less than significant.

This impact would be similar to Impact Aqua-33 (CP1). The impact could be greater because the increased reservoir capacity associated with an 18.5-foot raise compared to a 6.5-foot raise would allow additional water volume (and flows) to be stored behind the raised dam. However, these changes are unlikely to result in substantial effects on the distribution or abundance of these species in the CVP and SWP service areas. The effects from CP4 on CVP and SWP reservoir elevations, filling, spilling, and planned releases, and resulting downstream flows, would be small and well within the range of variability that commonly occurs in these reservoirs and downstream flows. Therefore, this impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

CP5 – 18.5-Foot Dam Raise, Combination Plan

CP5 focuses primarily on increased water supply reliability, Shasta Lake-area environmental resources, and increased recreation opportunities. Major components of this plan include the following:

- Raising Shasta Dam and appurtenant facilities by 18.5 feet.
- Constructing additional resident fish habitat in Shasta Lake and along the lower reaches of the Sacramento River, McCloud River, and Squaw Creek.
- Constructing shoreline fish habitat around Shasta Lake.
- Improving operation and enhancing recreation facilities at various locations around Shasta Lake.
- Enlarging the Shasta Lake cold-water pool.
- Modifying the TCD.
- Increasing conservation storage.

- Reducing demand.
- Modifying flood operations.
- Increasing public safety at Shasta Dam.
- Modifying hydropower facilities.

The additional storage created by the 18.5-foot dam raise would be used primarily to increase water supply reliability, while also improving the ability to meet temperature objectives for winter-run Chinook salmon during drought years. The capacity of the reservoir would increase by 634,000 acre-feet to a total of 5.19 million acre-feet, and the existing TCD would be extended to achieve efficient use of the expanded reservoir.

CP5 includes restoring resident fish habitat in Shasta Lake and fisheries and riparian habitat at several locations along the lower reaches of the upper Sacramento River, McCloud River, and Squaw Creek. Specific locations and total area of restoration in the Shasta Lake area will be the subject of future studies.

Shasta Lake and Vicinity

Impact Aqua-1 (CP5): Effects on Nearshore, Warm-Water Habitat in Shasta Lake from Project Operations Under CP5, this impact would be similar to CP3. Its impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact Aqua-2 (CP5): Effects on Nearshore, Warm-Water Habitat in Shasta Lake from Project Construction This impact would be similar to CP3. This impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact Aqua-3 (CP5): Effects on Cold-Water Habitat in Shasta Lake Under CP5, operations-related changes in the ratio of the volume of cold-water storage to surface area would increase the availability of suitable habitat for cold-water fish in Shasta Lake, including rainbow trout. This impact would be beneficial.

This impact would be similar to CP3 and would be beneficial. Mitigation for this impact is not needed, and thus not proposed.

Impact Aqua-4 (CP5): Effects on Special-Status Aquatic Mollusks Under CP5, habitat for special-status mollusks could be inundated. Seasonal fluctuations in the surface area and WSEL of Shasta Lake could also adversely affect special-status aquatic mollusks that could occupy habitat in or near Shasta Lake and its tributaries. Tributary investigations are ongoing and will provide additional information and analysis for inclusion in the FEIS. This impact would be potentially significant.

This impact would be similar to CP3 and would be potentially significant. Mitigation for this impact is proposed in Section 11.3.4.

Impact Aqua-5 (CP5): Effects on Special-Status Fish Species That Occupy Habitat Provided by Shasta Lake and its Tributaries The expansion of the surface area of Shasta Lake and the inundation of additional tributary habitat under CP5 could affect one species designated as sensitive by the USFS, the hardhead. Tributary investigations are ongoing and will provide additional information and analysis for inclusion in the FEIS. This impact would be less than significant.

This impact would be similar to Impact Aqua-5 (CP3) and would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact Aqua-6 (CP5): Creation or Removal of Barriers to Fish Between Tributaries and Shasta Lake Under CP5, project implementation would result in the periodic inundation of steep and low-gradient tributaries to Shasta Lake up to the 1,090-foot contour, the maximum inundation level under this alternative. Tributary investigations are ongoing and will provide additional information and analysis for inclusion in the FEIS. However, based on digital topographic data and stream channel data generated from field inventories, it appears no substantial barriers between the 1,070-foot and 1,090-foot contours would be inundated under this alternative. This impact would be less than significant.

This impact would be similar to Impact Aqua-6 (CP3) and would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact Aqua-7 (CP5): Effects on Spawning and Rearing Habitat of Adfluvial Salmonids in Low-Gradient Tributaries to Shasta Lake CP5 would result in additional periodic inundation of potentially suitable spawning and rearing habitat for adfluvial salmonids in low-gradient tributaries to Shasta Lake. Tributary investigations are ongoing and will provide additional information and analysis for inclusion in the FEIS. A total of 11 miles of low-gradient reaches that could potentially provide some spawning and rearing habitat for adfluvial salmonids would be affected by CP5, which is only about 2.8 percent of the low-gradient habitat upstream from Shasta Lake. This impact would be less than significant.

This impact would be similar to CP3 and would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact Aqua-8 (CP5): Effects on Aquatic Connectivity in Non-Fish-Bearing Tributaries to Shasta Lake CP5 would result in periodic inundation of the lower reaches of high-gradient, non-fish-bearing tributaries to Shasta Lake. About 24 miles of non-fish-bearing tributary habitat would be affected by CP5, which is only about 1 percent of the total length of non-fish-bearing tributaries

upstream from Shasta Lake. Tributary investigations are ongoing and will provide additional information and analysis for inclusion in the FEIS. This impact would be less than significant.

This impact would be similar to Impact Aqua-8 (CP3) and would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact Aqua-9 (CP5): Effects on Water Quality at Livingston Stone Hatchery Reclamation provides the water supply to the Livingston Stone Hatchery from a pipeline emanating from Shasta Dam. This supply would not be interrupted by any activity associated with CP5. There would be no impact.

This impact would be similar to Impact Aqua-9 (CP1), and there would be no impact. Mitigation for this impact is not needed, and thus not proposed.

Upper Sacramento River (Shasta Dam to RBDD)
Impact Aqua-10 (CP5): Loss or Degradation of Aquatic Habitat in the Upper Sacramento River During Construction Activities Construction activities have the potential to increase sediments and turbidity, and release and exposure of contaminants. With environmental commitments in place, this would be a less than significant impact

This impact would be similar to Impact Aqua-10 (CP1). The impact could be greater because of the increased activity associated with an 18.5-foot dam raise compared to a 6.5-foot dam raise. Similar to CP4, CP5 also includes a 10-year gravel augmentation program as an additional environmental commitment. The placement of gravel along the Sacramento River channel and bank on an annual basis would result in an additional source of fine sediment being released and exposed to the river and aquatic communities. However, the gravel augmentation activities would only occur during pre-specified in-water work windows, which would minimize the potential for impacts associated with this activity.

Also similar to CP4, CP5 also includes a riparian, floodplain, and side channel habitat restoration in the upper Sacramento River at Reading Island. The Reading Island riparian, floodplain, and side channel restoration could result in additional disturbed surfaces, but most of this construction is expected to occur away from the wetted channel, and all disturbed areas would be revegetated.

However, the environmental commitments for all action would result in less than significant impacts. Mitigation for this impact is not needed, and thus not proposed. *Impact Aqua-11 (CP5): Release and Exposure of Contaminants in the Upper Sacramento River During Construction Activities* Construction-related activities have the potential to result in the release and exposure of contaminants, resulting in adverse effects on aquatic habitats, the aquatic food web, and fish populations, including special-status species, within the primary

study area downstream from project construction activities. This impact would be less than significant with all environmental commitments in place.

This impact would be similar to Impact Aqua-11 (CP1). The impact could be greater because of the increased activity associated with an 18.5-foot raise compared to a 6.5-foot raise. Similar to CP4, CP5 also includes the implementation of the gravel augmentation program and restoration of riparian, floodplain, and side channel habitat at Reading Island. However, the environmental commitments for all action would result in less than significant impacts. Mitigation for this impact is not needed, and thus not proposed.

Impact Aqua-12 (CP5): Improved Flow and Water Temperature in the Upper Sacramento River Resulting From Project Operation – Chinook Salmon Project operation would result in improved flow and water temperature conditions in the upper Sacramento River for fish species of management concern. This impact would be beneficial.

Winter-Run Chinook Salmon Impacts and benefits under CP5 to winter-run Chinook salmon are the same as those identified under CP3. Mitigation for this impact is not needed, and thus not proposed.

Spring-Run Chinook Salmon Impacts and benefits under CP5 to spring-run Chinook salmon are the same as those identified under CP3. Mitigation for this impact is not needed, and thus not proposed.

Fall-Run Chinook Salmon Impacts and benefits under CP5 to fall-run Chinook salmon are the same as those identified under CP3. Mitigation for this impact is not needed, and thus not proposed.

Late Fall–Run Chinook Salmon Impacts and benefits under CP5 to late fall-run Chinook salmon are the same as those identified under CP3. Mitigation for this impact is not needed, and thus not proposed.

Impact Aqua-13 (CP5): Changes in Flow and Water Temperatures in the Upper Sacramento River Resulting from Project Operation – Steelhead, Green Sturgeon, Sacramento Splittail, American Shad, and Striped Bass Project operation would result in slightly improved flow and water temperature conditions in the upper Sacramento River for steelhead, green sturgeon, Sacramento splittail, American shad, and striped bass. This impact would be less than significant.

This impact would be the same as Impact Aqua-13 (CP3). Flow- and water temperature-related effects on these fish species would be less than significant, relative to the Existing Condition and No-Action Alternative. This impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact Aqua-14 (CP5): Reduction in Ecologically Important Geomorphic Processes in the Upper Sacramento River Resulting from Reduced Frequency and Magnitude of Intermediate to High Flows Project operation could result in reduced intermediate to large flows that are necessary for channel forming and maintenance, meander migration, and the creation of seasonally inundated floodplains, all of which are processes necessary for the maintenance of important aquatic habitat functions and values for the fish and macroinvertebrate community. A reduction in these ecologically important geomorphic processes and related aquatic habitat functions and values in the Sacramento River and lowermost (confluence) areas of tributaries would be a potentially significant impact.

This impact would be similar to Impact Aqua-14 (CP1). The impact could be greater because the increased reservoir capacity associated with an 18.5-foot raise compared to a 6.5-foot raise would allow additional water volume (and flows) to be stored behind the raised dam. Sediment transport, deposition, and scour regulate the formation of key habitat features such as point bars, gravel deposits, and SRA habitat. Intermediate to high flows and associated stage elevation of water surface also provide a backwater effect on the lowermost segment of tributaries, which reduces the potential for downcutting. These processes are regulated by the magnitude and frequency of flow, with relatively large floods providing the energy required to mobilize sediment from the river bed, produce meander migration, increase stage elevation, and create seasonally inundated floodplains. Project operation could result in reduced intermediate to large flows that are necessary for channel forming and maintenance, meander migration, and the creation of seasonally inundated floodplains.

CP5 would lead to a further reduction in the magnitude, duration, and frequency of intermediate to large flows. Overall, the project would increase the existing, ongoing impacts on geomorphic processes resulting from operation of Shasta Dam that are necessary for channel forming and maintenance, meander migration, and the creation of seasonally inundated floodplains.

These effects would likely occur along the upper Sacramento River, downstream from Shasta Dam, throughout the primary study area. As discussed above, CP5 also includes a 10-year gravel augmentation program and the restoration of riparian, floodplain, and side channel habitat at Reading Island as additional environmental commitments. The placement of gravel along the Sacramento River channel and bank on an annual basis and restoration of riparian, floodplain, and side channel habitat at Reading Island would result in ecological process (e.g., sediment transport and deposition, floodplain inundation) benefits that would partially offset the impacts described above. Nevertheless, reductions in the magnitude of high flows would likely be sufficient to reduce ecologically important processes along the upper Sacramento River, downstream from Shasta Dam, throughout the primary study area. These impacts would be potentially significant within the primary study area. Mitigation for this impact is proposed in Section 11.3.4.

Lower Sacramento River and Tributaries, Delta, and Trinity River
Impact Aqua-15 (CP5): Changes in Flow and Water Temperatures in the Lower Sacramento River and Tributaries and Trinity River Resulting from Project Operation – Fish Species of Primary Management Concern Project operation would result in no discernable change in mean monthly flow or water temperature conditions in the lower Sacramento River; however, predicted changes in flow in the Feather River, American River, and Trinity River could result in an adverse effect on Chinook salmon, steelhead, Coho salmon, green sturgeon, Sacramento splittail, American shad, and striped bass if they were to occur. This impact would be potentially significant.

This impact would be similar to Impact Aqua-15 (CP1). The impact could be greater because the increased reservoir capacity associated with an 18.5-foot raise compared to a 6.5-foot raise would allow additional water volume (and increased cold-water pool) to be stored behind the raised dam.

Similar to CP1, monthly mean flows at model locations (i.e., Verona, Freeport) within the lower Sacramento River under CP5 would be essentially equivalent (less than 2 percent difference) to flows under the Existing Condition and No-Action Alternative conditions simulated for all months (see the *Hydrology, Hydraulics, and Water Management Technical Report* for complete modeling results). All potential changes in flows diminish rapidly downstream from RBDD because of increasing effects of inflows from tributaries and of diversions and flood bypasses. Potential flow-related effects on fish species of management concern in the lower Sacramento River from this alternative would be minimal. Differences in mean monthly flow were generally small (less than 2 percent) and within the existing range of variability. All potential changes in water temperatures in the lower Sacramento River due to small changes in releases would diminish rapidly downstream because of increasing effects of inflows, atmospheric influences, and groundwater. Therefore, flow- and temperature-related impacts on fish species in the lower Sacramento River would be less than significant.

Also similar to CP1, monthly mean flows at all model locations within the lower Feather River, the American River, and Trinity River under CP2 would be essentially equivalent (less than 2 percent difference) to flows under the Existing Condition and No-Action Alternative simulated for most months. However, several months within the modeling record showed substantial changes (based on model simulations) to flows in tributaries (see the *Hydrology, Hydraulics, and Water Management Technical Report* for complete CalSim-II modeling results). All potential changes in flows could be diminished in these areas per existing operational rules, and because of operation of upstream reservoirs (i.e., Lake Oroville, Folsom Lake, and Trinity Lake), and increasing effects of inflows from tributaries and of diversions and flood bypasses. Nevertheless, based on predicted changes in flow and associated flow-habitat relationships, potential flow-related impacts on species of management concern in the American, Feather, and Trinity rivers could occur and would be a

potentially significant impact. Mitigation for this impact is proposed in Section 11.3.4.

Impact Aqua-16 (CP5): Reduction in Ecologically Important Geomorphic Processes in the Lower Sacramento River Resulting from Reduced Frequency and Magnitude of Intermediate to High Flows Project operation could result in reduced intermediate to large flows that are necessary for channel forming and maintenance, meander migration, and the creation of seasonally inundated floodplains, all of which are processes necessary for the maintenance of important aquatic habitat functions and values for the fish and macroinvertebrate community. A reduction in these ecologically important geomorphic processes and related aquatic habitat functions and values in the lower Sacramento River and lowermost (confluence) areas of tributaries would be a potentially significant impact.

This impact would be similar to Impact Aqua-16 (CP1). The impact could be greater because the increased reservoir capacity associated with an 18.5-foot raise compared to a 6.5-foot raise would allow additional water volume (and flows) to be stored behind the raised dam. Sediment transport, deposition, and scour regulate the formation of key habitat features such as point bars, gravel deposits, and SRA habitat. Intermediate to high flows and associated stage elevation of water surface also provide a backwater effect on the lowermost segment of tributaries, which reduces the potential for downcutting. These processes are regulated by the magnitude and frequency of flow, with relatively large floods providing the energy required to mobilize sediment from the bed, produce meander migration, increase stage elevation, create seasonally inundated floodplains, and inundate floodplain bypasses. Project operation could result in reduced intermediate to large flows that are necessary for channel forming and maintenance, meander migration, and the creation of seasonally inundated floodplains.

CP5 would lead to a further reduction in the magnitude, duration, and frequency of intermediate to large flows, relative to the Existing Condition and No-Action Alternative. Overall, the project would increase the existing, ongoing impacts on geomorphic processes resulting from operation of Shasta Dam that are necessary for channel forming and maintenance, meander migration, the creation of seasonally inundated floodplains, and the inundation of floodplain bypasses. These effects would likely occur along the upper reaches of the lower Sacramento River. Reductions in the magnitude of high flows would likely be sufficient to reduce ecologically important processes along the upper Sacramento River and its floodplain bypasses. These impacts would be potentially significant. Mitigation for this impact is proposed in Section 11.3.4.

Impact Aqua-17 (CP5): Effects to Delta Fishery Habitat Resulting from Changes to Delta Outflow Delta outflow conditions under CP5 would be identical to those under CP3. Therefore, CP5 would have a less than significant

effect on Delta fisheries and hydrologic transport processed within the Bay-Delta. Mitigation for this impact is not needed, and thus not proposed.

Impact Aqua-18 (CP5): Effects to Delta Fishery Habitat Resulting from Changes to Delta Inflow Changes in upstream reservoir storage have the potential to affect Delta inflow. Delta inflow may affect hydrologic conditions within Delta channels, hydraulic residence times, salinity gradients, and the transport and movement of various life stages of fish, invertebrates, phytoplankton, and nutrients into and through the Delta. Delta inflow serves as a surrogate metric for a variety of habitat conditions within the Delta that directly, or indirectly, affects fish and other aquatic resources. Delta inflow conditions under CP5 would be the same as those under CP3; therefore, CP5 would have a less than significant effect on Delta fisheries and hydrologic transport processed within the Bay-Delta. Mitigation for this impact is not needed, and thus not proposed.

Impact Aqua-19(CP5): Effects to Delta Fisheries Resulting from Changes in Sacramento River Inflow CP5 operations would be the same as those under CP3 and would result in a variable response in Sacramento River flow, resulting in both increases and decreases in river flow above basis-of-comparison conditions depending on month and water year. This impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact Aqua-20 (CP5): Effects to Delta Fisheries Resulting from Changes in San Joaquin River Flow at Vernalis CP5 operation would be the same as under CP3 and result in no discernable change in San Joaquin River flows at Vernalis; and therefore CP5 would have no effect on Delta fisheries or transport mechanisms within the lower San Joaquin River and Delta compared with both the No-Action Alternative and Existing Condition. This impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact Aqua-21 (CP5): Reduction in Low Salinity Habitat Conditions Resulting from an Upstream Shift in X2 Location CP5 operation would be the same as under CP3 and result in a less than 0.5 km movement upstream or downstream from the X2 location. This impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact Aqua-22 (CP5): Increase in Mortality of Species of Primary Management Concern as a Result of Increased Reverse Flows in Old and Middle Rivers CP5 operations would be the same as under CP3 and would result in an increase of reverse flows in Old and Middle rivers. The increase in reverse flows would be expected to contribute to a small increase in the vulnerability of juvenile striped bass, threadfin shad, and other resident warm-water fish to increased salvage and potential losses. This impact would be potentially significant. Mitigation for this impact is not proposed because operations will be guided by RPAs established by NMFS and USFWS BOs.

Impact Aqua-23 (CP5): Increase in the Risk of Entrainment or Salvage of Species of Primary Management Concern at CVP and SWP Export Facilities Due to Changes in CVP and SWP Exports CP5 operations, which are the same as CP3 operations, may result in an increase of CVP and SWP exports, which is assumed to result in a direct proportional increase or decrease in the risk of fish being entrained and salvaged at the facilities. This is considered a less than significant impact to Chinook salmon, steelhead, and longfin smelt. This is considered a potentially significant impact to delta smelt, striped bass, and splittail. Mitigation for this impact is not proposed because operations will be guided by RPAs established by NMFS and USFWS BOs.

CVP/SWP Service Areas

Impact Aqua-24 (CP5): Impacts on Aquatic Habitats and Fish Populations in the CVP and SWP Service Areas Resulting from Modifications to Existing Flow Regimes Project implementation could result in modified flow regimes that would reduce the frequency and magnitude of high winter flows along the Sacramento River; however, the hydrologic effects in tributaries and reservoirs (e.g., New Melones and San Luis) from CVP and SWP dams are expected to be less than impacts on the lower Sacramento River. The change in hydrology could affect aquatic habitats that provide habitat for the fish community. These changes are unlikely to result in substantial effects on the distribution or abundance of these species in the CVP and SWP service areas. Therefore, this impact would be less than significant.

This impact would be similar to Impact Aqua-24 (CP1). The impact could be greater because the increased reservoir capacity associated with an 18.5-foot raise compared to a 6.5-foot raise would allow additional water volume (and flows) to be stored behind the raised dam. However, these changes are unlikely to result in substantial effects on the distribution or abundance of these species in the CVP and SWP service areas. The effects from CP4 on CVP and SWP reservoir elevations, filling, spilling, and planned releases, and the resulting downstream flows, would be small and well within the range of variability that commonly occurs in these reservoirs and downstream flows. Therefore, this impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

11.3.4 Mitigation Measures

Table 11-7 presents a summary of mitigation measures for fisheries and aquatic ecosystems.

No-Action Alternative

Under the No-Action Alternative, no action would be taken, including implementation of mitigation measures; rather, existing conditions would continue to change into the future.

Table 11-37. Summary of Mitigation Measures for Fisheries and Aquatic Ecosystems

Impact		No-Action Alternative	CP1	CP2	CP3	CP4	CP5
Impact Aqua-1: Effects on Nearshore, Warm-Water Habitat in Shasta Lake from Project Operations	LOS before Mitigation	PS	LTS	LTS	LTS	LTS	LTS
	Mitigation Measure	None required.	None needed; thus, none proposed.				
	LOS after Mitigation	PS	LTS	LTS	LTS	LTS	LTS
Impact Aqua-2: Effects on Nearshore, Warm-Water Habitat in Shasta Lake from Project Construction	LOS before Mitigation	NI	LTS	LTS	LTS	LTS	LTS
	Mitigation Measure	None required.	None needed; thus, none proposed.				
	LOS after Mitigation	NI	LTS	LTS	LTS	LTS	LTS
Impact Aqua-3: Effects on Cold-Water Habitat in Shasta Lake	LOS before Mitigation	PS	B	B	B	B	B
	Mitigation Measure	None required.	None needed; thus, none proposed.				
	LOS after Mitigation	PS	B	B	B	B	B

Table 11-37. Summary of Mitigation Measures for Fisheries and Aquatic Ecosystems (contd.)

Impact		No-Action Alternative	CP1	CP2	CP3	CP4	CP5
Impact Aqua-4: Effects on Special-Status Aquatic Mollusks	LOS before Mitigation	LTS	PS	PS	PS	PS	PS
	Mitigation Measure	None required.	Mitigation Measure Aqua-4: Implement Mitigation Measure Geo-2: Replace Lost Ecological Functions of Aquatic Habitats by Restoring Existing Degraded Aquatic Habitats in the Vicinity of the Impact.				
	LOS after Mitigation	LTS	LTS	LTS	LTS	LTS	LTS
Impact Aqua-5: Effects on Special-Status Fish Species	LOS before Mitigation	LTS	LTS	LTS	LTS	LTS	LTS
	Mitigation Measure	None required.	None needed; thus, none proposed.				
	LOS after Mitigation	LTS	LTS	LTS	LTS	LTS	LTS
Impact Aqua-6: Creation or Removal of Barriers to Fish Between Tributaries and Shasta Lake	LOS before Mitigation	NI	LTS	LTS	LTS	LTS	LTS
	Mitigation Measure	None required.	None needed; thus, none proposed.				
	LOS after Mitigation	NI	LTS	LTS	LTS	LTS	LTS
Impact Aqua-7: Effects on Spawning and Rearing Habitat of Adfluvial Salmonids in Low-Gradient Tributaries to Shasta Lake	LOS before Mitigation	NI	LTS	LTS	LTS	LTS	LTS
	Mitigation Measure	None required.	None needed; thus, none proposed.				
	LOS after Mitigation	NI	LTS	LTS	LTS	LTS	LTS

Table 11-37. Summary of Mitigation Measures for Fisheries and Aquatic Ecosystems (contd.)

Impact		No-Action Alternative	CP1	CP2	CP3	CP4	CP5
Impact Aqua-8: Effects on Aquatic Connectivity in Non-Fish-Bearing Tributaries to Shasta Lake	LOS before Mitigation	NI	LTS	LTS	LTS	LTS	LTS
	Mitigation Measure	None required.	None needed; thus, none proposed.				
	LOS after Mitigation	NI	LTS	LTS	LTS	LTS	LTS
Impact Aqua-9: Effects on Water Quality at Livingston Stone Hatchery	LOS before Mitigation	NI	NI	NI	NI	NI	NI
	Mitigation Measure	None required.	None needed; thus, none proposed.				
	LOS after Mitigation	NI	NI	NI	NI	NI	NI
Impact Aqua-10: Loss or Degradation of Aquatic Habitat in the Upper Sacramento River During Construction Activities	LOS before Mitigation	NI	LTS	LTS	LTS	LTS	LTS
	Mitigation Measure	None required.	None needed; thus, none proposed.				
	LOS after Mitigation	NI	LTS	LTS	LTS	LTS	LTS
Impact Aqua-11: Release and Exposure of Contaminants in the Upper Sacramento River During Construction Activities	LOS before Mitigation	NI	LTS	LTS	LTS	LTS	LTS
	Mitigation Measure	None required.	None needed; thus, none proposed.				
	LOS after Mitigation	NI	LTS	LTS	LTS	LTS	LTS

Table 11-37. Summary of Mitigation Measures for Fisheries and Aquatic Ecosystems (contd.)

Impact		No-Action Alternative	CP1	CP2	CP3	CP4	CP5
Impact Aqua-12: Changes in Flow and Water Temperature in the Upper Sacramento River Resulting from Project Operation—Chinook Salmon	LOS before Mitigation	PS	B	B	B	B	B
	Mitigation Measure	None required.	None needed; thus, none proposed.				
	LOS after Mitigation	PS	B	B	B	B	B
Impact Aqua-13: Changes in Flow and Water Temperature in the Upper Sacramento River Resulting from Project Operation – Steelhead, Green Sturgeon, Sacramento Splittail, American Shad, and Striped Bass	LOS before Mitigation	PS	LTS	LTS	LTS	B	LTS
	Mitigation Measure	None required.	None needed; thus, none proposed.				
	LOS after Mitigation	PS	LTS	LTS	LTS	B	LTS
Impact Aqua-14: Reduction in Ecologically Important Geomorphic Processes in the Upper Sacramento River Resulting from Reduced Frequency and Magnitude of Intermediate to High Flows	LOS before Mitigation	NI	PS	PS	PS	PS	PS
	Mitigation Measure	None required.	Mitigation Measure Aqua-14: Implement Mitigation Measure Bot-7: Develop and Implement a Riverine Ecosystem Mitigation and Adaptive Management Plan to Avoid and Compensate for the Impact of Altered Flow Regimes on Riparian and Wetland Communities.				
	LOS after Mitigation	NI	LTS	LTS	LTS	LTS	LTS

Table 11-37. Summary of Mitigation Measures for Fisheries and Aquatic Ecosystems (contd.)

Impact		No-Action Alternative	CP1	CP2	CP3	CP4	CP5
Impact Aqua-15: Changes in Flow and Water Temperatures in the Lower Sacramento River and Tributaries and Trinity River Resulting from Project Operation – Fish Species of Primary Management Concern	LOS before Mitigation	NI	PS	PS	PS	PS	PS
	Mitigation Measure	None required.	Mitigation Measure Aqua-15: Maintain Flows in the Feather River, American River, and Trinity River Consistent with Existing Regulatory and Operational Requirements and Agreements.				
	LOS after Mitigation	NI	LTS	LTS	LTS	LTS	LTS
Impact Aqua-16: Reduction in Ecologically Important Geomorphic Processes in the Lower Sacramento River Resulting from Reduced Frequency and Magnitude of Intermediate to High Flows	LOS before Mitigation	NI	PS	PS	PS	PS	PS
	Mitigation Measure	None required.	Mitigation Measure Aqua-16: Implement Mitigation Measure Bot-7: Develop and Implement a Riverine Ecosystem Mitigation and Adaptive Management Plan to Avoid and Compensate for the Impact of Altered Flow Regimes on Riparian and Wetland Communities.				
	LOS after Mitigation	NI	LTS	LTS	LTS	LTS	LTS
Impact Aqua-17: Effects to Delta Fishery Habitat Resulting from Changes to Delta Outflow	LOS before Mitigation	NI	LTS	LTS	LTS	LTS	LTS
	Mitigation Measure	None required.	None needed; thus, none proposed.				
	LOS after Mitigation	NI	LTS	LTS	LTS	LTS	LTS

Table 11-37. Summary of Mitigation Measures for Fisheries and Aquatic Ecosystems (contd.)

Impact		No-Action Alternative	CP1	CP2	CP3	CP4	CP5
Impact Aqua-18: Effects to Delta Fishery Habitat Resulting from Changes to Delta Inflow	LOS before Mitigation	NI	LTS	LTS	LTS	LTS	LTS
	Mitigation Measure	None required.	None needed; thus, none proposed.				
	LOS after Mitigation	NI	LTS	LTS	LTS	LTS	LTS
Impact Aqua-19: Effects to Delta Fisheries Resulting from Changes in Sacramento River Inflow	LOS before Mitigation	NI	LTS	LTS	LTS	LTS	LTS
	Mitigation Measure	None required.	None needed; thus, none proposed.				
	LOS after Mitigation	NI	LTS	LTS	LTS	LTS	LTS
Impact Aqua-20: Effects to Delta Fisheries Resulting from Changes in San Joaquin River Flow at Vernalis	LOS before Mitigation	NI	NI	NI	LTS	LTS	LTS
	Mitigation Measure	None required.	None needed; thus, none proposed.				
	LOS after Mitigation	NI	NI	NI	LTS	LTS	LTS
Impact Aqua-21: Reduction in Low Salinity Habitat Conditions Resulting from an Upstream Shift in X2 Location	LOS before Mitigation	NI	LTS	LTS	LTS	LTS	LTS
	Mitigation Measure	None required.	None needed; thus, none proposed.				
	LOS after Mitigation	NI	LTS	LTS	LTS	LTS	LTS

Table 11-37. Summary of Mitigation Measures for Fisheries and Aquatic Ecosystems (contd.)

Impact		No-Action Alternative	CP1	CP2	CP3	CP4	CP5
Impact Aqua-22: Increase in Mortality of Species of Primary Management Concern as a Result of Increased Reverse Flows in Old and Middle Rivers	LOS before Mitigation	NI	PS	PS	PS	PS	PS
	Mitigation Measure	None required.	None proposed.				
	LOS after Mitigation	NI	PS	PS	PS	PS	PS
Impact Aqua-23: Increase in the Risk of Entrainment or Salvage of Species of Primary Management Concern at CVP and SWP Export Facilities Due to Changes in CVP and SWP Exports	LOS before Mitigation	NI	LTS for Chinook salmon, steelhead, and longfin smelt: PS for delta smelt, striped bass, and splittail	LTS for Chinook salmon, steelhead, and longfin smelt: PS for delta smelt, striped bass, and splittail	LTS for Chinook salmon, steelhead, and longfin smelt: PS for delta smelt, striped bass, and splittail	LTS for Chinook salmon, steelhead, and longfin smelt: PS for delta smelt, striped bass, and splittail	LTS for Chinook salmon, steelhead, and longfin smelt: PS for delta smelt, striped bass, and splittail
	Mitigation Measure	None required.	None proposed.				
	LOS after Mitigation	NI	LTS	LTS	LTS	LTS	LTS

Table 11-37. Summary of Mitigation Measures for Fisheries and Aquatic Ecosystems (contd.)

Impact		No-Action Alternative	CP1	CP2	CP3	CP4	CP5
Impact Aqua-24: Impacts on Aquatic Habitats and Fish Populations in the CVP and SWP Service Areas Resulting from Modifications to Existing Flow Regimes	LOS before Mitigation	NI	LTS	LTS	LTS	LTS	LTS
	Mitigation Measure	None required.	None needed; thus, none proposed.				
	LOS after Mitigation	NI	LTS	LTS	LTS	LTS	LTS

Notes:
B = beneficial
LOS = level of significance
LTS = less than significant
NI = No Impact
PS = potentially significant
S = significant

CP1 – 6.5-Foot Dam Raise, Anadromous Fish Survival and Water Supply Reliability

No mitigation is needed for Impacts Aqua-1 (CP1), through Aqua-13 (CP1), or Aqua-17 through Aqua-21 (CP1). No mitigation is proposed for Impacts Aqua-22 (CP1) or Aqua-22 (CP1). Mitigation measures are provided below for other impacts of CP1 on fisheries and aquatic ecosystems.

Mitigation Measure Aqua-4 (CP1): Implement Mitigation Measure Geo-2 (CP1) This mitigation measure is the same as Mitigation Measure Geo-2 (CP1) described in Chapter 4, "Geology, Geomorphology, Minerals, and Soils." The loss of riparian habitat provided by springs, seeps and streams will be mitigated by compensating for the impact by replacing or providing substitute resources or environments. Compensation will be accomplished by restoring and enhancing the aquatic functions of existing, degraded aquatic habitats in or near the study sub-area. Examples of techniques that may be used include channel and bank stabilization, channel re-direction, channel reconstruction, culvert replacement and elimination of barriers to fish passage, and enhancement of habitat physical structure (e.g., placement of woody debris, rocks). The nature and extent of the restoration and enhancement activities will be based on an assessment of the ecological functions that are lost as a consequence of implementing this alternative. Implementation of this mitigation measure would reduce Impact Aqua-2 (CP1) to a less than significant level.

Mitigation Measure Aqua-14 (CP1): Implement Mitigation Measure Bot-7 (CP1): Develop and Implement a Riverine Ecosystem Mitigation and Adaptive Management Plan to Avoid and Compensate for the Impact of Altered Flow Regimes on Riparian and Wetland Communities This measure is the same as Mitigation Measure Bot-7 (CP1), described in Chapter 12, "Botanical Resources and Wetlands." Implementation of this mitigation measure would reduce Impact Aqua-14 (CP1) to a less than significant level.

Mitigation Measure Aqua-15 (CP1): Maintain Flows in the Feather River, American River, and Trinity River Consistent with Existing Regulatory and Operational Requirements and Agreements Flows in the Feather, American, and Trinity rivers will be maintained pursuant to existing operational agreements, BOs, criteria, and standards that are protective of fisheries resources. Implementation of this measure would reduce Impact Aqua-15 (CP1) to a less than significant level.

Mitigation Measure Aqua-16 (CP1): Implement Mitigation Measure Bot-7 (CP1): Develop and Implement a Riverine Ecosystem Mitigation and Adaptive Management Plan to Avoid and Compensate for the Impact of Altered Flow Regimes on Riparian and Wetland Communities
Implementation of mitigation measure Bot-7 (CP1) would reduce Impact Aqua-16 (CP1) to a less than significant level.

CP2 – 12.5-Foot Dam Raise, Anadromous Fish Survival and Water Supply Reliability

No mitigation is needed for Impacts Aqua-1 (CP2) through Aqua-13 (CP2), or Aqua-17 through Aqua-21 (CP2). No mitigation is proposed for Aqua-22 (CP2) or Aqua-23 (CP2). Mitigation measures are provided below for other impacts of CP2 on fisheries and aquatic ecosystems.

Mitigation Measure Aqua-4 (CP2): Implement Mitigation Measure Geo-2 (CP2): Replace Lost Ecological Functions of aquatic Habitats by Restoring Existing Degraded aquatic Habitats in the Vicinity of the Impact This mitigation measure is the same as Mitigation Measure Geo-2 (CP2) described in Chapter 4, "Geology, Geomorphology, Minerals, and Soils." The loss of riparian habitat provided by springs, seeps and streams will be mitigated by compensating for the impact by replacing or providing substitute resources or environments. Compensation will be accomplished by restoring and enhancing the aquatic functions of existing, degraded aquatic habitats in or near the study sub-area. Examples of techniques that may be used include channel and bank stabilization, channel re-direction, channel reconstruction, culvert replacement and elimination of barriers to fish passage, and enhancement of habitat physical structure (e.g., placement of woody debris, rocks). The nature and extent of the restoration and enhancement activities will be based on an assessment of the ecological functions that are lost as a consequence of implementing this alternative. Implementation of this mitigation measure would reduce Impact Aqua-2 (CP2) to a less than significant level.

Mitigation Measure Aqua-14 (CP2): Implement Mitigation Measure Bot-7 (CP2): Develop and Implement a Riverine Ecosystem Mitigation and Adaptive Management Plan to Avoid and Compensate for the Impact of Altered Flow Regimes on Riparian and Wetland Communities This measure is identical to Mitigation Measure Bot-7 (CP2), described in Chapter 12, "Botanical Resources and Wetlands." Implementation of this mitigation measure would reduce Impact Aqua-14 (CP2) to a less than significant level.

Mitigation Measure Aqua-15 (CP2): Maintain Flows in the Feather River, American River, and Trinity River Consistent with Existing Regulatory and Operational Requirements and Agreements Flows in the Feather, American, and Trinity rivers will be maintained pursuant to existing operational agreements, BOs, criteria, and standards that are protective of fisheries resources. Implementation of this measure would reduce Impact Aqua-15 (CP2) to a less than significant level.

Mitigation Measure Aqua-16 (CP2): Implement Mitigation Measure Bot-7 (CP2): Develop and Implement a Riverine Ecosystem Mitigation and Adaptive Management Plan to Avoid and Compensate for the Impact of Altered Flow Regimes on Riparian and Wetland Communities This measure is identical to Mitigation Measure Bot-7 (CP2), described in Chapter

12, "Botanical Resources and Wetlands." Implementation of this measure would reduce Impact Aqua-16 (CP2) to a less than significant level.

CP3 – 18.5-Foot Dam Raise, Anadromous Fish Survival and Water Supply

No mitigation is needed for Impacts Aqua-1 (CP3) through Aqua-13 (CP3), or Aqua-17 through Aqua-21 (CP3). No mitigation is proposed for Aqua-22 (CP3) or Aqua-23 (CP3). Mitigation measures are provided below for other impacts of CP3 on fisheries and aquatic ecosystems.

Mitigation Measure Aqua-4 (CP3): Implement Mitigation Measure Geo-2 (CP3) : Replace Lost Ecological Functions of aquatic Habitats by Restoring Existing Degraded aquatic Habitats in the Vicinity of the Impact This mitigation measure is the same as Mitigation Measure Geo-2 (CP3) described in Chapter 4, "Geology, Geomorphology, Minerals, and Soils." The loss of riparian habitat provided by springs, seeps and streams will be mitigated by compensating for the impact by replacing or providing substitute resources or environments. Compensation will be accomplished by restoring and enhancing the aquatic functions of existing, degraded aquatic habitats in or near the study sub-area. Examples of techniques that may be used include channel and bank stabilization, channel re-direction, channel reconstruction, culvert replacement and elimination of barriers to fish passage, and enhancement of habitat physical structure (e.g., placement of woody debris, rocks). The nature and extent of the restoration and enhancement activities will be based on an assessment of the ecological functions that are lost as a consequence of implementing this alternative. Implementation of this mitigation measure would reduce Impact Aqua-2 (CP3) to a less than significant level.

Mitigation Measure Aqua-14 (CP3): Implement Mitigation Measure Bot-7 (CP3): Develop and Implement a Riverine Ecosystem Mitigation and Adaptive Management Plan to Avoid and Compensate for the Impact of Altered Flow Regimes on Riparian and Wetland Communities This measure is identical to Mitigation Measure Bot-7 (CP3), described in Chapter 12, "Botanical Resources and Wetlands." Implementation of this mitigation measure would reduce Impact Aqua-14 (CP3) to a less than significant level.

Mitigation Measure Aqua-15 (CP3): Maintain Flows in the Feather River, American River, and Trinity River Consistent with Existing Regulatory and Operational Requirements and Agreements Flows in the Feather, American, and Trinity rivers will be maintained pursuant to existing operational agreements, BOs, criteria, and standards that are protective of fisheries resources. Implementation of this measure would reduce Impact Aqua-15 (CP3) to a less than significant level.

Mitigation Measure Aqua-16 (CP3): Implement Mitigation Measure Bot-7 (CP3): Develop and Implement a Riverine Ecosystem Mitigation and Adaptive Management Plan to Avoid and Compensate for the Impact of Altered Flow Regimes on Riparian and Wetland Communities This

measure is identical to Mitigation Measure Bot-7 (CP3), described in Chapter 12, "Botanical Resources and Wetlands." Implementation of this measure would reduce Impact Aqua-16 (CP3) to a less than significant level.

CP4 – 18.5-Foot Dam Raise, Anadromous Fish Focus with Water Supply Reliability

No mitigation is needed for Impacts Aqua-1 (CP4) through Aqua-13 (CP4), or Aqua-17 through Aqua-21 (CP4). No mitigation is proposed for Aqua-22 (CP4) or Aqua-23 (CP4). Mitigation measures are provided below for other impacts of CP4 on fisheries and aquatic ecosystems.

Mitigation Measure Aqua-4 (CP4): Implement Mitigation Measure Geo-2 (CP4) : Replace Lost Ecological Functions of aquatic Habitats by Restoring Existing Degraded aquatic Habitats in the Vicinity of the Impact This mitigation measure is the same as Mitigation Measure Geo-2 (CP3) described in Chapter 4, "Geology, Geomorphology, Minerals, and Soils." The loss of riparian habitat provided by springs, seeps and streams will be mitigated by compensating for the impact by replacing or providing substitute resources or environments. Compensation will be accomplished by restoring and enhancing the aquatic functions of existing, degraded aquatic habitats in or near the study sub-area. Examples of techniques that may be used include channel and bank stabilization, channel re-direction, channel reconstruction, culvert replacement and elimination of barriers to fish passage, and enhancement of habitat physical structure (e.g., placement of woody debris, rocks). The nature and extent of the restoration and enhancement activities will be based on an assessment of the ecological functions that are lost as a consequence of implementing this alternative. Implementation of this mitigation measure would reduce Impact Aqua-2 (CP4) to a less than significant level.

Mitigation Measure Aqua-14 (CP4): Implement Mitigation Measure Bot-7 (CP1): Develop and Implement a Riverine Ecosystem Mitigation and Adaptive Management Plan to Avoid and Compensate for the Impact of Altered Flow Regimes on Riparian and Wetland Communities This measure is identical to Mitigation Measure Bot-7 (CP1), described in Chapter 12, "Botanical Resources and Wetlands." Implementation of this mitigation measure would reduce Impact Aqua-14 (CP4) to a less than significant level.

Mitigation Measure Aqua-15 (CP4): Maintain Flows in the Feather River, American River, and Trinity River Consistent with Existing Regulatory and Operational Requirements and Agreements Flows in the Feather, American, and Trinity rivers will be maintained pursuant to existing operational agreements, BOs, criteria, and standards that are protective of fisheries resources. Implementation of this measure would reduce Impact Aqua-15 (CP4) to a less than significant level.

Mitigation Measure Aqua-16 (CP4): Implement Mitigation Measure Bot-7: Implement Mitigation Measure Bot-7 (CP1): Develop and Implement a

Riverine Ecosystem Mitigation and Adaptive Management Plan to Avoid and Compensate for the Impact of Altered Flow Regimes on Riparian and Wetland Communities This measure is identical to Mitigation Measure Bot-7 (CP1), described in Chapter 12, "Botanical Resources and Wetlands." Implementation of this measure would reduce Impact Aqua-16 (CP4) to a less than significant level.

CP5 – 18.5-Foot Dam Raise, Combination Plan

No mitigation is needed for Impacts Aqua-1 (CP5) through Aqua-13 (CP5), or Aqua-17 through Aqua-21 (CP5). No mitigation is proposed for Impacts Aqua-22 (CP5) or Aqua-23 (CP5). Mitigation measures are provided below for the other impacts of CP5 on fisheries and aquatic ecosystems.

Mitigation Measure Aqua-4 (CP5): Implement Mitigation Measure Geo-2 (CP5) : Replace Lost Ecological Functions of aquatic Habitats by Restoring Existing Degraded aquatic Habitats in the Vicinity of the Impact This mitigation measure is the same as Mitigation Measure Geo-2 (CP3) described in Chapter 4, "Geology, Geomorphology, Minerals, and Soils." The loss of riparian habitat provided by springs, seeps and streams will be mitigated by compensating for the impact by replacing or providing substitute resources or environments. Compensation will be accomplished by restoring and enhancing the aquatic functions of existing, degraded aquatic habitats in or near the study sub-area. Examples of techniques that may be used include channel and bank stabilization, channel re-direction, channel reconstruction, culvert replacement and elimination of barriers to fish passage, and enhancement of habitat physical structure (e.g., placement of woody debris, rocks). The nature and extent of the restoration and enhancement activities will be based on an assessment of the ecological functions that are lost as a consequence of implementing this alternative. Implementation of this mitigation measure would reduce Impact Aqua-2 (CP5) to a less than significant level.

Mitigation Measure Aqua-14 (CP5): Implement Mitigation Measure Bot-7 (CP3): Develop and Implement a Riverine Ecosystem Mitigation and Adaptive Management Plan to Avoid and Compensate for the Impact of Altered Flow Regimes on Riparian and Wetland Communities This measure is identical to Mitigation Measure Bot-7 (CP3), described in Chapter 12, "Botanical Resources and Wetlands." Implementation of this mitigation measure would reduce Impact Aqua-14 (CP5) to a less than significant level.

Mitigation Measure Aqua-15 (CP5): Maintain Flows in the Feather River, American River, and Trinity River Consistent with Existing Regulatory and Operational Requirements and Agreements Flows in the Feather, American, and Trinity rivers will be maintained pursuant to existing operational agreements, BOs, criteria, and standards that are protective of fisheries resources. Implementation of this measure would reduce Impact Aqua-15 (CP5) to a less than significant level.

Mitigation Measure Aqua-16 (CP5): Implement Mitigation Measure Bot-7 (CP3): Implement Mitigation Measure Bot-7: Develop and Implement a Riverine Ecosystem Mitigation and Adaptive Management Plan to Avoid and Compensate for the Impact of Altered Flow Regimes on Riparian and Wetland Communities This measure is identical to Mitigation Measure Bot-7 (CP3), described in Chapter 12, "Botanical Resources and Wetlands." Implementation of this measure would reduce Impact Aqua-16 (CP5) to a less than significant level.

11.3.5 Cumulative Effects

Chapter 3, "Considerations for Describing the Affected Environment and Environmental Consequences," discusses overall cumulative impacts of the project alternatives and the No-Action Alternative, including the relationship to CALFED Programmatic Cumulative Impacts Analysis, qualitative and quantitative assessment, past and future actions in the study area, and significance criteria.

As described in Section 11.3, "Affected Environment," aquatic habitats within the primary and extended study areas historically contained large populations of anadromous and other native fish species. Water supply projects, urban development, and flood control modifications have resulted in altered and degraded habitat conditions and reduced this historical fishery throughout. The combined effects of past and present projects have resulted in a significant adverse cumulative impact on fisheries and aquatic ecosystems in the primary and extended study areas.

Many of the reasonably foreseeable future projects identified would involve changes to SWP and CVP water operations that would in turn be anticipated to affect fisheries and aquatic ecosystems. While some of these changes could result in beneficial effects compared to current conditions, aquatic habitat and fisheries resources would remain limited.

The effects of climate change on operations at Shasta Lake could potentially result in changes to water temperature, flow, and ultimately, fish populations. As described in the Climate Change Projection Appendix, climate change could result in increased inflows to Shasta Lake and higher reservoir releases in the future due to an increase in winter and early spring inflow into the lake from high-intensity storm events. The change in reservoir releases could be necessary to manage flood events resulting from these potentially larger storms. Climate change could also result in reduced-end-of September carryover storage volumes, resulting in lower lake levels for a portion of the year, and a smaller cold-water pool resulting in warmer water temperature and reduced water quality within Shasta Reservoir. Most importantly, it is expected that climate change will result in increased water temperatures downstream from Shasta Dam, particularly in summer months, and more frequent wet and drought (particularly extended drought) years. The increased water temperatures, and

greater inter-annual precipitation variability will compound the threats to fish (especially anadromous fish) in the Sacramento River. Winter-run Chinook salmon are particularly vulnerable to climate warming, prolonged droughts, and other catastrophic environmental events because they have only one remaining population that spawns during the summer months, when water temperature increases are expected to be the largest (NMFS 2009). Additionally, ocean productivity is expected to decline from altered upwelling cycles. This could reduce the available food resources for ocean-rearing salmonids and sturgeon, impacting fish survival.

The following analysis evaluates the potential cumulative impacts on fisheries and aquatic ecosystems when considering the project alternatives in combination with other past, present, and reasonably foreseeable future projects.

CP1– 6.5-Foot Dam Raise, Anadromous Fish Survival and Water Supply Reliability

As described in Section 11.3, without mitigation, CP1 could cause potentially significant effects on vegetation and habitats and special-status species in the primary and extended study areas. These effects would be caused by the loss or degradation of aquatic habitats in the primary study area, or by alteration of the flow regime of the upper Sacramento River and associated geomorphic processes in the primary and extended study areas.

Given the scale and duration of the project construction activities associated with CP1, the contribution to construction-related cumulative impacts on fisheries and aquatic ecosystems would be cumulatively considerable. CP1 would be undertaken in accordance with a project-specific SWPPP as reviewed and approved by the RWQCB. The SWPPP would require implementation of extensive BMPs during project construction as well as post-construction site restoration and stabilization to control erosion and sedimentation and to prevent the discharge of pollutants into the Sacramento River and other waterways. Implementation of these measures would reduce the proposed project's contribution to cumulative construction-related impacts to a less than significant level.

Given major past alterations to the Sacramento River aquatic ecosystem and associated aquatic habitats, the contributing adverse effects from CP1 would be cumulatively considerable. With implementation of Mitigation Measures Aqua-14 (CP1) and Aqua-16 (CP1), adverse effects from CP1 would be reduced and would no longer result in a cumulatively considerable incremental contribution to cumulative effects on these resources.

As stated previously, effects of climate change on operations of Shasta Lake could include increased inflows and releases at certain times of the year, and decreased inflows at other times. The additional storage associated with CP1 would potentially reduce these effects and allow Shasta Lake to capture some of the increased runoff in the winter and early spring for release in late spring and

summer. More importantly, an increased cold-water pool volume will allow Shasta Lake to be managed to provide cooler water releases downstream during critical life stages, particularly for winter-run Chinook spawning. Under CP1, potential impacts to fish would be beneficial.

CP2 – 12.5-Foot Dam Raise, Anadromous Fish Survival and Water Supply Reliability

The cumulative effects of CP2 are similar to those of CP1, but greater in magnitude because CP2 would require additional construction and would result in the potential for increased alteration of flows associated with increased storage volume.

Given the scale and duration of the project construction activities associated with CP2, the contribution to construction-related cumulative impacts on fisheries and aquatic ecosystems would be cumulatively considerable. CP2 would be undertaken in accordance with a project-specific SWPPP as reviewed and approved by the RWQCB. The SWPPP would require implementation of extensive BMPs during project construction as well as post-construction site restoration and stabilization to control erosion and sedimentation and to prevent the discharge of pollutants into the Sacramento River and other waterways. Implementation of these measures would reduce the proposed project's contribution to cumulative construction-related impacts to a less than significant level.

Given major past alterations to the Sacramento River aquatic ecosystem and associated aquatic habitats, the contributing adverse effects from CP2 would be cumulatively considerable. With implementation of Mitigation Measures Aqua-14 (CP2) and Aqua-16 (CP2), adverse effects from CP2 would be reduced and would no longer result in a cumulatively considerable incremental contribution to cumulative effects on these resources.

As stated previously, effects of climate change on operations of Shasta Lake could include increased inflows and releases at certain times of the year, and decreased inflows at other times. The additional storage associated with CP2 would potentially reduce these effects and allow Shasta Lake to capture some of the increased runoff in the winter and early spring for release in late spring and summer. More importantly, an increased cold-water pool volume will allow Shasta Lake to be managed to provide cooler water releases downstream during critical life stages, particularly for winter-run Chinook spawning. Under CP2, potential impacts to fish would be beneficial.

CP3 – 18.5-Foot Dam Raise, Anadromous Fish Survival and Water Supply

The cumulative effects of CP3 are similar to those of CP1 and CP2, but greater in magnitude because CP3 would require additional construction and would result in the potential for increased alteration of flows associated with increased storage volume.

Given the scale and duration of the project construction activities associated with CP3, the contribution to construction-related cumulative impacts on fisheries and aquatic ecosystems would be cumulatively considerable. CP3 would be undertaken in accordance with a project-specific SWPPP as reviewed and approved by the RWQCB. The SWPPP would require implementation of extensive BMPs during project construction as well as post-construction site restoration and stabilization to control erosion and sedimentation and to prevent the discharge of pollutants into the Sacramento River and other waterways. Implementation of these measures would reduce the proposed project's contribution to cumulative construction-related impacts to a less than significant level.

Given major past alterations to the Sacramento River aquatic ecosystem and associated aquatic habitats, the contributing adverse effects from CP3 would be cumulatively considerable. With implementation of Mitigation Measures Aqua-14 (CP3) and Aqua-16 (CP3), adverse effects from CP3 would be reduced and would no longer result in a cumulatively considerable incremental contribution to cumulative effects on these resources.

As stated previously, effects of climate change on operations of Shasta Lake could include increased inflows and releases at certain times of the year, and decreased inflows at other times. The additional storage associated with CP3 would potentially reduce these effects and allow Shasta Lake to capture some of the increased runoff in the winter and early spring for release in late spring and summer. More importantly, an increased cold-water pool volume will allow Shasta Lake to be managed to provide cooler water releases downstream during critical life stages, particularly for winter-run Chinook spawning. Under CP3, potential impacts to fish would be beneficial.

CP4 – 18.5-Foot Dam Raise, Anadromous Fish Focus with Water Supply Reliability

The cumulative effects of CP4 are similar to those of CP1, CP2 and CP3, but greater in magnitude because CP3 would require additional construction and would result in the potential for increased alteration of flows associated with increased storage volume. Some of these impacts would be partially offset with the implementation of the gravel augmentation program, floodplain and riparian restoration at Reading Island, and cold-water supply for anadromous fish management.

Given the scale and duration of the project construction activities associated with CP4, the contribution to construction-related cumulative impacts on fisheries and aquatic ecosystems would be cumulatively considerable. CP4 would be undertaken in accordance with a project-specific SWPPP as reviewed and approved by the RWQCB. The SWPPP would require implementation of extensive BMPs during project construction as well as post-construction site restoration and stabilization to control erosion and sedimentation and to prevent the discharge of pollutants into the Sacramento River and other waterways.

Implementation of these measures would reduce the proposed project's contribution to cumulative construction-related impacts to a less than significant level.

Given major past alterations to the Sacramento River aquatic ecosystem and associated aquatic habitats, the contributing adverse effects from CP4 would be cumul--14 (CP4) and Aqua-16 (CP4), adverse effects from CP4 would be reduced and would no longer result in a cumulatively considerable incremental contribution to cumulative effects on these resources.

As stated previously, effects of climate change on operations of Shasta Lake could include increased inflows and releases at certain times of the year, and decreased inflows at other times. The additional storage associated with CP4 would potentially reduce these effects and allow Shasta Lake to capture some of the increased runoff in the winter and early spring for release in late spring and summer. More importantly, an increased cold-water pool volume will allow Shasta Lake to be managed to provide cooler water releases downstream during critical life stages, particularly for winter-run Chinook spawning. Under CP4, potential impacts to fish would be beneficial.

CP5 – 18.5-Foot Dam Raise, Combination Plan

The cumulative effects of CP5 are similar to those of CP1, CP2 and CP3, but greater in magnitude because CP3 would require additional construction and would result in the potential for increased alteration of flows associated with increased storage volume. Some of these impacts would be partially offset with the implementation of the gravel augmentation program, floodplain and riparian restoration at Reading Island.

Given the scale and duration of the project construction activities associated with CP5, the contribution to construction-related cumulative impacts on fisheries and aquatic ecosystems would be cumulatively considerable. CP5 would be undertaken in accordance with a project-specific SWPPP as reviewed and approved by the RWQCB. The SWPPP would require implementation of extensive BMPs during project construction as well as post-construction site restoration and stabilization to control erosion and sedimentation and to prevent the discharge of pollutants into the Sacramento River and other waterways. Implementation of these measures would reduce the proposed project's contribution to cumulative construction-related impacts to a less than significant level.

Given major past alterations to the Sacramento River aquatic ecosystem and associated aquatic habitats, the contributing adverse effects from CP5 would be cumulatively considerable. With implementation of Mitigation Measures Aqua-14 (CP5) and Aqua-16 (CP5), adverse effects from CP5 would be reduced and would no longer result in a cumulatively considerable incremental contribution to cumulative effects on these resources.

As stated previously, effects of climate change on operations of Shasta Lake could include increased inflows and releases at certain times of the year, and decreased inflows at other times. The additional storage associated with CP5 would potentially reduce these effects and allow Shasta Lake to capture some of the increased runoff in the winter and early spring for release in late spring and summer. More importantly, an increased cold-water pool volume will allow Shasta Lake to be managed to provide cooler water releases downstream during critical life stages, particularly for winter-run Chinook spawning. Under CP5, potential impacts to fish would be beneficial.

Chapter 12
Botanical Resources and Wetlands

12.1 Affected Environment

This section describes the affected environment related to botanical resources for the dam and reservoir modifications proposed under the SLWRI. For a more in-depth description, see the *Botanical Resources and Wetlands Technical Report*.

The botanical resources and wetlands setting for the Shasta Lake and vicinity portion of the primary study area consists of the impoundment area (five arms and the Main Body of Shasta Lake, as described below) and the relocation areas (Figure 12-1).

Reclamation established project boundaries for focused surveys in the areas that would be subject to inundation under the various enlargement scenarios. The lower boundary corresponds to the current full-pool elevation defined by Reclamation (1,070-foot mean sea level contour line). The upper boundary was established using the 1,090-foot mean sea level contour line around the entire lake. This area is referred to as the "impoundment area" (Figure 12-1).

Areas subject to physical disturbance as an indirect result of the proposed project (i.e., areas proposed as relocation sites for roadways, bridges, utilities, and campgrounds that would be inundated after the enlargement of Shasta Dam as well as proposed dike locations) were incorporated into the Shasta Lake and vicinity portion of the primary study area. These locations are hereafter referred to as "relocation areas" (Figure 12-1).

To examine the biological resources along riverine reaches that would be subject to inundation if Shasta Dam were enlarged, reaches of 11 streams and rivers that are tributary to Shasta Lake were also incorporated into the Shasta Lake and vicinity portion of the primary study area. These streams were selected by Reclamation in conjunction with USFS as an initial sampling of streams representative of riverine and riparian habitats. Subsequently, botany studies have been expanded into select areas of the impoundment area and within all of the relocation areas.

For the purposes of this investigation, approximate acreages for vegetation types and waters of the United States are reported by arm of the lake. For a relocation area that falls between two arms, the area is included with the arm that has the most acreage of the vegetation type or water of the United States.

Vegetation communities and special-status plant species in the extended study area are discussed in less detail. The extended study area includes the Sacramento River basin from Red Bluff Diversion Dam (RBDD) south to the Delta. It also includes the San Francisco Bay/Sacramento–San Joaquin River Delta (Bay-Delta) area and portions of the American River basin, San Joaquin River basin, and the water service areas of the CVP and the SWP.

Descriptions of biological resources were derived primarily from the following sources:

- Shasta Lake Water Resources Investigation Mission Statement Milestone Report (Reclamation 2003)
- Shasta Lake Water Resources Investigation Initial Alternatives Information Report (Reclamation 2004)
- Chapter 3, "Biological Environment," in the Draft Shasta Lake Water Resources Investigation Plan Formulation Report (Reclamation 2007)
- USFWS Endangered Species Lists
- The California Natural Diversity Database (CNDDB)
- The California Native Plant Society (CNPS) online inventory

Several attachments to the *Botanical Resources and Wetlands Technical Report* provide detailed lists and descriptions of special-status species present in the primary and extended study areas:

- Attachment 1, "Lists of All Special-Status Plant Species Known from or Potentially Present in the Primary and Extended Study Areas"
- Attachment 2, "List of Plant Species Observed in the Shasta Lake and Vicinity Portion of the Primary Study Area"
- Attachment 3, "Special-Status Plant Species Known to Occur in the Shasta Lake and Vicinity Portion of the Primary Study Area"
- Attachment 4, "List of All Sensitive Plant Species in the Extended Study Area Reported to the CNDDB"
- Attachment 5, "Known Weed Source Locations, Potential Mode of Spread, and Risk of Spread"

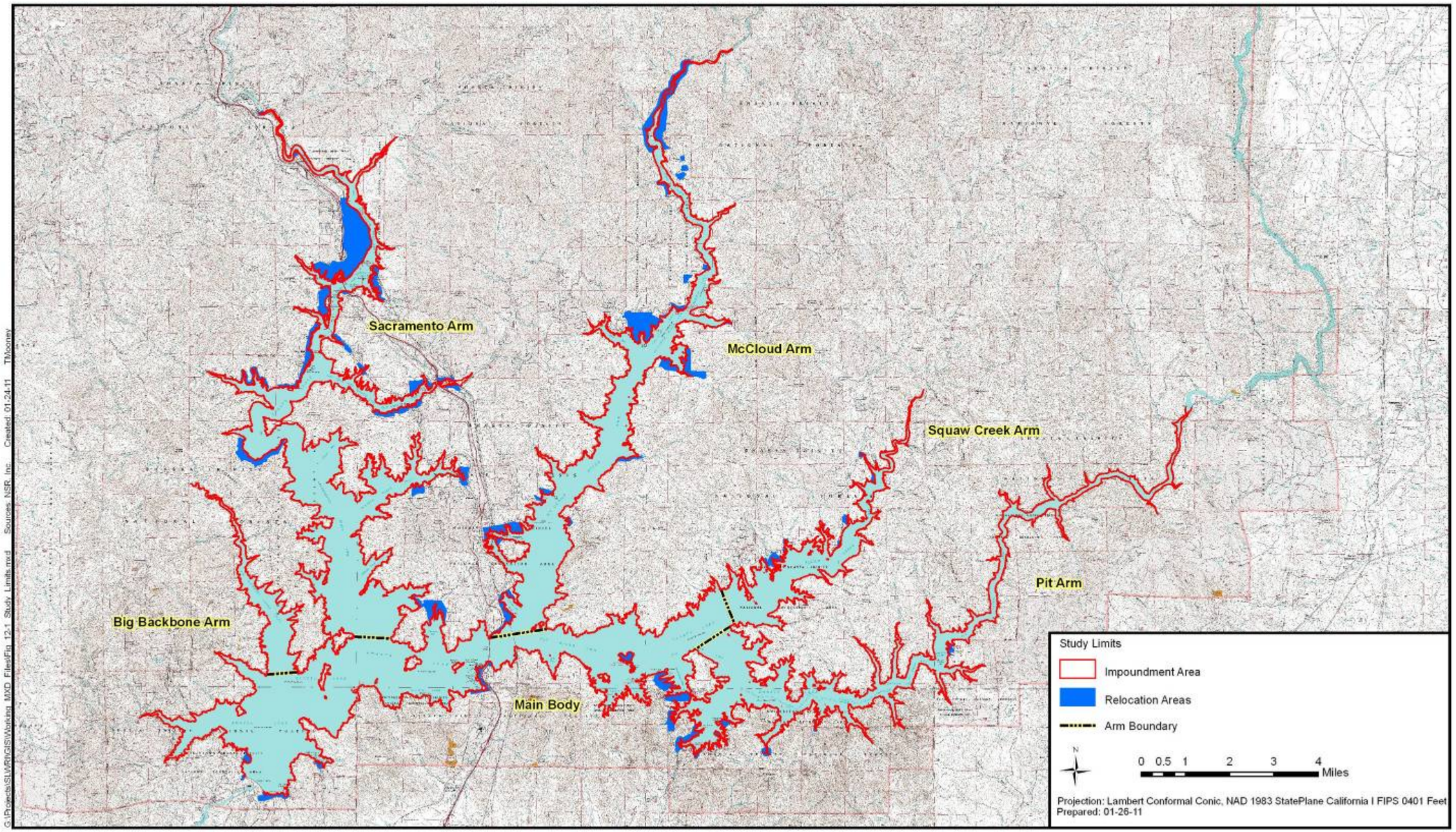


Figure 12-1. Study Limits

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12.1.1 Vegetation Communities

Shasta Lake and Vicinity

North State Resources, Inc. (NSR) conducted extensive mapping to characterize the plant communities in the Shasta Lake and vicinity portion of the primary study area. The study area for botanical resources in the Shasta Lake and vicinity portion of the primary study area corresponds to the area that would be subject to inundation under the five action alternatives and areas where infrastructure would be removed, modified, or relocated (Figure 12-1). The vegetation mapping followed the technical approach described in *A Manual of California Vegetation* (Sawyer and Keeler-Wolf 1995) (MCV), using the vegetation alliance classification system described in *A Manual of California Vegetation, Second Edition* (Sawyer et al. 2009).

MCV represents the most recent effort to provide a common and accepted vegetation classification system for use throughout California. It classifies vegetation into a set of plant alliances, provisional alliances, special stands, or semi-natural stands. In this system, the plant species dominance or importance in the layer (i.e., tree, shrub, and ground) with the greatest amount of cover determines the vegetation alliance classification. The same approach used to describe and classify MCV types was applied when other vegetation types not described in the current MCV were encountered and determined to be significant vegetative components.

The vegetation mapping used recent 1:2,400-scale color aerial photography provided by Reclamation. All vegetation mapping was performed in the field by ground truthing the study area from boat, vehicle, and/or on foot. MCV plant alliances were identified and delineated onto the aerial photographs. The delineated boundaries were digitized and generated in ArcGIS/ArcInfo software for display and data query purposes.

The Shasta Lake and vicinity area is characterized by a variety of vegetation types typical of transitional mixed woodland and low-elevation forest habitats. MCV plant series types in this portion of the primary study area are birch-leaf mountain mahogany chaparral, black willow thicket, blue oak woodland, Brewer's oak scrub, buck brush chaparral, California annual grassland, California black oak forest, California ash chaparral, California buckeye groves, California yerba santa scrub, canyon live oak forest, deer brush chaparral, Fremont cottonwood forest, ghost pine woodland, Himalayan blackberry brambles, interior live oak chaparral, interior live oak woodland, knobcone pine forest, mixed willow, Oregon ash groves, Oregon white oak woodland, pale spike rush marshes, ponderosa pine–Douglas fir forest, ponderosa pine forest, red osier thickets, sandbar willow thickets, spicebush thickets, valley oak woodland, white alder groves, and white leaf manzanita chaparral. Vegetation in each of these series varies, with dramatic changes often occurring in relation to aspect, slope, geologic substrate, or juxtaposition with other habitats.

The acreage of MCV types found in the impoundment area along the Main Body and the five arms of Shasta Lake is shown in Table 12-1, and the acreage of MCV types found in the relocation areas along the Main Body and the five arms of Shasta Lake is shown in Table 12-2. The locations of each type are depicted on Figures 12-2a through 12-2f. General descriptions of each type are provided below.

Table 12-1. Summary of Plant Communities in the Impoundment Area

Plant Series	Area (Acres)					
	Main Body	Big Backbone Arm	Sacramento Arm	McCloud Arm	Squaw Creek Arm	Pit Arm
Barren[1]	1.05	0.00	0.55	0.00	0.00	0.00
Birch-leaf mountain-mahogany chaparral	0.00	0.00	0.00	2.23	0.00	0.00
Black willow thicket	0.00	0.00	0.02	0.00	0.00	0.02
Blue oak woodland	1.27	0.00	0.00	0.70	0.00	4.07
Brewer oak scrub	9.78	0.17	51.64	4.99	4.50	7.78
Buck brush chaparral	1.46	2.42	2.11	1.59	0.67	0.19
California annual grassland	0.58	0.33	4.17	0.94	0.00	0.33
California black oak forest	71.45	14.14	160.32	47.44	1.72	5.05
California buckeye groves	0.00	0.00	0.20	0.001	0.00	0.00
California yerba santa scrub	0.00	0.00	0.00	0.00	0.00	15.89
Canyon live oak forest	9.80	18.41	53.80	48.40	26.79	110.51
Deer brush chaparral	0.18	0.00	0.00	0.08	0.00	2.34
Fremont cottonwood forest	0.00	0.00	0.07	0.00	0.00	0.05
Ghost pine woodland	54.05	0.00	51.29	13.50	22.03	30.54
Himalayan blackberry brambles	0.00	0.00	0.00	0.00	0.00	0.44
Interior live oak chaparral	1.24	0.00	10.05	0.01	0.00	24.86
Interior live oak woodland	2.00	0.00	0.14	0.09	0.00	2.28
Lacustrine**	10,196.88	1,014.12	7,225.14	5,032.68	2,081.60	4,372.80
Knobcone pine forest	32.96	0.40	16.38	20.61	47.92	85.35
Mixed willow	1.54	1.46	14.56	0.16	0.19	0.83

Table 12-1. Summary of Plant Communities in the Impoundment Area (contd.)

Plant Series	Area (Acres)					
	Main Body	Big Backbone Arm	Sacramento Arm	McCloud Arm	Squaw Creek Arm	Pit Arm
Oregon ash groves	0.00	0.00	0.00	0.17	0.00	0.00
Oregon white oak woodland	0.00	0.00	0.00	1.09	0.00	0.66
Ponderosa pine – Douglas fir forest	5.01	0.00	28.37	50.04	69.14	127.51
Ponderosa pine forest	226.04	36.67	212.79	208.87	59.38	101.21
Red osier thickets	0.00	0.00	0.00	0.12	0.00	0.00
Riverine[1]	0.00	0.88	5.24	15.42	1.41	0.00
Sandbar willow thickets	0.00	0.00	0.00	0.28	0.07	0.00
Spicebush thickets	0.00	0.00	0.00	0.06	0.00	0.00
Urban[1]	22.04	0.00	0.00	0.00	0.00	1.92
White alder groves	1.34	4.46	9.70	12.40	1.18	2.85
White leaf manzanita chaparral	16.80	12.30	98.21	6.13	7.49	2.86
Total	10,655.47	1,105.79	7,944.75	5,468.00	2,324.09	4,900.34

Notes:

Data to be provided at a later date.

[1] WHR Wildlife Habitat Type (Mayer and Laudenslayer 1988); no corresponding plant series type included in *A Manual of California Vegetation* (Sawyer et al. 2009).

**Lacustrine values are included for the entire surface area of Shasta Lake. The extent of activity occurring within Shasta Lake has yet to be determined.

Table 12-2. Summary of Plant Communities in the Relocation Areas

Plant Series	Area (Acres)					
	Main Body	Big Backbone Arm	Sacramento Arm	McCloud Arm	Squaw Creek Arm	Pit Arm
Barren[1]	23.76	0.00	88.27	36.62	12.15	22.19
Birch-leaf mountain-mahogany chaparral	0.00	0.00	0.07	2.57	0.00	0.00
Black willow thicket	0.00	0.00	0.03	0.00	0.00	0.00
Blue oak woodland	0.00	0.00	0.00	3.89	0.00	2.29
Brewer oak scrub	9.24	0.00	0.00	23.83	0.00	0.91
Buck brush chaparral	0.00	0.00	1.30	2.11	0.00	0.22
California annual grassland	5.02	0.00	23.24	10.65	1.29	1.25
California ash chaparral	0.00	0.00	0.00	0.68	0.00	0.00

Table 12-2. Summary of Plant Communities in the Relocation Areas (contd.)

Plant Series	Area (Acres)					
	Main Body	Big Backbone Arm	Sacramento Arm	McCloud Arm	Squaw Creek Arm	Pit Arm
California black oak forest	45.08	0.00	190.50	124.80	1.29	0.72
California buckeye groves	0.30	0.00	0.00	1.58	0.00	0.00
California yerba santa scrub	0.33	0.00	0.00	0.00	0.00	18.5
Canyon live oak forest	1.18	0.00	13.92	99.86	4.98	32.58
Deer brush chaparral	0.18	0.00	0.00	0.65	0.00	9.67
Fremont cottonwood forest	0.00	0.00	0.56	0.00	0.00	0.05
Ghost pine woodland	124.50	0.00	84.08	49.91	13.48	20.05
Himalayan blackberry brambles	0.18	0.00	0.00	0.06	0.00	0.16
Interior live oak chaparral	0.00	0.00	2.42	0.00	0.00	64.85
Interior live oak woodland	0.72	0.00	0.00	0.00	0.00	3.41
Knobcone pine forest	0.11	0.00	55.68	12.50	1.94	39.25
Lacustrine	0.00	0.00	0.00	32.49	0.00	0.00
Mixed willow	0.079	0.00	1.26		0.06	1.11
Oregon ash groves	0.00	0.00	0.00	0.50	0.00	0.00
Oregon white oak woodland	0.00	0.00	0.00	5.82	0.07	0.00
Pale spike rush marshes	0.00	0.00	6.51	0.00	0.00	0.00
Ponderosa pine–Douglas fir forest	0.00	0.00	23.78	155.57	28.80	19.27
Ponderosa pine forest	185.35	0.00	557.30	501.66	43.08	62.03
Riverine[1]	3.75	0.00	0.39	0.00	0.00	0.00
Sandbar willow thickets	0.00	0.00	0.00	0.37	0.00	0.00
Spicebush thickets	0.00	0.00	0.00	0.70	0.00	0.00
Urban[1]	21.05	0.00	229.37	0.48	0.00	2.49
Valley oak woodland	0.00	0.00	1.05	0.00	0.00	0.00
White alder groves	0.00	0.00	2.51	6.33	0.17	0.00
White leaf manzanita chaparral	15.97	0.00	78.43	14.98	4.38	0.40
Total	433.05	0.00	1,400.06	1,092.36	111.67	301.40

Note:

[1] WHR Wildlife Habitat Type (Mayer and Laudenslayer 1988); no corresponding plant series type included in *A Manual of California Vegetation* (Sawyer et al. 2009).

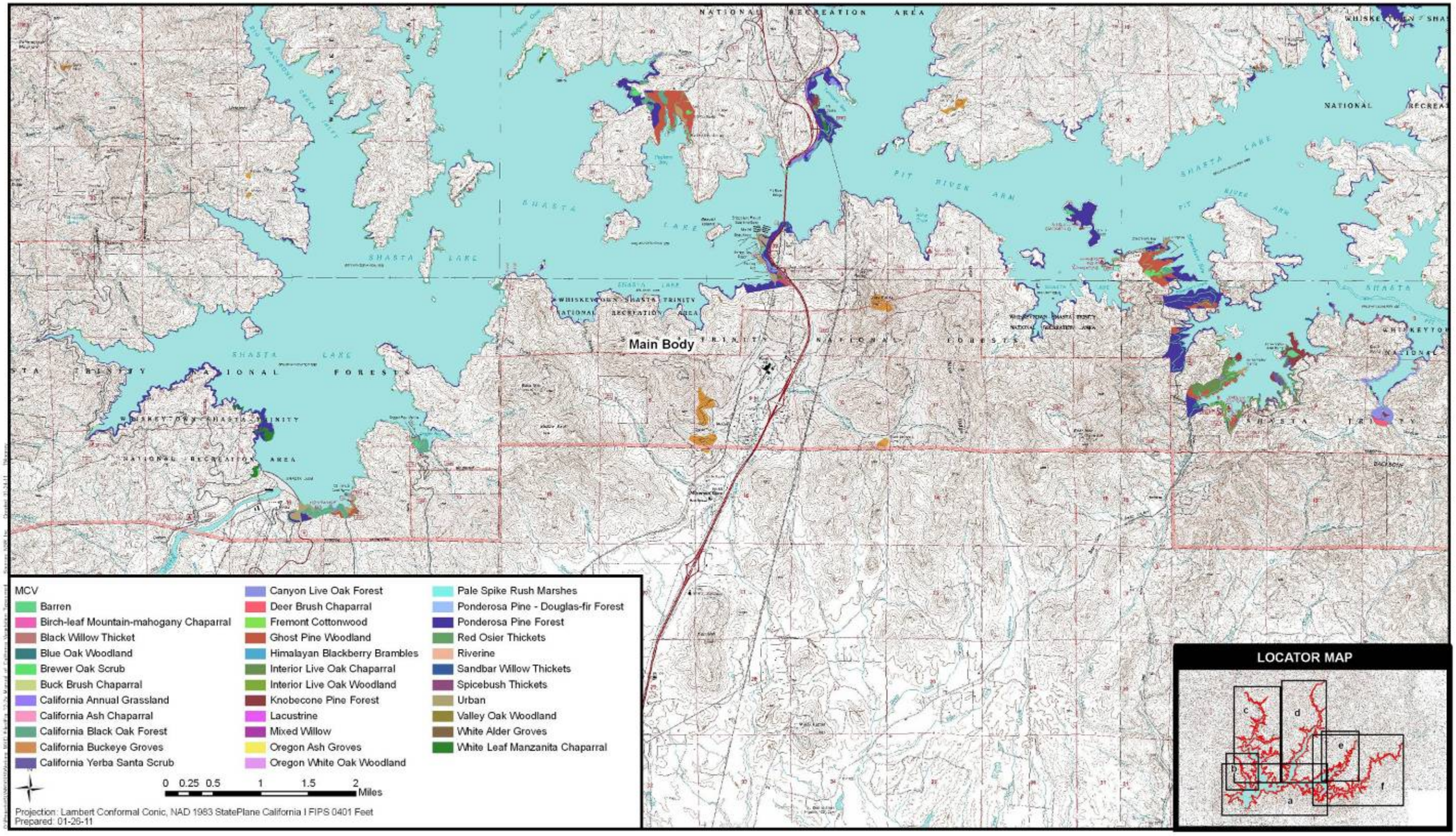


Figure 12-2a. Manual of California Vegetation Types

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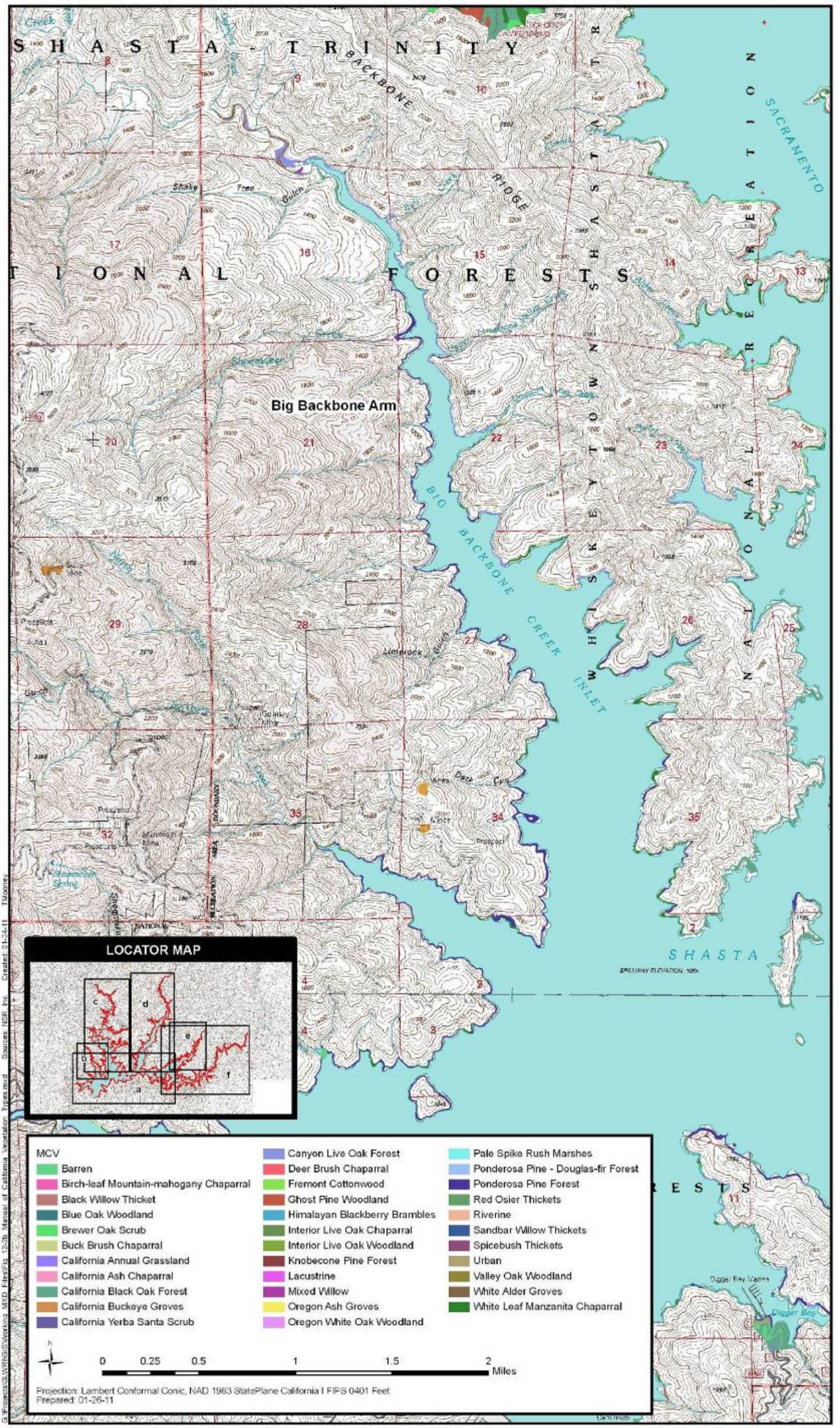


Figure 12-2b. Manual of California Vegetation Types

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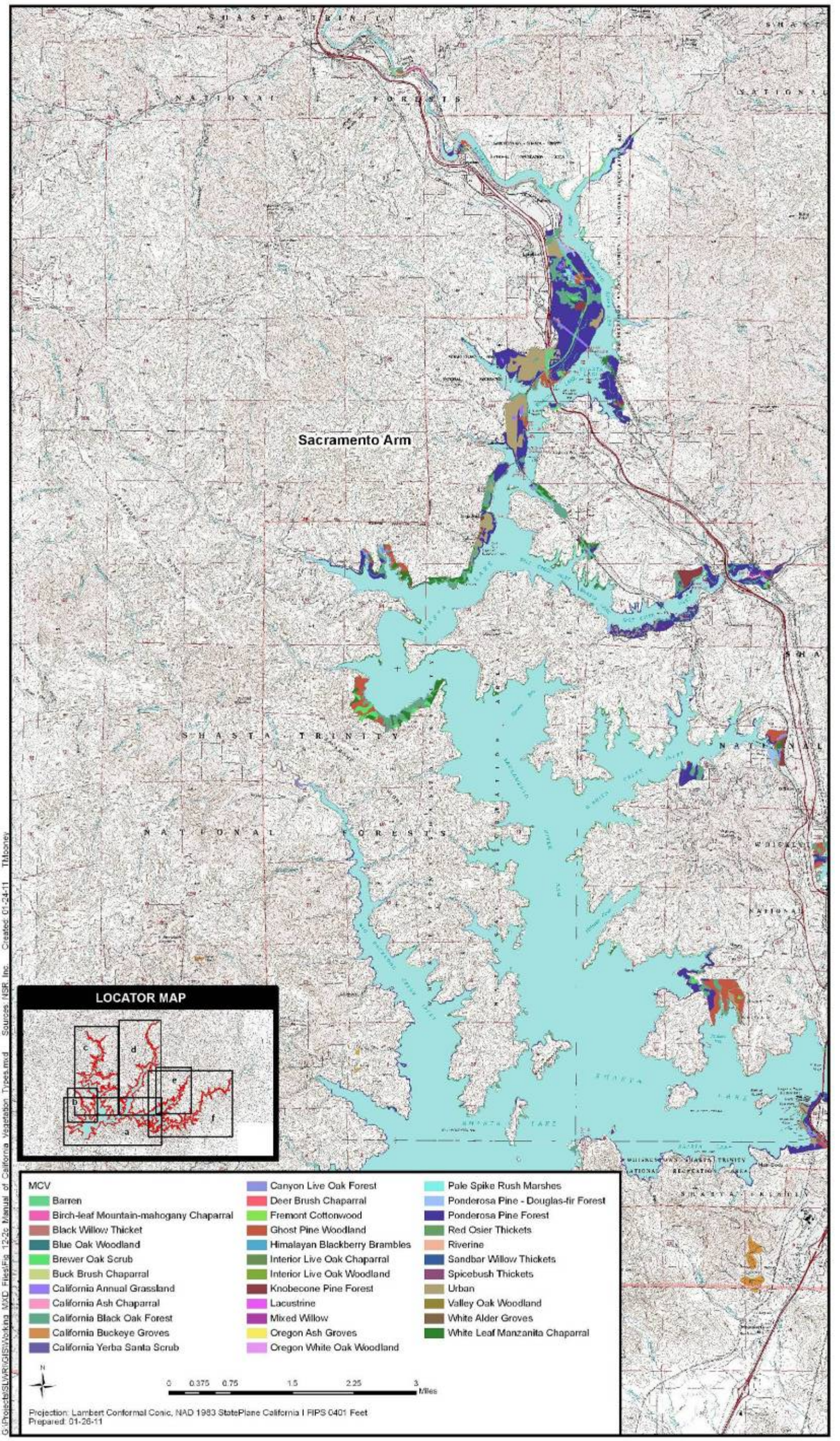


Figure 12-2c. Manual of California Vegetation Types

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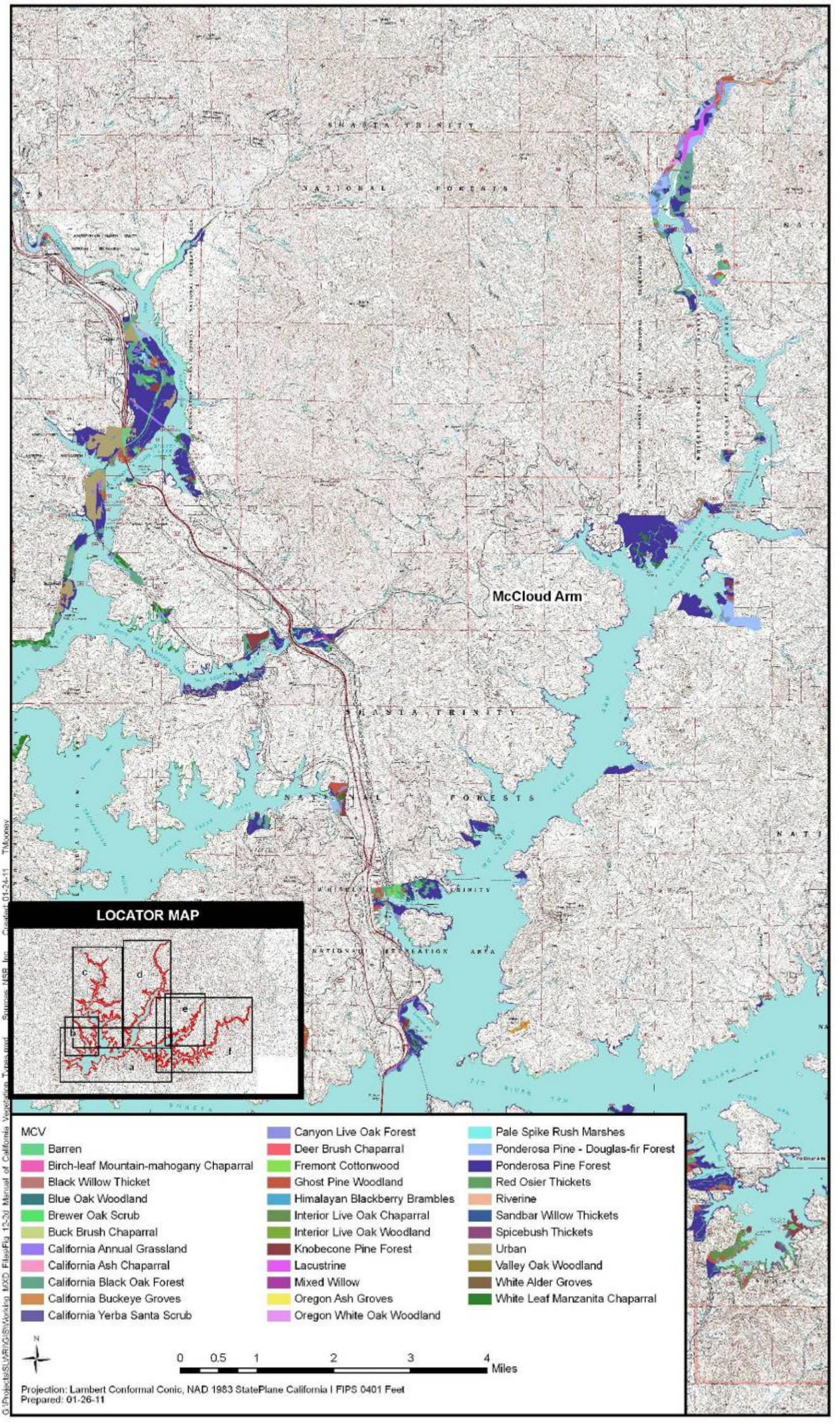


Figure 12-2d. Manual of California Vegetation Types

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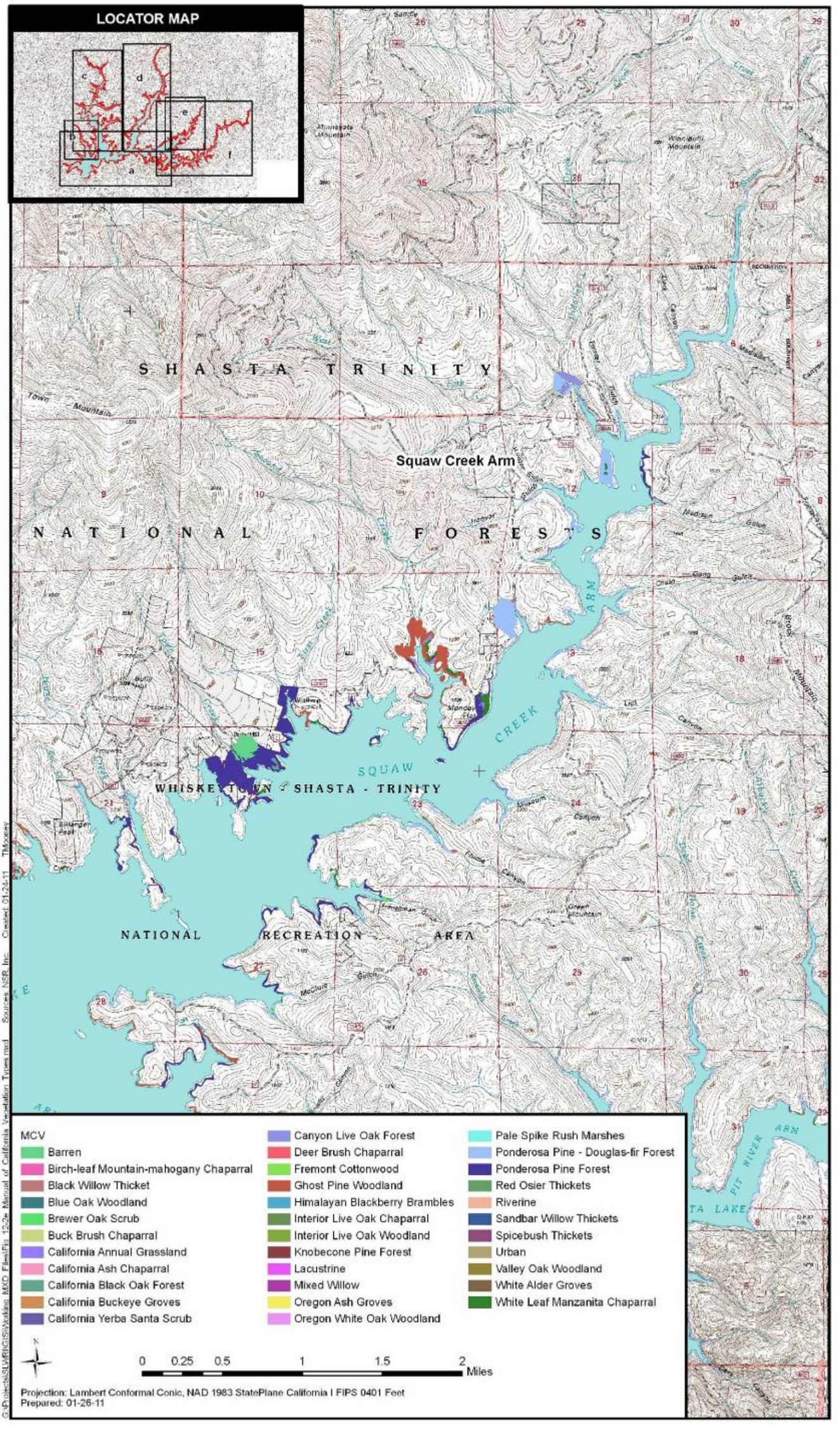


Figure 12-2e. Manual of California Vegetation Types

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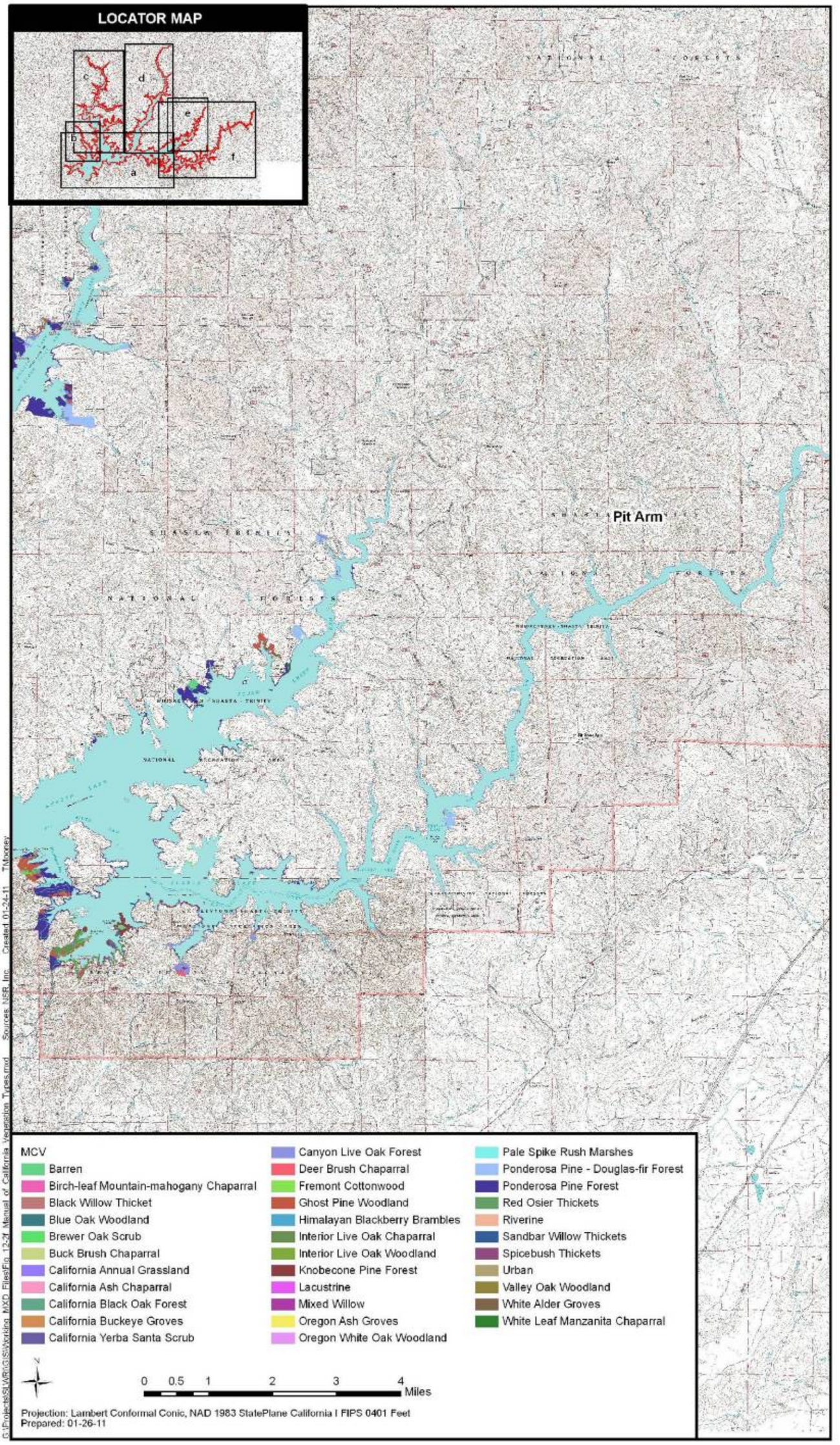


Figure 12-2f. Manual of California Vegetation Types

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Barren Barren habitat consists mainly of nonvegetated man-made features. Barren habitat is scattered throughout the Shasta Lake and vicinity portion of the primary study area, including boat ramps, parking lots, and roads. Other barren habitats are a large gravel plain feature at the confluence of Butcher Creek and Shasta Lake (Main Body) and a sealed riprap feature adjacent to Interstate 5 near the upper Sacramento Arm and Shasta Lake confluence. Vegetation is usually not present, although sparse opportunistic grasses/forbs or weedy species may occur.

Birch-Leaf Mountain-Mahogany Chaparral Birch-leaf mountain-mahogany chaparral is a relatively common associate species in many chaparral and woodland plant series types. As a plant series, birch-leaf mountain-mahogany occurs in the Shasta Lake and vicinity portion of the primary study area along the upper McCloud and Sacramento arms. These sites are located on floodplain terraces and are characterized as moderate to dense chaparral stands dominated by birch-leaf mountain-mahogany (*Cercocarpus betuloides*), with occasional buck brush (*Ceanothus cuneatus*), poison oak (*Toxicodendron diversilobum*), western redbud (*Cercis occidentalis*), yerba santa (*Eriodictyon californicum*), and Brewer oak (*Q. garryana* var. b*reweri*).

Black Willow Thicket Although commonly associated with willow and other riparian plant series types, black willow thicket is uncommon in the Shasta Lake and vicinity portion of the primary study area. This plant series is dominated by black willow (*Salix gooddingii*), with spicebush (*Calycanthus occidentalis*), rushes (*Juncus* spp.), and California grape (*Vitis californica*). It occurs at only two locations in the Shasta Lake and vicinity portion of the primary study area, one along the Sacramento Arm and the other in the Jones Valley area (Pit Arm).

Blue Oak Woodland The blue oak plant series occurs mainly as small inclusions within other more prevalent plant series types; however, moderate-sized stands also occur. This plant series occurs at scattered locations along the Main Body, McCloud Arm, and Pit Arm and is characterized by open to moderate woodlands dominated by blue oak (*Quercus douglasii*). Associated tree species include occasional interior live oak (*Q. wislizenii* var. *wislizenii*) and gray pine (*Pinus sabiniana*). The shrub layer is open or absent, and a moderate to dense forb layer dominates the understory.

Brewer Oak Scrub The Brewer oak plant series consists of moderate to very dense stands of Brewer oak, the shrub form of Oregon white oak (*Q. garryana* var. *garryana*). This plant series type is widespread throughout the Shasta Lake and vicinity portion of the primary study area. Brewer oak stands are often nearly pure; occasionally, however, shrub species such as poison oak, white leaf manzanita, yerba santa, buck brush, bush poppy (*Dendromecon rigida*), Fremont's silktassel (*Garrya fremontii*), deer brush (*Ceanothus integerrimus*), skunkbrush (*Rhus trilobata*), and snowdrop bush (*Styrax officinalis*) occur in association with Brewer oak.

Buck Brush Chaparral Buck brush chaparral occurs at scattered locations throughout the Shasta Lake and vicinity portion of the primary study area. This plant series is dominated by moderate to dense stands of buck brush. Associated species include white leaf manzanita, poison oak, western redbud, yerba santa, Brewer oak, birch-leaf mountain-mahogany, and coffeeberry (*Rhamnus* sp.).

California Annual Grassland California annual grassland is uncommon in the Shasta Lake and vicinity portion of the primary study area, occurring only as small inclusions in other more prevalent plant series types or in areas subjected to previous disturbance. Dominant species include wild oat (*Avena fatua*), cheatgrass (*Bromus tectorum*), ripgut (*B. diandrus*), yellow star-thistle (*Centaurea solstitialis*), squirreltail (*Elymus elymoides*), and European hairgrass (*Aira caryophyllea*).

California Ash Chaparral California ash is a relatively common associate species in many chaparral and woodland plant series types. As a plant series, California ash chaparral occurs in the Shasta Lake and vicinity portion of the primary study area at several locations along the McCloud Arm. This plant series is characterized as a moderate to dense chaparral stand dominated by birch-leaf mountain-mahogany, with occasional buck brush, poison oak, western redbud, yerba santa, and Brewer oak.

California Black Oak The black oak series is characterized by moderate to dense stands of California black oak (*Quercus kelloggii*). This plant series is relatively common throughout the Shasta Lake and vicinity portion of the primary study area. Understory associates include white leaf manzanita (*Arctostaphylos viscida*), poison oak, snowdrop bush (*Styrax officinalis*), and buck brush. The ground layer is open to dense and is dominated by various grasses and forbs.

California Buckeye Groves Although a common associate in many plant series types in the Shasta Lake and vicinity portion of the primary study area, California buckeye groves are uncommon as a plant series type. This plant series is dominated by California buckeye (*Aesculus californica*). Associated species include poison oak, Brewer oak, buck brush, and various grasses and forbs. It occurs at only several scattered locations in the Sacramento Arm, McCloud Arm, and Pit Arm.

California Yerba Santa Scrub California yerba santa scrub is a relatively common associate species in many chaparral and woodland plant series types. California yerba santa is a pioneer species that readily responds to various disturbances and wildfire. As a plant series, California yerba santa scrub occurs in the Shasta Lake and vicinity portion of the primary study area at two general locations subject to recent wildfire: the Dry Creek area (Main Body) and the Jones Valley area (Pit Arm). This plant series is characterized as moderate to dense chaparral stands dominated by California yerba santa, with occasional

shrub interior live oak, shrub canyon live oak, buck brush, poison oak, western redbud, and Brewer oak.

Canyon Live Oak Forest The canyon live oak plant series is characterized by moderate to dense stands of canyon live oak (*Quercus chrysolepis*). This plant series is relatively common throughout the Shasta Lake and vicinity portion of the primary study area. Associated tree species include occasional California black oak. Understory associates include white leaf manzanita and poison oak. The ground layer is open to moderate and is dominated by various grasses and forbs.

Deer Brush Chaparral Deer brush chaparral is a relatively common associate in chaparral and forest plant series types in the Shasta Lake and vicinity portion of the primary study area; however, deer brush is uncommon in the study area as a plant series type. This plant series is dominated by deer brush. It occurs at several scattered locations along the Main Body, McCloud Arm, and Pit Arm.

Fremont Cottonwood Forest In the Shasta Lake and vicinity portion of the primary study area, Fremont cottonwood forest is an uncommon plant series type that occurs as single stands of trees along small portions of the upper Sacramento Arm and the Pit Arm. The dominant species is Fremont cottonwood (*Populus fremontii*).

Ghost (Gray) Pine The ghost pine plant series occurs in all parts of the Shasta Lake and vicinity portion of the primary study area except along the Big Backbone Arm. This plant series type is characterized by open to moderate stands of gray pine. Associated species include blue oak, canyon live oak, interior live oak, and California black oak. Shrub species are moderate to dense and include white leaf manzanita, western redbud, buck brush, Brewer oak, poison oak, and yerba santa.

Himalayan Blackberry Brambles Himalayan blackberry (*Rubus discolor*) is a common associate in many riparian plant series and in various other plant series with mesic microhabitats and/or previous disturbance. As a plant series, Himalayan blackberry brambles occur in portions of the Dry Creek (Main Body) and Jones Valley (Pit Arm) areas recently disturbed by wildfire. This plant series occurs in and along drainage and stream features and is characterized as dense thickets of Himalayan blackberry. Associated species include spicebush, willow, and rushes.

Interior Live Oak Chaparral In the Shasta Lake and vicinity portion of the primary study area, the interior live oak chaparral plant series is relatively uncommon, occurring mainly along the Sacramento Arm. However, this plant series also occurs at scattered locations along the Main Body, the McCloud Arm, and the Pit Arm. This plant series is dominated by moderate to dense stands of the shrub form of interior live oak. Associated species include Brewer oak, white leaf manzanita, poison oak, and buck brush.

Interior Live Oak Woodland The interior live oak woodland plant series is uncommon in the Shasta Lake and vicinity portion of the primary study area. It occurs in several small areas along the Sacramento Arm, the Pit Arm, the McCloud Arm, and the Main Body.

Knobcone Pine Forest The knobcone pine forest plant series consists of open to dense knobcone pine (*Pinus contorta*) stands. This plant series is scattered throughout all portions of the Shasta Lake and vicinity portion of the primary study area. Knobcone pine forest often occurs at locations characterized by disturbances, including historic mining activities and past or recent wildfires. Dominant species include knobcone pine, with occasional canyon live oak, California black oak, ponderosa pine (*Pinus ponderosa*), and gray pine. The shrub layer is moderate to dense and is dominated by white leaf manzanita and poison oak. The ground layer varies and is dominated by various grasses and forbs.

Lacustrine Lacustrine habitat consists of the area regularly inundated by Shasta Lake (i.e., areas at and below the 1,070-foot elevation). Most of this area is barren of vegetation and is characterized as exposed soil and/or rock. Portions of the lacustrine habitat do support vegetation, including woody riparian species such as black willow, button willow (*Cephalanthus occidentalis*), Fremont cottonwood, and various grasses and forbs, during draw-down periods.

Mixed Willow Mixed willow is the most common willow plant series type in the Shasta Lake and vicinity portion of the primary study area and occurs throughout the entire area. Dominant species include red willow (*Salix laevigata*), black willow, shining willow (*S. lasiandra*), arroyo willow (*S. lasiolepis*), and narrowleaf willow (*S. exigua*).

Oregon Ash Groves Oregon ash groves are an uncommon plant series type in the Shasta Lake and vicinity portion of the primary study area. This type occurs along the upper McCloud Arm and is dominated by open to moderate stands of Oregon ash (*Fraxinus latifolia*) with willow, California grape, mock orange, brickellbush (*Brickellia* sp.), and poison oak.

Oregon White Oak Woodland The Oregon white oak woodland plant series is uncommon in the Shasta Lake and vicinity portion of the primary study area and occurs as small inclusions in other more prevalent plant series types. This plant series is characterized by open to moderate woodlands dominated by Oregon white oak. Associated tree species include occasional canyon live oak, blue oak, and California black oak. The shrub layer is open or absent, and a moderate to dense forb layer dominates the understory.

Pale Spike Rush Marshes Pale spike rush is an uncommon plant series in the Shasta Lake and vicinity portion of the primary study area; it is known to occur only in a portion of one relocation area near Lakehead (Sacramento Arm). This plant series is characterized as a seasonal wetland dominated by a complex of

annual and perennial upland and wetland plant species. Dominant species include pale spike rush (*Eleocharis macrostachya*), jointed coyote-thistle (*Eryngium articulatum*), pennyroyal (*Mentha pulegium*), panic grass (*Panicum acuminatum*), iris-leaf rush (*Juncus xiphioides*), sedges (*Carex* spp.), rushes, poison oak, white leaf manzanita, western choke-cherry (*Prunus virginiana*), interior rose (*Rosa woodsii*), and Himalayan blackberry.

Ponderosa Pine–Douglas-Fir Ponderosa pine-Douglas-fir is the second-most-common conifer plant series type in the Shasta Lake and vicinity portion of the primary study area, occurring everywhere except along the Big Backbone Arm. This plant series is characterized by open to dense conifer stands dominated by Douglas-fir (*Pseudotsuga menziesii*) and ponderosa pine. Associated species include occasional sugar pine (*P. lambertiana*), incense cedar (*Calocedrus decurrens*), canyon live oak, and California black oak. Associated understory species vary and include Pacific dogwood (*Cornus nuttallii*), mock orange (*Philadelphus lewisii*), poison oak, snowdrop bush, and white leaf manzanita. The ground layer is open to moderate and is dominated by various grasses and forbs.

Ponderosa Pine Ponderosa pine is the most common conifer plant series type in the Shasta Lake and vicinity portion of the primary study area and is scattered throughout all portions of the area. This plant series is characterized by open to dense conifer stands dominated by ponderosa pine. Associated species include occasional Douglas-fir, sugar pine, incense cedar, canyon live oak, and California black oak. Associated understory species vary and include redbud, buck brush, mock orange, poison oak, snowdrop bush, and white leaf manzanita. The ground layer is open to moderate and is dominated by various grasses and forbs.

Red Osier Thickets Red osier is a common associate in many riparian plant series types in the Shasta Lake and vicinity portion of the primary study area. As a plant series, red osier thickets are an uncommon plant series type. In the vicinity of Shasta Lake, red osier thickets are found along the upper McCloud Arm. Dominant species include red osier (*Cornus stolonifera*), brown dogwood (*C. glabrata*), mock orange, spicebush, and California grape.

Riverine Riverine habitat includes the free-flowing portions of the larger Shasta Lake tributaries occurring in the Shasta Lake and vicinity portion of the primary study area. The riverine habitat is highly variable and ranges from moderate, low-gradient to steep, well-confined stream reaches.

Sandbar Willow Thickets Sandbar willow thicket is an uncommon plant series that occurs at one location each along the McCloud Arm and the Squaw Creek Arm. Dominant species include narrowleaf willow, with occasional red willow, black willow, shining willow, and arroyo willow.

Spicebush Thickets Spicebush is a common associate in many riparian plant series types in the Shasta Lake and vicinity portion of the primary study area. As a plant series, spicebush thickets are an uncommon plant series type. This plant series occurs at several locations along the McCloud Arm. Dominant species include spicebush, red osier, mock orange, and California grape.

Urban Urban habitat consists of various man-made features scattered throughout the Shasta Lake and vicinity portion of the primary study area, including resorts and a portion of the visitor center complex at Shasta Dam. These features are typically a combination of various buildings, pavement areas with manicured landscaping, and lawns.

Valley Oak Woodland Valley oak woodland is an uncommon plant series and occurs at two small locations in the Lakehead area (Sacramento Arm). Dominant species include valley oak (*Quercus lobata*) with white leaf manzanita, redbud, poison oak, and various grasses and forbs.

White Alder Groves The white alder plant series occurs in the riparian vegetation found in drainages throughout the Shasta Lake and vicinity portion of the primary study area. This plant series is characterized as narrow bands of vegetation occurring in and along the margins of rivers, streams, or other drainages. Dominant species include white alder (*Alnus rhombifolia*) with occasional Oregon ash, red osier, big-leaf maple (*Acer macrophyllum*), narrowleaf willow, red willow, shining willow, and arroyo willow. Associated shrubs include spicebush, mock orange, California blackberry (*Rubus ursinus*), mugwort (*Artemisia douglasiana*), ninebark (*Physocarpus capitatus*), and western azalea (*Rhododendron occidentale*). Common lianas include California grape, pipevine (*Aristolochia californica*), greenbriar (*Smilax californica*), and virgin's bower (*Clematis ligusticifolia*). The ground layer is open to dense and is dominated by sedges with various grasses and forbs.

White Leaf Manzanita Chaparral White leaf manzanita is the most common chaparral plant series type in the Shasta Lake and vicinity portion of the primary study area and is scattered throughout all portions of the area. The dominant species is white leaf manzanita. Associated species include occasional common manzanita (*A. manzanita*), western redbud, buck brush, deer brush, poison oak, birch-leaf mountain-mahogany, interior live oak (shrub form), Fremont's silktassel, bush poppy, yerba santa, and Brewer's oak.

Upper Sacramento River (Shasta Dam to Red Bluff)

The plant communities present in the primary study area between Shasta Dam and RBDD are grouped into common and sensitive communities as described below, and the relevant aspects of their ecology are discussed in detail in the *Botanical Resources and Wetlands Technical Report*, and summarized below for sensitive communities. These descriptions are generally applicable to the extended study area as well. (Plant community names and descriptions used in

this section are based primarily on the Preliminary Descriptions of the Terrestrial Natural Communities of California (Holland 1986).)

Common plant communities present within the primary study area include annual grassland, chaparral, and agricultural lands. The upper banks along steep-sided, bedrock constrained segments of the Sacramento River and its tributaries are characterized primarily by upland communities including blue oak woodland, foothill pine-oak woodland, and chaparral. These segments occur primarily between Shasta Dam and Redding.

Sensitive plant communities include those that are of special concern to resource agencies or are afforded specific consideration through CEQA, Section 1602 of the California Fish and Game Code, Section 404 of the Federal Clean Water Act (CWA), and the State's Porter-Cologne Water Quality Control Act, as discussed under "Regulatory Framework."

Oak Woodlands Oak woodlands present in the study area include blue oak woodland, blue oak savanna, foothill pine-oak woodland, and valley oak woodland. The oaks that dominate the tree layer of oak savannas and woodlands are long-lived trees that are resilient to damage; their stems often survive fire, and when their stems are killed by fire or are cut down, basal sprouts often grow into new stems. (Valley oak also tolerates inundation during winter before it has leafed out.) Nonetheless, there are concerns regarding the status and ongoing trends of tree mortality and recruitment in tree canopies of blue oak- and valley oak-dominated savannas and woodlands (Tyler et al. 2006).

Riparian Communities California's riparian communities have experienced the most extensive reductions in their acreage, and in the Sacramento Valley more than 90 percent of riparian vegetation has been converted to agriculture or development, and the remainder substantially altered by dams, diversions, gravel mining, grazing practices, and invasive species (Hunter et al. 1999).

In the primary study area, much of the Sacramento River from Shasta Dam to Redding is deeply entrenched in bedrock, which precludes development of extensive areas of riparian vegetation. The river corridor between Redding and Red Bluff, however, still maintains extensive areas of riparian vegetation.

Riparian communities present within the floodplain of the Sacramento River, within the study area, include blackberry scrub, Great Valley willow scrub, Great Valley cottonwood riparian forest, Great Valley mixed riparian forest, and Great Valley valley oak riparian forest. Willow and blackberry scrub and cottonwood- and willow-dominated riparian communities are present along active channels and on the lower flood terraces whereas valley oak–dominated communities occur on higher flood terraces.

More than 15 native species of deciduous trees and shrubs occur in the riparian forests, woodlands, and scrubs of the Central Valley and the Delta (Conard et al.

1977, Vaghti and Greco 2007). Flow regime, disturbance, and species attributes determine the species composition and physical structure of this woody vegetation. Although flow regime influences the dispersal, establishment, growth, and survival of all the woody riparian species, Fremont's cottonwood (*Populus fremontii*) and the willow species (*Salix* sp.) particularly depend on specific hydrologic events for their recruitment. During seed release, flows must be high enough to disperse seed to surfaces where scouring by subsequent flows does not occur, yet not so high that seedlings desiccate after flows recede, and flows must recede gradually to enable germination and seedling establishment while the substrate is still moist (Mahoney and Rood 1998).

Fremont's cottonwood and willow species are rapidly growing, shade intolerant and relatively short-lived (Burns and Honkala 1990, Vaghti and Greco 2007). Within 10 to 20 years, initially shrubby thickets have reached 10-40 feet in height. Other species, such as Oregon ash (*Fraxinus latifolia*) and valley oak (*Quercus lobata*), establish concurrently or subsequent to the willows and cottonwood, grow more slowly but are more tolerant of shade, and are longer-lived (Burns and Honkala 1990; Tu 2000). In the absence of frequent disturbance, these species enter the canopy, particularly after 50 years, as mortality of willows and cottonwood frees space. Conversely, frequent disturbance prevents the transition to mature mixed riparian or valley oak forests.

The operation of Shasta Dam has limited the frequency, magnitude, and duration of intermediate and larger flows during fall and winter, since the dam's construction, and flow volumes have been greater during the growing season. The operation of Shasta Dam also produces increasing flow volumes during the period of cottonwood seed dispersal (rather than flow volume decreasing during this period), largely precluding establishment of cottonwoods (and to a lesser extent willows) throughout much of the riparian zone (Roberts et al. 2002). The combined effect of these changes in flow regime has been a decrease in early- and mid-successional communities along the Sacramento River that is still ongoing (Fremier 2003).

Wetland Communities *S*imilar to riparian communities, much of the wetland habitat that once occurred in the Sacramento River Valley has been eliminated as a consequence of land use conversion to agriculture and urbanization. It is estimated that nearly 1.5 million acres of wetlands once occurred in the Central Valley. Today, approximately 123,000 acres remain. Wetland communities that are likely to occur in the primary study area between Shasta Dam and RBDD include freshwater marsh, freshwater seep, northern hardpan vernal pools, northern volcanic mudflow vernal pools, and other seasonal wetlands.

Freshwater marshes are herbaceous wetland plant communities that occur along rivers and lakes and are characterized by dense cover of perennial, emergent plant species. Marshes are typically perennial wetlands, but may dry out for short periods of time. In marsh vegetation, vegetation structure and species

richness are strongly influenced by disturbance, changes in water levels, and the range of elevations present at a site (Keddy 2000). Disturbances, and water level drawdowns that expose previously submerged surfaces, provide opportunities for species to establish, which creates diversity in species composition and vegetation structure. With increasing depth of water, the growth of marsh plants is reduced, and thus this vegetation type is typically restricted to shallow water.

Freshwater seep is a wetland plant community characterized by dense cover of perennial herb species usually dominated by rushes, sedges, and grasses. Freshwater seep communities occur on sites with permanently moist or wet soils resulting from daylighting groundwater.

Vernal pools are seasonal wetlands that fill during winter rains and dry up in spring. They occur in undulating or mima mound (i.e., mound-intermound) topography where the soil or underlying rock has layers that are relatively impermeable to water. Vernal pools may be isolated from one another, but more often they are interconnected by swales or ephemeral drainages in vernal pool complexes that may extend for hundreds of acres. Vernal pool complexes generally include water features. The two predominant types of vernal pool communities in the study area are northern hardpan vernal pools and northern volcanic mudflow vernal pools.

Pool size and the depth, duration, and seasonal timing of ponding are important factors that influence the composition and diversity of plant and animal species in vernal pools (Solomeshch et al. 2007). Consequently, the vegetation of vernal pools can vary substantially from year to year in response to interannual fluctuations in climate.

Management activities such as grazing and burning also influence species composition and diversity. In fact, recent research indicates that the abundance of nonnative grasses, grazing practices, and hydrology are strongly interrelated and can substantially affect the plant communities of vernal pools (Robins and Vollmar 2002; Pyke 2004; Marty 2005).

Seasonal wetlands are ephemeral wetlands that pond or remain flooded for long periods during a portion of the year, generally the rainy winter season, then dry up, typically in spring. They often occur in shallow depressions on flood terraces that are occasionally to infrequently flooded. Seasonal wetlands are herbaceous communities typically characterized by species adapted for growth in both wet and dry conditions, and may contain considerable cover of upland species as well. Seasonal wetlands differ from vernal pools in that they do not have a restrictive hardpan layer and are usually dominated by nonnative plant species, especially nonnative grasses.

Lower Sacramento River and Delta A large number of natural plant communities occur in the extended study area, and some are described in this section and the “CVP/SWP Service Areas” section, or in the *Botanical*

Resources and Wetlands Technical Report. The other natural plant communities are described in the following sections, and in Mayer and Laudenslayer 1988, Sawyer and Keeler-Wolf 1995, and CALFED 2000a. In addition to natural plant communities, plant communities of agricultural and urban areas occupy extensive portions of the extended study area.

The lower Sacramento River can be subdivided into distinct reaches that differ in topography, hydrology, and geomorphology; and thus, in vegetation and associated habitat functions.

Red Bluff Diversion Dam to Colusa In this reach, the Sacramento River is classified as a meandering river, where relatively stable, straight sections alternate with more sinuous, dynamic sections (Resources Agency 2003). The channel remains active and has the potential to migrate in times of high water. Point bars, islands, high and low terraces, instream woody cover, early-successional riparian plant growth, and other evidence of river meander and erosion are common in this reach. Major physiographic features include floodplains, basins, terraces, active and remnant channels, and oxbow sloughs. These features sustain a diverse array of riparian plant communities.

Colusa to the Delta The general character of the Sacramento River changes quite drastically downstream from Colusa from a dynamic and active meandering channel to a confined, narrow channel restricted from migration. Surrounding agricultural lands encroach directly adjacent to the levees, which have cut the river off from most of its riparian corridor, especially on the eastern side of the river. Most of the levees in this reach are lined with riprap, allowing the river no erodible substrate and limiting the extent of riparian vegetation.

Primary Tributaries to the Lower Sacramento River The primary tributaries of the lower Sacramento River are the Feather River, American River, and the Sacramento River floodplain bypasses. The aquatic ecosystem in the lower Feather River, down to the confluence with the Sacramento River at Verona, is influenced by DWR's Oroville Facilities. The upper extent is fairly confined by levees as the river flows through the city of Oroville. Downstream from Oroville, the Feather River is fairly active and meanders its way south to Marysville. However, this stretch is bordered by active farmland, which confines the river into an incised channel in certain stretches and limits the width of riparian woodland. Some of this adjacent farmland is in the process of being restored to floodplain habitat with the relocation of levees to become setback levees.

The lower American River (below Folsom and Nimbus Dams) is fairly low gradient. Most of the lower American River is surrounded by the American River Parkway, which preserves the surrounding riparian zone. The river channel does not migrate to a large degree because it has become deeply incised, leaving tall cliffs and bluffs adjacent to the river.

Multiple water diversion structures in the lower Sacramento River move floodwaters into floodplain bypass areas during high-flow events. These floodplain bypass areas – the Butte Basin, Sutter Bypass, and Yolo Bypass – provide broad, inundated floodplain habitat during wet years. Unlike other Sacramento River and Delta habitats, floodplains and floodplain bypasses are seasonally dewatered (as high flows recede). Their predominant communities include grassland, seasonal wetlands, and agricultural vegetation.

Sacramento–San Joaquin River Delta The Delta comprises an area of approximately 750,000 acres divided into a number of islands by hundreds of miles of waterways. Before reclamation, the Delta was inundated each year by winter and spring runoff, which changed channel geometry in response to flood conditions and tidal influence. Consequently, there were extensive areas of marsh in the Delta.

Nearly all of the Delta's marshland has since been reclaimed by agriculture, peat production, and urban and industrial uses. More than 1,000 miles of levees protect this reclaimed land (CALFED 2000b). However, some small islands remain in a quasinatural state, as do some other areas with aquatic and wetland communities (e.g., "flooded islands" that were once reclaimed land, but have been abandoned after levee failures). The species composition and ecology of these riparian, marsh, and aquatic plant communities differ from the composition and ecology of communities in the upper and lower Sacramento River portions of the study area and are described below.

Along the lower Sacramento River and in the Delta, riparian vegetation is characterized by narrow linear strips of trees and shrubs, in single- to multiple-story canopies. Tree canopies may be continuous or discontinuous, or absent altogether (as in riparian scrubs). These patches of riparian vegetation may be on or at the toe of levees (particularly in the Delta). Riparian communities in this region include cottonwood-willow woodland, Valley oak riparian woodland, riparian scrub, and willow scrub. These communities are described below.

The dynamics of riparian communities along the lower Sacramento River and in the Delta are similar to those described for riparian communities along the upper Sacramento River. However, along the Sacramento River south of Colusa, in the flood bypasses, and in the Delta, the disturbances that remove riparian vegetation, or create newly exposed surfaces where riparian vegetation can establish, differ somewhat from those along the upper Sacramento River. In these downstream areas, disturbances related to meander migration are more limited, and anthropogenic (human-caused) disturbances, such as levee maintenance and trampling, are greater than those upstream. This is because of the close proximity to levees, extensive placement of bank protection, and greater human population.

In addition to the wetland communities described for the upper Sacramento River, the Delta has tidal freshwater and brackish-water emergent marshes that like nontidal marshes are dominated by clonal perennial plants. This community occurs on instream islands and along mostly unleveed, tidally influenced waterways. In addition to the environmental factors affecting nontidal marshes, the species composition of tidal marshes in the Delta is also affected by regional salinity gradients.

The Delta also supports extensive areas of aquatic vegetation. These communities consists of submerged plants generally rooted in the substrate, whose stems may partially extend above the water surface (e.g., during flowering) and floating plants that are generally not rooted in the substrate. The availability of light (which decreases with depth), turbidity, and shade cast by overtopping vegetation can restrict submerged plants to relatively shallow areas. In the Delta (which has turbid waters), most submerged vegetation appears to be restricted to areas less than 5 to 10 feet deep. The velocity of flows may contribute to this depth restriction.

CVP/SWP Service Areas Although agricultural and urban land uses have substantially reduced the area and connectivity of natural vegetation, the service areas still contain a large diversity of both lowland and upland plant communities, including many sensitive plant communities (see the *Botanical Resources and Wetlands Technical Report*). The most dramatic difference between historical and existing conditions is the fragmentation of what were once large contiguous blocks of habitat. Significant changes to the natural landscape in the region occurred in the late 1800s and early 1900s with land conversions to agriculture. However, in southern California, that pattern shifted dramatically compared to the pattern in the Central Valley, as urban growth in the region that started in the 1900s began to convert large areas of agricultural lands and of remaining natural vegetation to developed land uses.

12.1.2 Special-Status Species

Special-status species addressed in this section include plants that are legally protected or are otherwise considered sensitive by Federal, State, or local resource conservation agencies and organizations. These include species that are State listed and/or Federally listed as rare, threatened, or endangered; those considered as candidates or proposed for listing as threatened or endangered; species identified by DFG as Species of Special Concern or USFS as sensitive, endemic, or needing additional survey or management actions; and plants considered jointly by DFG and CNPS to be rare, threatened, or endangered; and species afforded protection under local planning documents, including the CALFED Bay-Delta Program's (CALFED) Multi-Species Conservation Strategy (MSCS).

Shasta Lake and Vicinity

Within the Shasta Lake and vicinity portion of the primary study area are a wide variety of vegetative communities and habitat components that support a large

diversity of plant species. To aid in determining the potential impacts of the project, a list of potential plant species of concern was developed.

For the purposes of this evaluation, botanical species of concern are plants, lichen, and fungi that fall into any of the following categories:

- Designated as rare or listed as threatened or endangered by the State or Federal government
- Proposed for designation as rare or listing as threatened or endangered by the State or Federal government
- Candidate species for State or Federal listing as threatened or endangered
- Ranked as California Rare Plant Rank (CRPR) 1B, 2, 3, or 4 (formerly CNPS List 1A, 1B, 2, 3, or 4)
- Considered sensitive or endemic by USFS
- Considered a survey and manage species by USFS or U.S. Bureau of Land Management (BLM)
- Designated as an MSCS covered species by CALFED

Potentially occurring plant species of concern were determined by performing several database searches, reviewing USFWS and DFG special-status species lists for Shasta County, reviewing other appropriate literature, discussions with resource agency personnel, and professional experience in the region. Additionally, results from the various vegetation habitat mapping efforts, botanical surveys, and wildlife surveys conducted in the area by NSR since 2002 were used in developing the list of species of concern.

Table 12-3 summarizes special-status plant species identified as having a potential to occur in the Shasta Lake and vicinity portion of the primary study area.

Table 12-3. Plant Species of Concern with Potential to Occur in the Shasta Lake and Vicinity Portion of the Primary Study Area

Common Name	Scientific Name	Status[1]
Shasta ageratina	Ageratina shastensis	CRPR 1B.2, USFS E
Bent-flowered fiddleneck	Amsinckia lunaris	CRPR 1B.2, BLMS
Mallory's manzanita	Arctostaphylos malloryi	CRPR 4.3
Shasta County arnica	Arnica venosa	CRPR 4.2, USFS E
Depauperate milk-vetch	Astragalus pauperculus	CRPR 4.3
Moonwort, grape-fern	Botrychium subgenus Botrychium	USFS S, S&M
Yellow-twist horsehair	Bryoria tortuosa	BLMS
Green bug moss	Buxbaumia viridis	USFS S, BLMS, S&M
Callahan's mariposa lily	Calochortus syntrophus	CRPR 1B.1
Butte County morning-glory	Calystegia atriplicifolia ssp. buttensis	CRPR 4.2
Castle Crags harebell	Campanula shetleri	CRPR 1B.3, USFS S, BLMS
Buxbaum's sedge	Carex buxbaumii	CRPR 4.2
Bristly sedge	Carex comosa	CRPR 2.1, MSCS r
Fox sedge	Carex vulpinoidea	CRPR 2.2
Shasta clarkia	Clarkia borealis ssp. arida	CRPR 1B.1, MSCS m, BLMS
Northern clarkia	Clarkia borealis ssp. borealis	CRPR 1B.3, BLMS
Silky cryptantha	Cryptantha crinita	CRPR 1B.2, MSCS m, BLMS
California lady's-slipper	Cypripedium californicum	CRPR 4.2
Clustered lady's-slipper	Cypripedium fasciculatum	CRPR 4.2, USFS S, BLMS, S&M
Mountain lady's-slipper	Cypripedium montanum	CRPR 4.2, USFS S, BLMS, S&M
Four-angled spike rush	Eleocharis quadrangulata	CRPR, MSCS m
Butte County fritillary	Fritillaria eastwoodiae	CRPR 3.2, USFS S
Dubious pea	Lathyrus sulphureus var. argillaceus	CRPR 3
Broad-lobed linanthus	Leptosiphon latisectus	CRPR 4.3
Cantelow's lewisia	Lewisia cantelovii	CRPR 1B.2, USFS S, BLMS
Howell's lewisia	Lewisia cotyledon var. howellii	CRPR 3.2
Bellinger's meadowfoam	Limnanthes floccosa ssp. bellingeriana	CRPR 1B.2, MSCS m, BLMS
Awl-leaved navarretia	Navarretia subuligera	CRPR 4.3
Shasta snow-wreath	Neviusia cliftonii	CRPR 1B.2, USFS S, MSCS m, BLMS
Thread-leaved beardtongue	Penstemon filiformis	CRPR 1B.3, MSCS m, USFS S, BLMS
Narrow-petaled rein orchid	Piperia leptopetala	CRPR 4.3
Bidwell's knotweed	Polygonum bidwelliae	CRPR 4.3
Eel-grass pondweed	Potamogeton zosteriformis	CRPR 2.2, MSCS m
Pacific fuzzwort	Ptilidium californicum	USFS S, BLMS, S&M
Brownish beaked-rush	Rhynchospora capitellata	CRPR 2.2
Sanford's arrowhead	Sagittaria sanfordii	CRPR 1B.2, MSCS m, BLMS
Marsh skullcap	Scutellaria galericulata	CRPR 2.2, MSCS m
Canyon Creek stonecrop	Sedum obtusatum ssp. paradisum	CRPR 1B.3, USFS S, BLMS
English Peak greenbriar	Smilax jamesii	CRPR 1B.3, USFS S, MSCS m, BLMS
Obtuse starwort	Stellaria obtusa	CRPR 4.3
Slender false lupine	Thermopsis gracilis var. gracilis	CRPR 4.3
Shasta huckleberry	Vaccinium sp., undescribed	Genetically distinct from coastal and Sierra Nevada populations; may warrant taxonomic consideration.
Oval-leaved viburnum	Viburnum ellipticum	CRPR 2.3

Table 12-3. Plant Species of Concern with Potential to Occur in the Shasta Lake and Vicinity Portion of the Primary Study Area (contd.)

Notes:

[1] Status Codes

CRPR 1B = Plants rare, threatened, or endangered in California and elsewhere

CRPR 2 = Plants rare, threatened, or endangered in California but more common elsewhere

CRPR 3 = Plants for which more information is need—a review list

CRPR 4 = Plants of limited distribution—a watch list

CRPR Threat Ranks

0.1 = Seriously threatened in California

0.2 = Fairly threatened in California

0.3 = Not very threatened in California

Multi Species Conservation Strategy (MSCS) covered species

R = Recovery. Recover species' populations within the MSCS focus area to levels that ensure the species' long-term survival in nature.

r = Contribute to recovery. Implement some of the actions deemed necessary to recover species' populations within the MSCS focus area.

m = Maintain. Ensure that any adverse effects on the species that could be associated with implementation of CALFED actions will be fully offset through implementation of actions beneficial to the species (CALFED 2000c).

Key:

BLMS = BLM sensitive

CRPR = California Rare Plant Rank

USFS = U.S. Forest Service

USFS E = USFS Endemic Species

USFS S = USFS Sensitive Species

S&M = Survey and Manage Species

MSCS = Multi Species Conservation Strategy

The CNDDB was reviewed for records of special-status plant species in or near the Shasta Lake and vicinity portion of the primary study area. The CNDDB is a database consisting of historical observations of special-status plant species, wildlife species, and natural communities. The CNDDB is limited to reported sightings and is not a comprehensive list of special-status species that may occur in a particular area.

A search of the CNPS Electronic Inventory was also conducted. The Electronic Inventory allows users to query the database using a set of variable search criteria. The result of the search is a list of potentially occurring special-status plant species. The criteria used for the query included all CRPR 1A, 1B, 2, 3, and 4 plants (formerly CNPS) occurring in Shasta County in closed-cone coniferous forest, chaparral, cismontane woodland, lower montane coniferous forest, marshes and swamps, pebble plain, valley and foothill grasslands, riparian forest, riparian woodland, and riparian scrub habitats between the elevations of approximately 900 feet and 2,500 feet.

Botanical Surveys Because botanical studies are ongoing, detailed technical memoranda describing methods, results, and conclusions will be provided in the Final Environmental Impact Statement (FEIS).

NSR conducted several botanical surveys for special-status plant species in the Shasta Lake and vicinity portion of the primary study area. Botanical surveys were conducted in 2002, 2003, 2004, 2009, and 2010. A list of species observed during the surveys is provided as Attachment 2. Hickman (1993) was used as the standard reference for taxonomic nomenclature and identification. Special-status plant species detected during the surveys are discussed in more detail in Attachment 3.

The first botanical surveys were performed during 2002 along the Big Backbone and Squaw Creek arms. The surveys were conducted in accordance with the technical methods prescribed by Nelson (1994). In 2003, botanical surveys were conducted along 11 selected riverine reaches: Little Backbone Creek, Sugarloaf Creek, upper Sacramento River, middle Salt Creek, Salt Creek, Nosoni Creek, Dekkas Creek, Campbell Creek, Flat Creek, Ripgut Creek, and Potem Creek. The surveys were conducted in accordance with the technical methods prescribed by Nelson (1994). In 2004, botanical surveys were conducted at a series of randomly and nonrandomly selected locations. Nonrandomly selected sites were located throughout the Shasta Lake and vicinity portion of the primary study area (not including relocation areas) based on 2002 and 2003 survey results. Sites were selected based on the presence of unique habitat and ecological attributes, such as recently burned areas, unique geologic substrates, late-seral forests, and relatively rare plant series. Nonrandomly selected sites varied in size and often included several plant series types. Randomly selected sites were selected throughout the area using plant series polygons developed from previously completed vegetation mapping. Using geographic information systems, individual vegetation polygons were assigned a unique number, and 100 numbers (i.e., vegetation polygons) were then randomly selected.

Based on previous surveys resulting in discoveries of Shasta snow-wreath (*Neviusia cliftonii*) and Shasta huckleberry (*Vaccinium* sp. undescribed), specific surveys for these species were conducted in 2009 and 2010. These surveys were designed to identify potential habitat for and locate populations of these species outside of the proposed project area. Pedestrian surveys were conducted to search the focus areas identified. Using methods described in Lindstrand and Nelson (2006), potential survey areas were identified using soil and geologic information at known sites and choosing areas with those same characteristics. In addition, survey sites were identified using intuitive techniques, such as selecting areas with vegetative cover types similar to those of known populations and areas near known populations (regardless of vegetative cover).

To address potential project impacts and evaluate potential mitigation measures, a genetic study of the Shasta snow-wreath was conducted in 2009 and 2010. The goal of the genetic study was to determine (1) whether all Shasta snow-wreath populations are genetically identical and (2) whether there are several homogeneous population clusters or whether some other pattern is present.

Twenty-one of the 23 known Shasta snow-wreath sites were included in the study. The genetic study determined that the species is characterized by low genetic diversity and high levels of genetic differentiation (National Forest Genetics Laboratory 2010). No strong patterns were found between the Shasta snow-wreath populations and several physical and geographic variables, including soil, geology, population size, and geographic location. Although high levels of genetic differentiation and no strong population patterns are present, the genetic study found three general population clusters, providing insight and basic species information for potential mitigation planning.

Concurrently with the Shasta snow-wreath genetic study, a genetic study was conducted in 2009 and 2010 to determine whether the huckleberry is different genetically from red huckleberry and, if so, to determine if it warrants recognition as a new taxon. The genetic study determined that the species is genetically distinct from other huckleberry populations (National Forest Genetics Laboratory 2010). Based on the results of the genetic studies combined with phenotypic characteristics, this species warrants recognition as a new taxon. The Shasta huckleberry appears to be an uncommon and geographically restricted species.

In 2010, botanical surveys were conducted in all relocation areas including the dam footprint. The surveys were conducted in accordance with the technical methods prescribed by Nelson (1994).

Shasta County arnica (*Arnica venosa*), Northern clarkia (*Clarkia borealis* ssp. *borealis*), Butte County fritillary (*Fritillaria eastwoodiae*), Cantelow's lewisia (*Lewisia cantelovii*), Shasta snow-wreath, slender false lupine (*Thermopsis gracilis* var. *gracilis*), Shasta huckleberry, and oval-leaved viburnum (*Viburnum ellipticum*) were special-status plant species found both incidentally and during the surveys efforts.

One population of Shasta County arnica was found in ponderosa pine habitat south of Bridge Bay Resort along the Main Body and one population was found near the privately owned cabins on National Forest System lands in the Salt Creek inlet on the Sacramento Arm. Additionally, the USFS has located a population along the Sacramento Arm north of Slaughterhouse Island during surveys conducted in 2010 (Figures 12-3a and 12-3c).

One population of northern clarkia was found in hardwood-conifer/chaparral habitat near Bailey Cove on the McCloud Arm, and another population was found in hardwood-conifer/chaparral habitat in Sugarloaf Cove west of Beehive Point on the Sacramento Arm. Locations of northern clarkia found incidentally and during the surveys are shown on Figures 12-3c through 12-3d.

Surveys conducted by the USFS in 2010 located five populations of Butte County fritillary; two populations along Flat Creek and three populations along Ripgut Creek on the Pit Arm (Figure 12-3f).

One population of Cantelow's lewisia was discovered on a rock outcrop on the right bank of the upper Sacramento River near the Shasta Lake/upper Sacramento River transition zone. Additionally, the USFS has located three populations along Sacramento Arm near Elmore Mountain during surveys conducted in 2010 (Figures 12-3c).

Shasta snow-wreath is currently known from 23 locations, most of which occur at or near the periphery of Shasta Lake. Ten Shasta snow-wreath populations occur in habitats associated with limestone formations, and 13 occur in other habitat types. Most populations are associated with stream drainages or the lower portions of upland slopes. Of these, 13 Shasta snow-wreath populations were discovered during the botanical surveys along the McCloud Arm (south of Shasta Caverns and Keluche Creek), Pit Arm (Brock Creek, Ripgut Creek, Flat Creek, Stein Creek, and west of Stein Creek), and the Main Body (Blue Ridge east, Blue Ridge west, Blue Ridge middle, Cove Creek, south of Cove Creek, and Jones Valley). Locations of Shasta snow-wreath found incidentally and during the surveys are shown on Figures 12-3a through 12-f.

Slender false lupine populations were discovered in all portions of the primary study area, generally on low-gradient slopes. Locations of slender false lupine found during the surveys and incidentally are shown on Figures 12-3a through 12-3f.

Shasta huckleberry is currently known from 12 locations in the upper Spring Creek, Dry Fork, (little) Squaw Creek, Shoemaker Gulch, and Little Backbone Creek drainages, and from the vicinity of Bully Hill. All locations occur in the area historically known as the Copper Belt of Shasta County in the immediate vicinity of historic copper mining activities. Shasta huckleberry occurs at four locations in the SLWRI project area: (little) Squaw Creek, Shoemaker Gulch, Little Backbone Creek, and Horse Creek near Bully Hill. Locations of Shasta huckleberry found incidentally and during the surveys are shown on Figures 12-3a through 12-3f.

Two oval-leaved viburnum populations were found during the surveys. One population was found in a forested upland slope west of Pine Point Campground along the McCloud Arm and a second population was found in chaparral habitat at Jones Valley along the Pit Arm near the Clikapudi Trail. Locations of oval-leaved viburnum found incidentally and during the surveys are shown on Figures 12-3d and 12-3f.

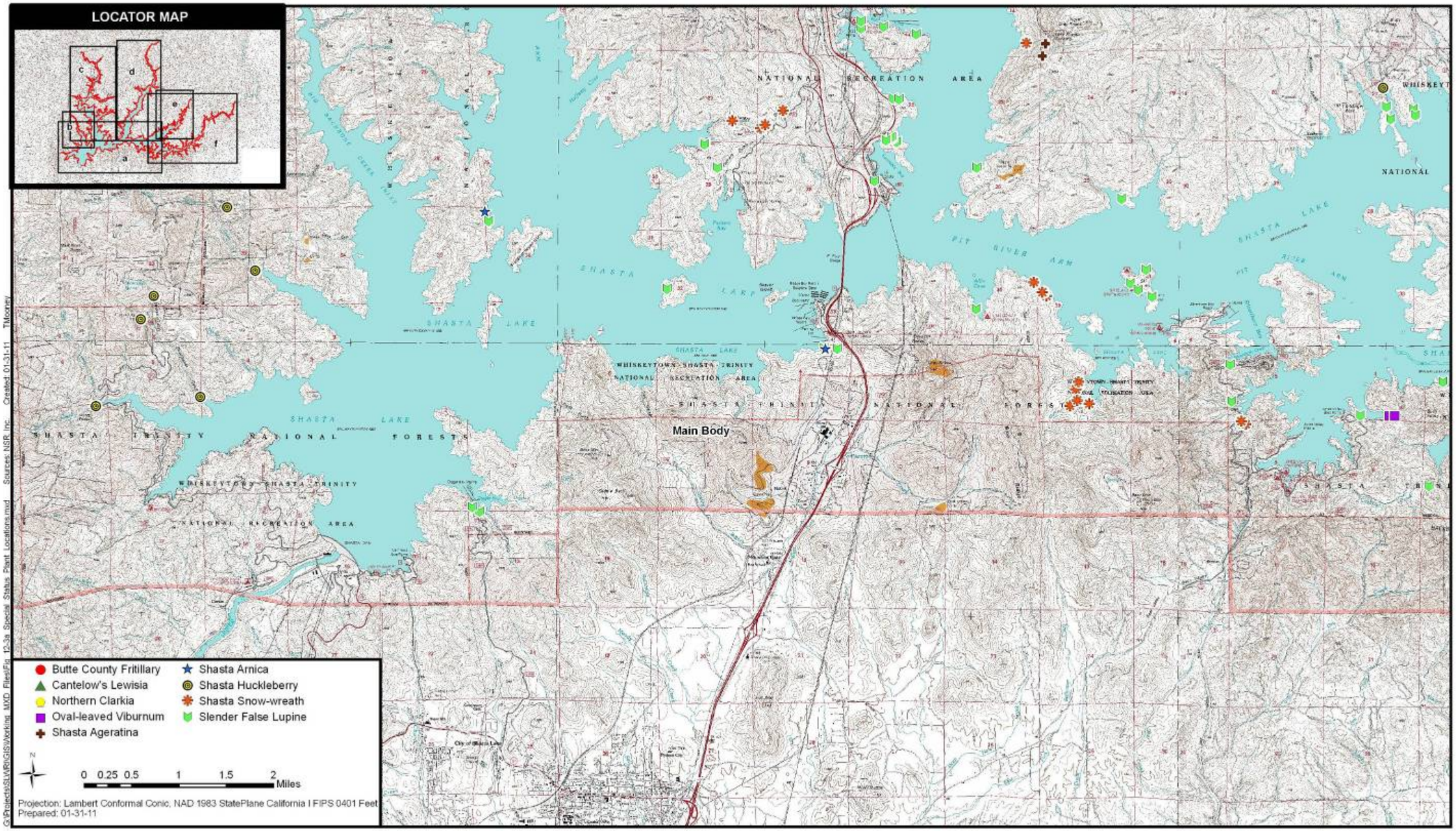


Figure 12-3a. Special-Status Plant Species Occurring in Shasta Lake and Vicinity

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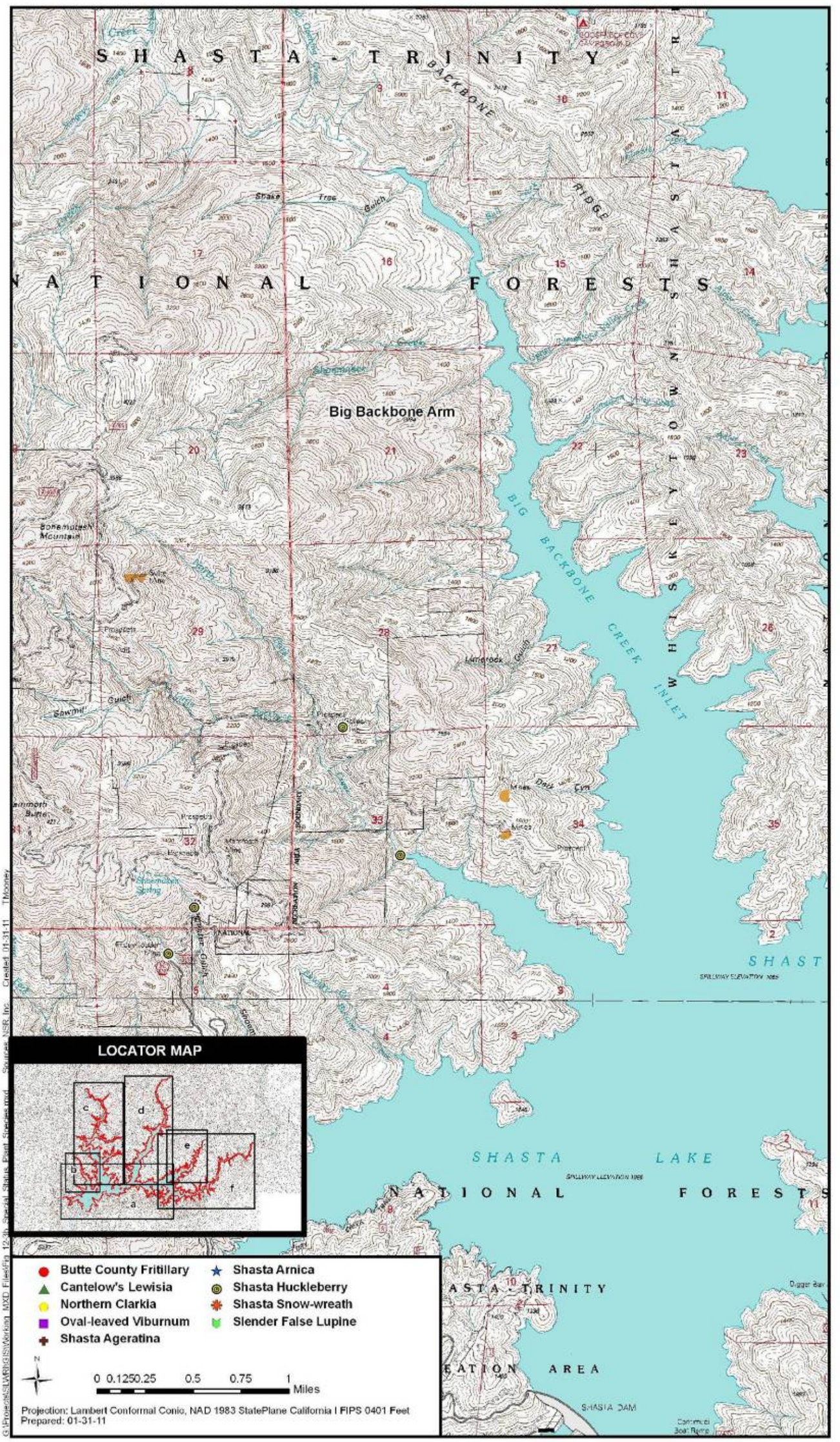


Figure 12-3b. Special-Status Plant Species Occurring in Shasta Lake and Vicinity

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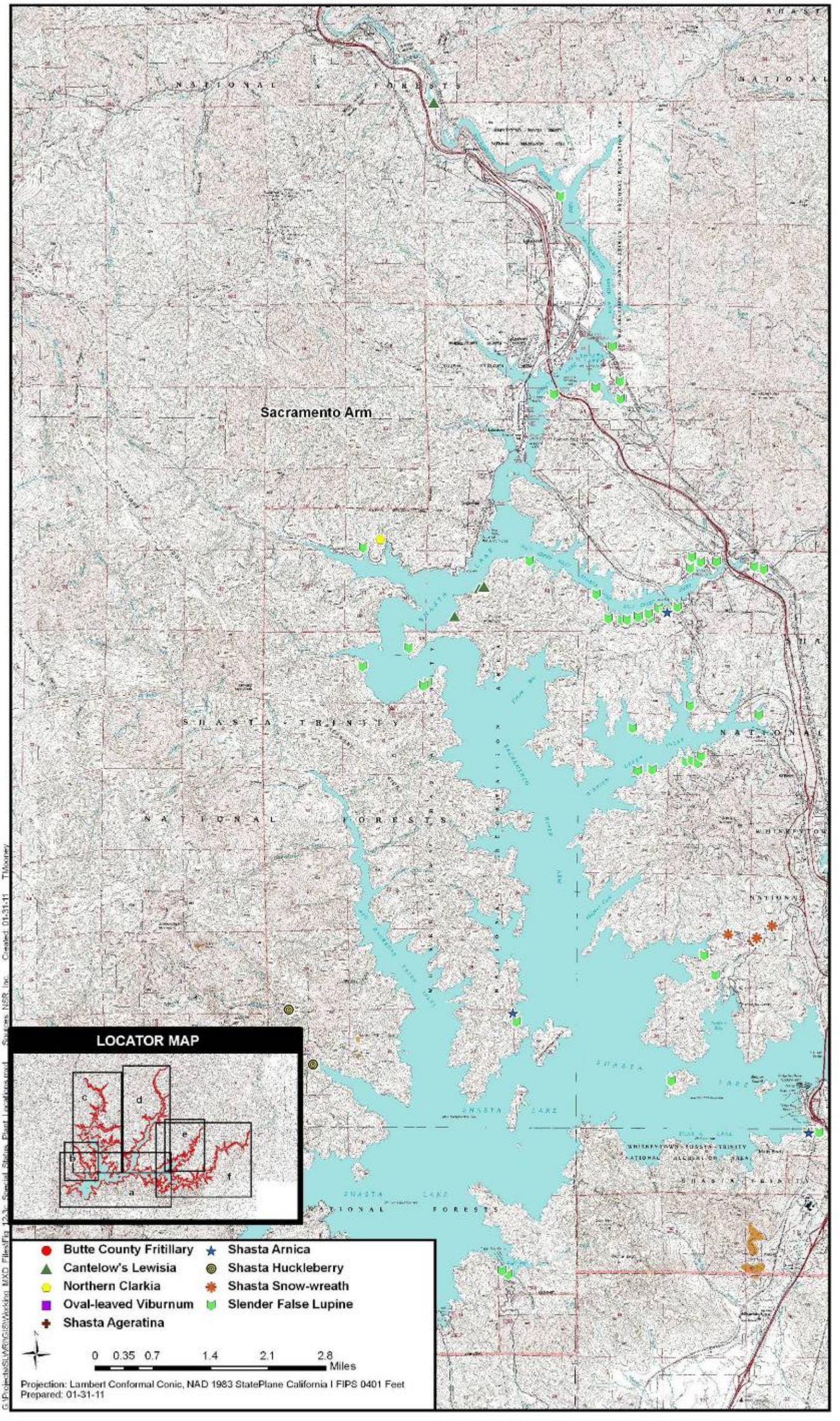


Figure 12-3c. Special-Status Plant Species Occurring in Shasta Lake and Vicinity

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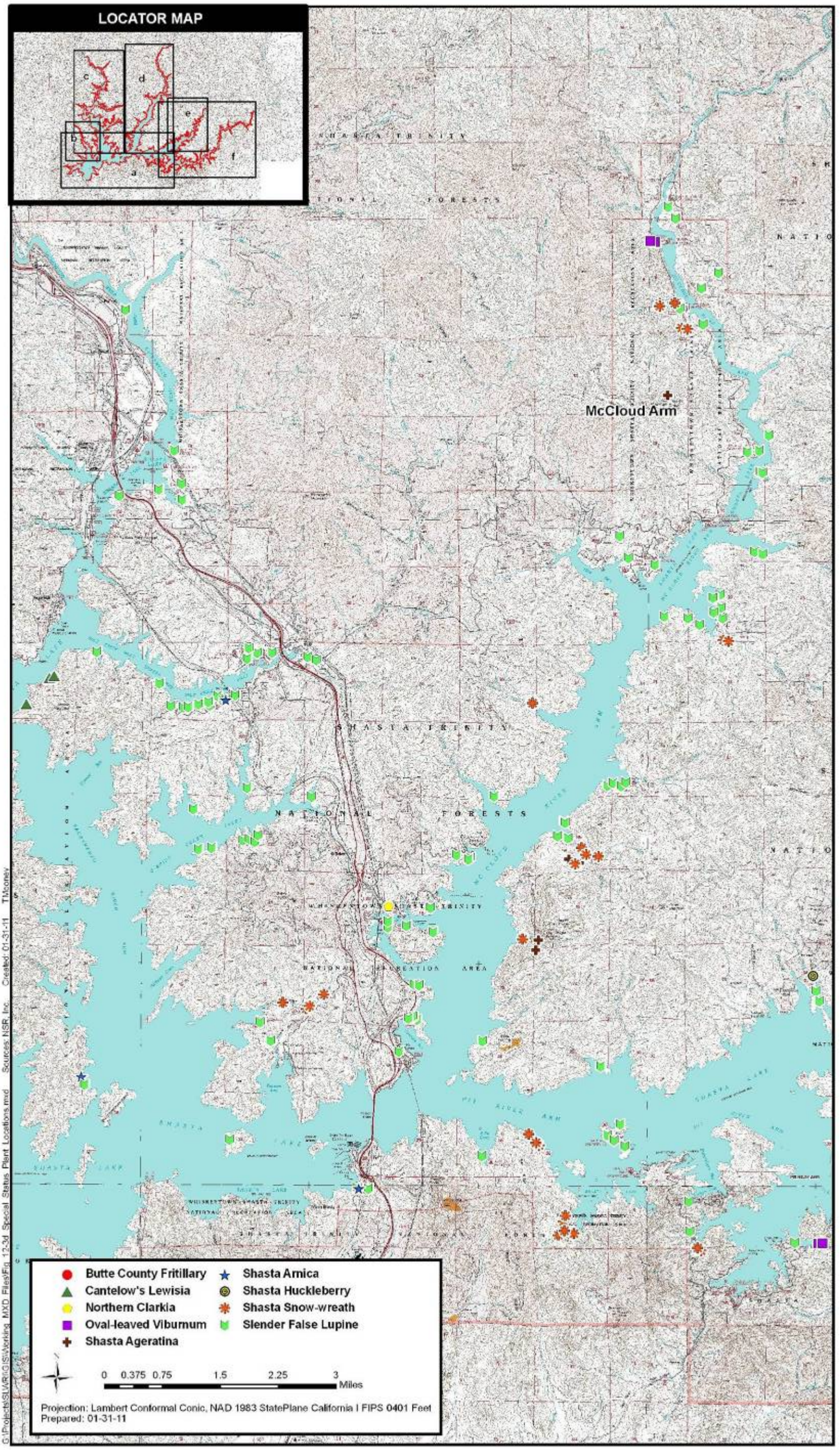


Figure 12-3d. Special-Status Plant Species Occurring in Shasta Lake and Vicinity

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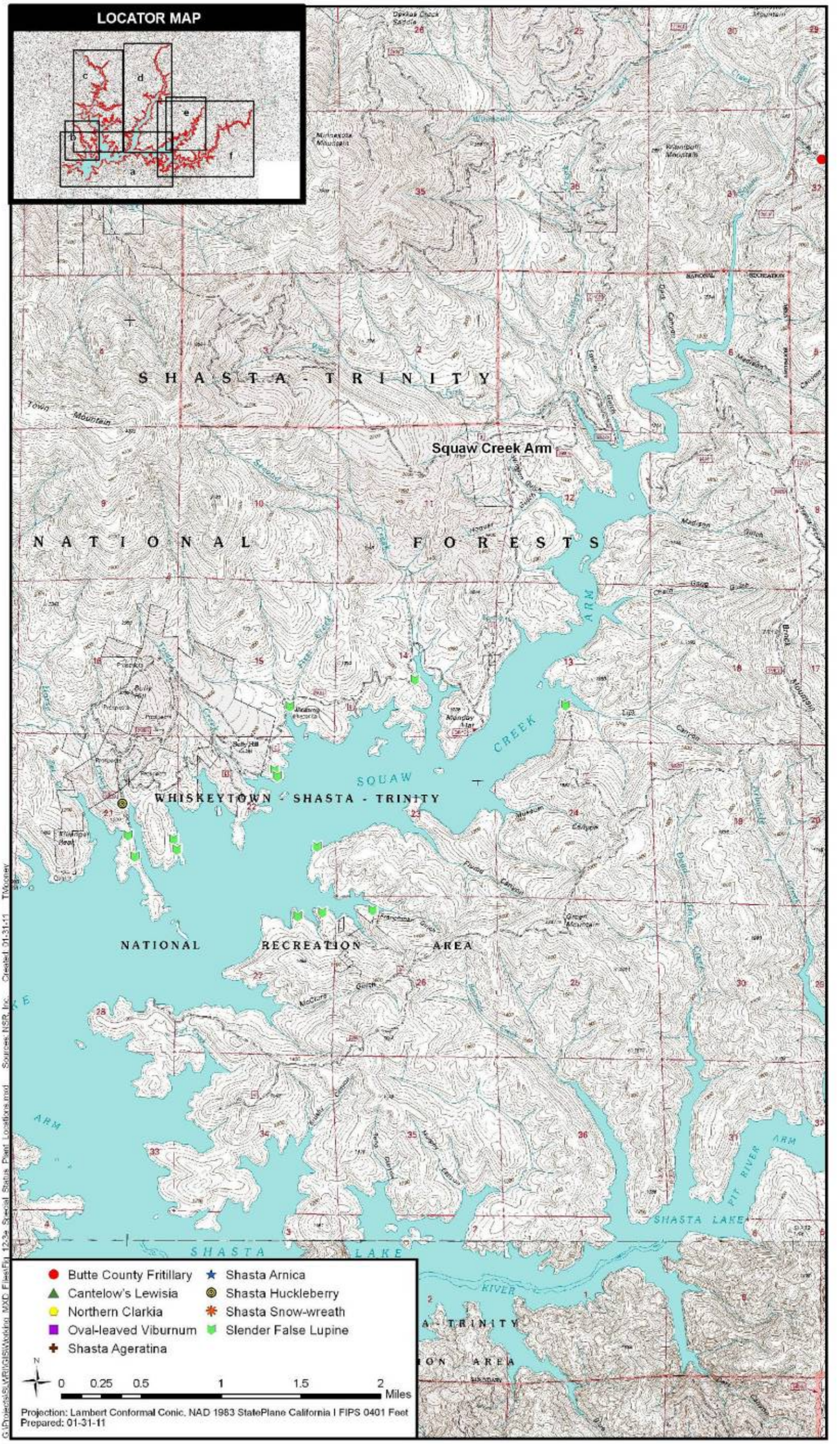


Figure 12-3e. Special-Status Plant Species Occurring in Shasta Lake and Vicinity

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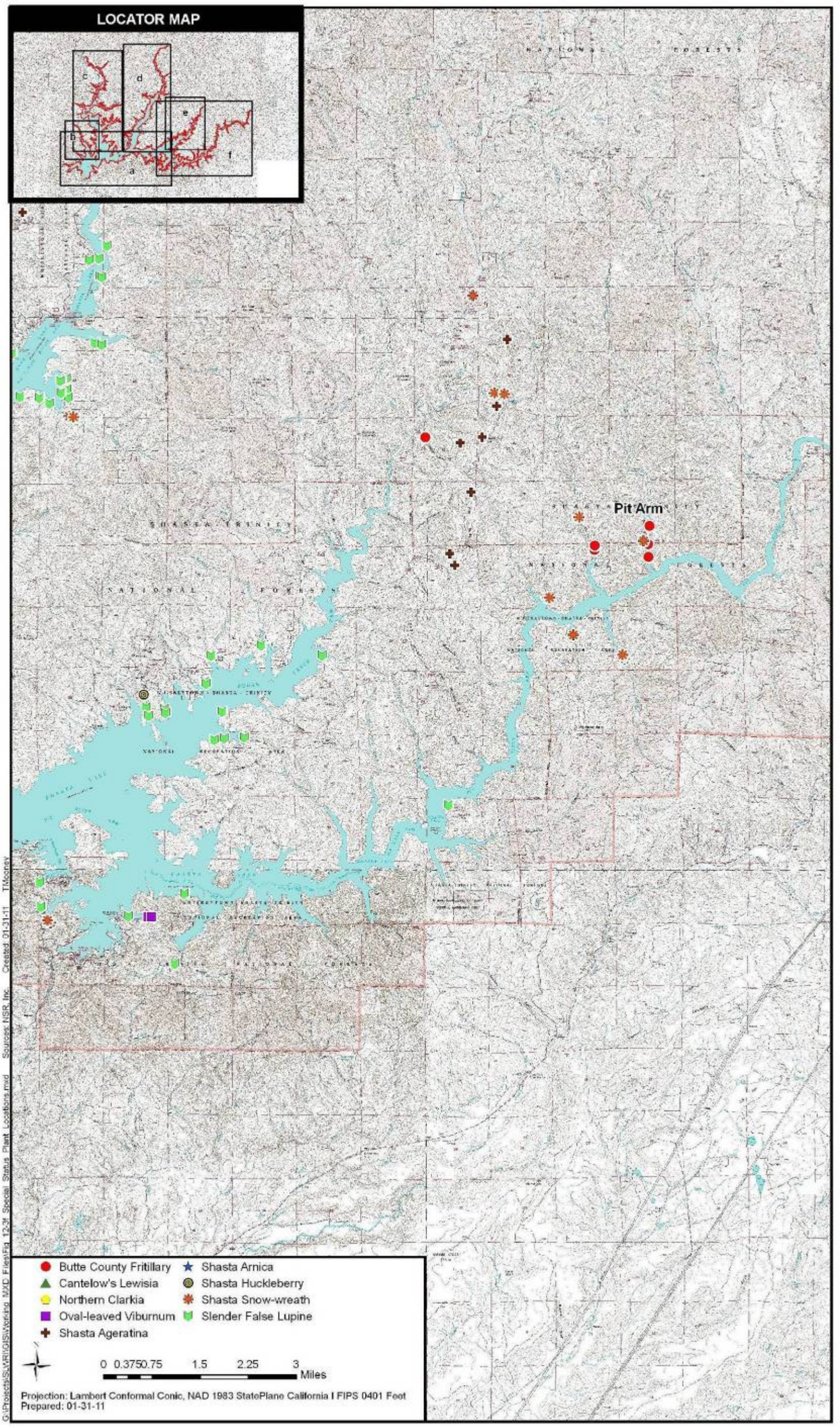


Figure 12-3f. Special-Status Plant Species Occurring in Shasta Lake and Vicinity

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Upper Sacramento River (Shasta Dam to Red Bluff)

Based on review of CNDDB and CNPS database searches, a USFWS list of species that could be potentially affected in this portion of the primary study area, and previously prepared biological reports for the area, 25 special-status plant species were identified as possibly occurring in the primary study area between Shasta Dam and RBDD, and thus their potential to occur in this portion of the study area was evaluated further. These special-status plant species, along with the legal status, habitat, and potential for occurrence of each species, are provided in Table 12-4.

Sixteen of the special-status plant species listed in Table 12-4 have the potential to occur within habitat present along the Sacramento River between Shasta Dam and RBDD. Many of these species, such as Bogg's Lake hedge hyssop (*Gratiola heterosepala*; State endangered, MSCS m, CNPS 1B), Ahart's dwarf rush (*Juncus leiospermus* var. *ahartii*; MSCS m, CNPS 1B), Ahart's paronychia (*Paronychia ahartii*; MSCS m, CNPS 1B), dwarf downingia (*Downingia pusilla*; CNPS 2), Greene's legenere (*Legenere limosa*; MSCS m, CNPS 1B), Henderson's bent grass (*Agrostis hendersonii*; MSCS m, CNPS 3), Red Bluff dwarf rush (*Juncus leiospermus* var. *leiospermus*; CNPS 1B), and slender Orcutt grass (*Orcuttia tenuis*; Federal endangered, state endangered, MSCS m, CNPS 1B), typically occur in vernal pools, which are generally not present within the active floodplain of regulated rivers in the extended study area. Other special-status plants, however, could occur in the extended study area in the freshwater marshes, swamps, and riparian woodlands that are found along the river corridor. These species include fox sedge (*Carex vulpinoidea*; CNPS 2), rose mallow (*Hibiscus lasiocarpus*; MSCS m, CNPS 2), and silky cryptantha (*Cryptantha crinita*; USFS SM, CNPS 1B). The remaining five species may occur in annual grassland, chaparral, cismontane woodland, and lower montane coniferous forest vegetation communities along the river corridor, including adobe-lily (*Fritillaria pluriflora*; MSCS m, CNPS 1B), Butte County fritillary (*Fritillaria eastwoodiae*; USFS S, CNPS 3), dubious pea (*Lathyrus sulphureus* var. *agillaceous*; CNPS 3), mountain lady's slipper (*Cypripedium fasciculatum*; USFS SM, CNPS 4), and oval-leaved viburnum (*Viburnum ellipticum*; CNPS 2).

Of the special-status species that could occur along the upper Sacramento River, four are known to occur along the edge of the Sacramento River channel, or along a Sacramento River tributary within 0.2 mile of the river proper, and their establishment and reproduction could potentially be affected by changes in flow regime: fox sedge, silky cryptantha, rose mallow, and Ahart's paronychia (CNDDB 2007, University of California 2011).

Table 12-4. Special-Status Plant Species Known or with Potential to Occur in the Primary Study Area, Along the Sacramento River from Shasta Dam to Red Bluff Diversion Dam

Species	Legal Status[1]					Habitat and Blooming Period	Potential for Occurrence
	USFWS	DFG	MSCS	USFS	CNPS		
Shasta ageratina *Ageratina shastensis*		–		E	4	Rocky carbonate outcrops in chaparral and lower montane coniferous forest; 1,300 – 5,900 feet elevation. Blooms June – October.	Could occur near Shasta Dam if suitable outcrops are present. Potential is low because most of the study area is below species' known elevation range.
Henderson's bent grass *Agrostis hendersonii*	–	–	m	–	3	Mesic sites in valley and foothill grassland, vernal pools; 230 – 1,000 feet elevation. Blooms April – May.	Could occur along the Sacramento River if suitable vernally mesic habitat is present.
Shasta County arnica *Arnica venosa*	–	–	–	E	4	Cismontane woodlands and lower montane coniferous forests, often in disturbed areas and roadcuts; 1,300 – 4,900 feet elevation. Blooms May – July.	Could occur along the Sacramento River and tributaries within the study area. Potential is low because most of the study area is below species' known elevation range.
Fox sedge *Carex vulpinoidea*	–	–	–	–	2	Freshwater marshes and swamps and riparian woodland; 100 – 4,000 feet elevation. Blooms May – June.	Could occur in suitable habitat along the Sacramento River.
Silky cryptantha *Cryptantha crinita*	–	–	m	–	1B	Gravelly streambeds within cismontane woodland, lower montane coniferous forest, riparian forest, riparian woodland, valley and foothill grassland; 275 – 4,000 feet elevation. Blooms April – May.	Could occur along the Sacramento River and tributaries within the study area.
Clustered lady's slipper *Cypripedium fasciculatum*	–	–	–	SM	4	Lower montane coniferous forest, North Coast coniferous forest; often in serpentinite seeps or on streambanks; 300 – 8,000 feet elevation. Blooms March – July.	Unlikely; no coniferous forest known in the study area.
Mountain lady's slipper *Cypripedium montanum*	–	–	–	SM	4	Broadleaved upland forest, cismontane woodland, lower montane coniferous forest, North Coast coniferous forest; 500 – 7,000 feet elevation. Blooms March – July.	Could occur at Shasta Dam or along the Sacramento River and tributaries.
Dwarf downingia *Downingia pusilla*	–	–	–	–	2	Mesic sites in valley and foothill grassland, vernal pools. Blooms March – May.	Could occur along the Sacramento River if suitable vernally mesic habitat is present.

Table 12-4. Special-Status Plant Species Known or with Potential to Occur in the Primary Study Area, Along the Sacramento River from Shasta Dam to Red Bluff Diversion Dam (contd.)

Species	Legal Status[1]					Habitat and Blooming Period	Potential for Occurrence
	USFWS	DFG	MSCS	USFS	CNPS		
Butte County fritillary *Fritillaria eastwoodiae*	–	–	–	S	3	Openings and sometime serpentine areas in chaparral, cismontane woodland, and lower montane coniferous forest; 160 – 4,900 feet elevation. Blooms March – June.	Could occur along the Sacramento River and tributaries within the study area.
Adobe-lily *Fritillaria pluriflora*	–	–	m	–	1B	Chaparral, cismontane woodland, valley and foothill grassland; often in adobe soils; 200 – 2,300 feet elevation. Blooms February – April.	Could occur at Shasta Dam and along the Sacramento River.
Bogg's Lake hedge hyssop *Gratiola heterosepala*	–	E	m	–	1B	Marshes and swamps, vernal pools; 30 – 8,000 feet elevation. Blooms April – August.	Could occur along the Sacramento River and tributaries.
Rose mallow *Hibiscus lasiocarpus*	–	–	m	–	2	Freshwater marshes and swamps.	Could occur along the Sacramento River and tributaries.
Ahart's dwarf rush *Juncus leiospermus* var. *ahartii*	–	–	m	–	1B	Mesic sites in valley and foothill grassland; 100 – 300 feet elevation. Blooms March – May.	Could occur along the Sacramento River if suitable vernally mesic habitat is present. Shasta Dam is higher than species' known elevation range.
Red Bluff dwarf rush *Juncus leiospermus* var. *leiospermus*	–	–	–	–	1B	Vernally mesic sites in chaparral, cismontane woodland, meadows and seeps, valley and foothill grassland, vernal pools; 100 –3,350 feet elevation. Blooms March – May.	Could occur at Shasta Dam or along the Sacramento River if suitable vernally mesic habitat is present.
Dubious pea *Lathyrus sulphureus* var. *argillaceous*	–	–	–	–	3	Cismontane woodland, lower montane coniferous forest, upper montane coniferous forest; 500 – 1,000 feet elevation. Blooms in April.	Could occur at Shasta Dam and along the Sacramento River.
Greene's legenere *Legenere limosa*	–	–	m	–	1B	Vernal pools; 1 – 3,000 feet elevation. Blooms April – June.	Could occur along Sacramento River if suitable vernal pool habitat is present.

Table 12-4. Special-Status Plant Species Known or with Potential to Occur in the Primary Study Area, Along the Sacramento River from Shasta Dam to Red Bluff Diversion Dam (contd.)

Species	Legal Status[1]					Habitat and Blooming Period	Potential for Occurrence
	USFWS	DFG	MSCS	USFS	CNPS		
Cantelow's lewisia *Lewisia cantelovii*	–	–	–	S	1B	Mesic granitic sites within broadleaved upland forest, chaparral, cismontane woodland, and lower montane coniferous forest; 1,250 – 4,500 feet. Sometimes in serpentinite seeps. Blooms May – October.	Could occur in the Shasta Dam area. The remainder of the study area is below species' known elevation range.
Bellinger's meadowfoam *Limnanthes floccosa* ssp. *bellingeriana*	–	–	m	–	1B	Mesic sites in cismontane woodland, meadows and seeps; 950 – 3,600 feet elevation. Blooms April – June.	Could occur at Shasta Dam. Potential along Sacramento River is low because majority of study area is below species known elevation range.
Shasta snow wreath *Neviusia cliftonii*	–	–	m	S	1B	Carbonate substrates in lower montane coniferous forest and riparian woodland; 1,000 – 1,600 feet elevation. Blooms May – June.	Could occur in Shasta Dam area. Unlikely to occur along Sacramento River because study area is lower than species known elevation range.
Slender orcutt grass *Orcuttia tenuis*	E	E	m	–	1B	Vernal pools; 100 – 6,000 feet elevation. Blooms May – October.	Could occur along the Sacramento River if suitable vernal pool habitat is present. Federally designated critical habitat for this species occurs east of the Sacramento River, east of Cottonwood (Units 3A and 3B) and northeast of Anderson (Units 2C and 2D).
Ahart's paronychia *Paronychia ahartii*	–	–	m	–	1B	Cismontane woodland, valley and foothill grassland, vernal pools; 100 – 1,700 feet elevation. Blooms March – June.	Could occur at Shasta Dam and along the Sacramento River.
Pacific fuzzwort *Ptilidium californicum*	–	–	–	SM	–	An epiphytic on bark at the base of standing mature to old-growth trees or recently fallen logs; rarely on other organic substrates such as decaying logs and stumps, or humus covering boulders; 1,275 – 5,725 feet elevation.	Could occur along the Sacramento River and tributaries within the study area. Potential is low because most of the study area is below species' known elevation range.

Table 12-4. Special-Status Plant Species Known or with Potential to Occur in the Primary Study Area, Along the Sacramento River from Shasta Dam to Red Bluff Diversion Dam (contd.)

Species	Legal Status[1]					Habitat and Blooming Period	Potential for Occurrence
	USFWS	DFG	MSCS	USFS	CNPS		
Canyon Creek stonecrop *Sedum paradisum*	–	–	–	S	1B	Granitic, rocky areas in broadleafed upland forest, chaparral, lower montane coniferous forest, subalpine coniferous forest; 980 – 6,100 feet elevation. Blooms May – June.	Could occur along the Sacramento River and tributaries within the study area. Potential is low because most of the study area is below species' known elevation range.
English Peak greenbriar *Smilax jamesii*	–	–	m	S	1B	Found along streambanks and lake margins in broadleafed upland forest, lower montane, upper montane, and north coast coniferous forests, and marshes and swamps; 1,600 – 8,200 feet elevation. Blooms May – July, rarely through August.	Could occur along the Sacramento River and tributaries within the study area. Potential is low because most of the study area is below species' known elevation range.
Oval-leaved viburnum *Viburnum ellipticum*	–	–	–	–	2	Chaparral, cismontane woodland, lower montane coniferous forest; 800 – 4,600 feet elevation. Blooms May – June.	Could occur at Shasta Dam and along the Sacramento River.

Sources: CNDDB 2007, CNPS 2011, USFS 2007, USFWS 2007

Notes:

[1] Legal Status

U.S. Fish and Wildlife Service Federal Listing Categories:

T	Threatened
E	Endangered

U.S. Forest Service Listing Categories:

E	Endemic to specific region or National Forest
S	Sensitive
SM	Species considered rare or threatened and recommended for survey and management per Northwest Forest Plan 2002

MSCS (Multi-Species Conservation Strategy) Listing Categories:

R	recovery
r	contribute to recovery
m	maintain

California Department of Fish and Game State Listing Categories:

R	California Rare
T	California Threatened
E	California Endangered

California Native Plant Society Listing Categories:

1B	Plants rare, threatened, or endangered in California and elsewhere
2	Plants rare, threatened, or endangered in California but more common elsewhere
3	Plants for which more information is needed—a review list
4	Plants of limited distribution—a watch list

Lower Sacramento River and Delta

Most of the special-status plant species listed in Table 12-4 have the potential to occur within the extended study area (lower Sacramento River and Delta and CVP/SWP service areas). Numerous additional special-status plant species could occur in the extended study area. Attachment 4 of the *Botanical Resources and Wetlands Technical Report* contains comprehensive lists of all sensitive plant species in the extended study area that have been reported to the

CNDDB, or that otherwise have the potential to occur in the extended study area.

A number of special-status plant species could be affected in the lower Sacramento River and Delta by changes in hydrology (CALFED 2000c). These include species associated with vernal pool, riparian, marsh, and aquatic plant communities; and several other species with restricted distributions on or near channel banks, active floodplains, flood bypasses, and Delta waterways. These assemblages of special-status species are described below.

Species of Vernal Pool Communities In addition to species that are potentially present in the primary study area (Table 12-4), special-status plant species that may be associated with vernal pools along the lower Sacramento River and in the Delta region include alkali milk-vetch (*Astragalus tener* var. *tener*; MSCS r, CNPS 1B), brittlescale (*Atriplex depressa*; MSCS m, CNPS 1B), Hoover's spurge (*Chamaesyce hooveri*; Federal threatened, MSCS m, CNPS 1B), Contra Costa goldfields (*Lasthenia conjugens*; Federal endangered, MSCS m, CNPS 1B), hairy orcutt grass (*Orcuttia pilosa*; Federal endangered, MSCS m, CNPS 1B), slender Orcutt grass (*Orcuttia tenuis*; Federal threatened, MSCS m, CNPS 1B), bearded popcornflower (*Plagoibothrys hystriculus*; CNPS 1B), Delta woolly-marbles (*Psilocarphus brevissimus* var. *multiflorus*; CNPS 4), Crampton's tuctoria (*Tuctoria mucronata*; Federal and State endangered, MSCS r, CNPS 1B), and Greene's tuctoria (*Tuctoria greenei*; Federal endangered, MSCS m, CNPS 1B). The primary threats affecting most of these species at multiple locations are habitat loss because of development, nonnative species, and incompatible grazing practices. Additional threats affecting some of these species at one or more location include game management practices (e.g., inundation of land for waterfowl during the growing season), off-road vehicle use and trampling, incompatible agricultural practices, and hydrological alterations.

Species of Riparian and Marsh Communities In addition to species considered potentially present in the primary study area (Table 12-4 of the *Botanical Resources and Wetlands Technical Report*), special-status plant species associated with riparian and marsh communities along the lower Sacramento River or in the Delta region include bristly sedge (*Carex comosa*; MSCS r, CNPS 2), Suisun thistle (*Cirsium hydrophilum* var. *hydrophilum*; Federal endangered, MSCS R, CNPS 1B), Soft bird's-beak (*Cordylanthus mollis* ssp. *mollis*; Federal endangered, State rare, MSCS R, CNPS 1B), Delta button-celery (*Eryngium racemosum*; MSCS r, CNPS 1B), Northern California black walnut (*Juglans hindsii*; MSCS r, CNPS 1B), Delta tule pea (*Lathyrus jepsonii* var. *jepsonii*; MSCS r, CNPS 1B), Mason's lilaeopsis (*Lilaeopsis masonii*; MSCS R, CNPS 1B), Delta mudwort (*Limosella subulata*; MSCS r, CNPS 2), Sanford's arrowhead (*Sagittaria sanfordii*; MSCS m, CNPS 1B), Marsh skullcap (*Scutellaria galericulata*; MSCS m, CNPS 2), blue skullcap (*Scutellaria lateriflora*; MSCS m, CNPS 2), and Suisun Marsh aster (*Symphytotrichum lentum*; CNPS 1B) (CNDDB 2007, CNPS 2011). The

primary threats affecting these species are habitat loss, competition from nonnative species, and alterations to hydrology (including trenching and diking). Additional threats include grazing and trampling, installation of riprap, and anthropogenic disturbances (e.g., off-road vehicles; road, utility, and levee maintenance).

Species of Aquatic Communities Eel-grass pondweed (P*otamogeton zosteriformis*; MSCS m, CNPS 2), a submerged aquatic plant of assorted freshwater habitats is rare in California but more common elsewhere (CNPS 2011). Overall, the distribution, abundance, and threats affecting this species in California are not well known.

CVP/SWP Service Areas

Special-status plants are not likely to occur in a substantial portion of the CVP and SWP service areas because the agricultural and urban land uses tend to preclude suitable habitat for most native species. Although agricultural and developed land uses account for most of the CVP and SWP service areas, a portion of these areas still remains in natural vegetation, Because of the large size of the CVP and SWP service areas, this natural vegetation is distributed over a wide range of climate and soils, and is varied in structure and species composition. Consequently, a large number of special-status plant species has the potential to occur in the natural vegetation that remains within the CVP and SWP service areas. (See the *Botanical Resources and Wetlands Technical Report*.)

12.1.3 Invasive Species

Shasta Lake and Vicinity

Nonnative plant species introduced to the region by early settlers are of concern in the Shasta Lake and vicinity portion of the study area. When plants that evolved in one region of the globe are moved by humans to another region, a few flourish, crowding out native vegetation and wildlife that feed on the native species. Some invasive plants can even change ecosystem processes such as hydrology, fire regimes, and soil chemistry. These invasive plants have a competitive advantage because they are no longer controlled by their natural predators and can quickly spread. In California, approximately 3 percent of the plant species growing in the wild are considered invasive, but they inhabit a much greater proportion of the landscape (Cal-IPC 2007).

Plant pests are defined by law, regulation, and technical organizations, and are regulated by many different bodies, including the California Department of Food and Agriculture (CDFA), U.S. Department of Agriculture, and the California Invasive Plant Council (Cal-IPC). CDFA uses an action-oriented pest-rating system. The low rating assigned to a pest by CDFA does not necessarily mean that the pest is not a problem; rather, the rating system is meant to prioritize response by CDFA and county agricultural commissioners. Plants on CDFA's highest priority "A" list are defined as plants "of known

economic importance subject to state-county enforced action involving eradication, quarantine regulation, containment, rejection or other holding action."

Cal-IPC has developed a list of plant pests specific to California wildlands. The Cal-IPC list is based on information submitted by land managers, botanists, and researchers throughout the state and on published sources. To determine plant pests potentially occurring in the Shasta Lake and vicinity portion of the primary study area, this list was reviewed and local agencies (BLM, USFS, California Department of Transportation, and Shasta County Department of Agriculture) were contacted to gather knowledge of known weed locations (Table 12-5). Incidental observations of noxious weeds by NSR biologists and botanists were also recorded. Attachment 5 describes each weed source location, the potential mode of spread, and the risk of spread at each of the known sites.

Management actions have been required to prevent the loss of habitat caused by some of the more invasive exotic species that outcompete native vegetation. However, these management actions have been limited and have been confined primarily to areas adjacent to campgrounds and USFS facilities.

Table 12-5. Nonnative Plant Species Known to Occur in the Shasta Lake and Vicinity Portion of the Primary Study Area

Common Name	Scientific Name	Cal-IPC Rating[1]	CDFA Ranking[2]	Habitat
Tree of heaven	Ailanthus altissima	Moderate	None	Grassland, oak woodland, riparian
Slender wild oats	Avena barbata	Moderate	None	Coastal scrub, grassland, oak woodland, forest
Common wild oats	Avena fatua	Moderate	None	Coastal scrub, grassland, oak woodland, forest
Rattlesnake grass	Briza maxima	Limited	None	Grassland
Ripgut brome	Bromus diandrus	Moderate	None	Dunes, scrub, grassland, woodland, forest
Soft brome	Bromus hordeaceus	Limited	None	Grassland, sage brush, serpentine soils
Red brome	Bromus madritensis ssp. rubens	High	None	Interior scrub, woodlands, grassland
Cheatgrass	Bromus tectorum	High	None	Interior scrub, woodlands, grassland
Lenspod whitetip	Cardaria chalapensis	Moderate-ALERT	B	Central Valley wetlands
Italian thistle	Carduus pycnocephalus	Moderate	None	Forest, scrub, grasslands, woodlands.

Table 12-5. Nonnative Plant Species Known to Occur in the Shasta Lake and Vicinity Portion of the Primary Study Area (contd.)

Common Name	Scientific Name	Cal-IPC Rating[1]	CDFA Ranking[2]	Habitat
White knapweed	Centaurea diffusa	Moderate	A	Great Basin scrub, coastal prairie
Spotted knapweed	Centaurea maculosa	High	A	Riparian, grassland, wet meadows, forests
Yellow star-thistle	Centaurea solstitialis	High	C	Grassland, woodlands, occasionally riparian
Squarrose knapweed	Centaurea virgata var. squarrosa	Moderate	A	Scrub, grassland, pinyon-juniper woodland
Rush skeleton weed	Chondrilla juncea	Moderate	A	Grassland
Canada thistle	Cirsium arvense	Moderate	B	Grassland, riparian areas, forests
Bull thistle	Cirsium vulgare	Moderate	None	Riparian areas, marshes, meadows
Field bindweed	Convolvulus arvensis	Evaluated, not listed	C	Agricultural weed
Bermuda grass	Cynodon dactylon	Moderate	C	Riparian scrub, common landscape weed
Scotch broom	Cystis scoparius	High	C	Coastal scrub, oak woodland
Longbeak stork's bill	Erodium botrys	Evaluated, not listed	None	Many upland habitats
Redstem stork's bill	Erodium cicutarium	Limited	None	Many upland habitats
Leafy spurge	Euphorbia esula	High-ALERT	A	Forests, woodlands, juniper forests
Fig	Ficus carica	Moderate	None	Riparian woodland
Fennel	Foeniculum vulgare	High	None	Grassland, scrub
French broom	Genista mospessulana	High	C	Coastal scrub, oak woodland, grassland
English ivy	Hedera helix	High	None	Coastal forest, riparian areas
Mediterranean barley, foxtail	Hordeum marinum, H. murinum	Moderate	None	Grassland
Common St. John's wort	Hypericum perforatum	Moderate	C	Many habitats, disturbed
Dyer's woad, Marlahan mustard	Isatis tinctoria	Moderate	B	Great Basin scrub and grassland
Dalmation toadflax	Linaria dalmatica	Moderate	A	Grassland, forest clearings
Italian ryegrass	Lolium multiflorum	Moderate	None	Grassland, oak woodlands, pinyon-juniper woodland
Oleander	Nerium oleander	Evaluated, not listed	None	Riparian areas
Pokeweed	Phytolacca americana	None	None	Riparian forest, riparian woodland

Table 12-5. Nonnative Plant Species Known to Occur in the Shasta Lake and Vicinity Portion of the Primary Study Area (contd.)

Common Name	Scientific Name	Cal-IPC Rating[1]	CDFA Ranking[2]	Habitat
Black locust	Robinia pseudoacacia	Limited	None	Riparian areas, canyons
Himalayan blackberry	Rubus discolor	High	None	Riparian areas, marshes, oak woodlands
Cutleaf blackberry	Rubus laciniatus	None	None	Riparian areas, marshes, oak woodlands
Curly dock	Rumex crispus	Limited	None	Grassland, vernal pools, meadows, riparian
Tansy ragwort	Senecio jacobaea	Limited	B	Grassland, riparian
Johnsongrass	Sorghum halepense	None	C	Disturbed sites, moist places
Spanish broom	Spartium junceum	High	None	Coastal scrub, grassland, wetlands, oak woodland, forests
Medusa-head	Taeniatherum caput-medusae	High	C	Grassland, scrub, woodland
Spreading hedgeparsley	Torilis arvensis	Moderate	None	Widespread
Common mullein	Verbascum thapsus	Limited	None	Meadows, riparian, sagebrush, pinyon-juniper woodland
Periwinkle	Vinca major	Moderate	None	Riparian, oak woodlands, coastal scrub
Rat-tail fescue	Vulpia myuros	Moderate	None	Coastal sage scrub, chaparral

Notes:

[1] Cal-IPC Inventory Categories:

- High — Severe ecological impacts on physical processes, plant and animal communities, and vegetation structure. Reproductive biology and other attributes are conducive to moderate to high rates of dispersal and establishment. Widely distributed ecologically.
- Moderate — Substantial and apparent ecological impacts on physical processes, plant and animal communities, and vegetation structure. Reproductive biology and other attributes are conducive to moderate to high rates of dispersal, although generally dependent on ecological disturbance. Ecological amplitude and distribution may range from limited to widespread.
- Limited — Invasive but ecological impacts are minor. Reproductive biology and other attributes result in moderate rates of invasiveness. Ecological amplitude and distribution are generally limited, but may be locally persistent and problematic (Cal-IPC 2007).

[2] CDFA Pest Ratings of Noxious Weed Species and Noxious Weed Seed

A – Eradication, containment, rejection, or other holding action at the state-county level.

B – Intensive control or eradication, where feasible, at the county level.

C – Control or eradication as local conditions warrant, at the county level.

Q – Rating as "A" is pending at the state or county level.

Key:

Cal-IPC = California Invasive Plant Council

CDFA = California Department of Food and Agriculture

Upper Sacramento River (Shasta Dam to Red Bluff) and Lower Sacramento River and Delta

A number of nonnative species have been introduced and become abundant in the riparian areas and marshes (fresh emergent wetlands) of the Sacramento Valley and Delta (Hunter et al. 2003). Several of these invasive nonnatives, including red sesbania (*Sesbania punicea*), Himalayan blackberry (*Rubus discolor*), giant reed (*Arundo donax*), and perennial pepperweed (*Lepidium latifolium*), form dense, monotypic stands that preclude the establishment of native species (Bossard et al. 2000). In general, these species displace native plants, reduce biodiversity, alter river flows, and reduce wildlife habitat values. Table 12-6 lists the most problematic of those species in Sacramento Valley and Delta riparian areas and marshes—invasive species rated "high" by Cal-IPC; these species have severe ecological impacts on physical processes, plant and animal communities, and vegetation structure (Cal-IPC 2006).

Table 12-6. Cal-IPC High-Rated Invasive Plants of Sacramento Valley and Delta Riparian and Marsh Habitats

Scientific Name Common Name	Cal-IPC Rating	Primary Riparian/ Marsh Habitat(s)	Plant Type
Arundo donax Giant Reed	H	Riparian Forest/Scrub	Perennial Grass
Cortaderia selloana Pampas Grass	H	Riparian Scrub	Perennial Grass
Foeniculum vulgare Fennel	H	Riparian Scrub	Perennial Herb
Lepidium latifolium Perennial Pepperweed	H	Tidal and Nontidal Marsh, Riparian Scrub	Perennial Herb
Lythrum salicaria Purple Loosestrife	H	Tidal And Nontidal Marsh	Perennial Herb
Rubus armeniacus (= R. discolor) Himalayan Blackberry	H	Riparian Forest and Scrub, Nontidal Marsh	Vine
Sesbania punicea Red Sesbania	H, A	Riparian Forest and Scrub	Tree
Tamarix chinensis, T. gallica, T. parviflora, T. ramosissima Chinese Tamarisk, French Tamarisk, Small Flower Tamarisk, Salt Cedar	H	Riparian Forest and Scrub	Tree, Shrub

Source: Cal-IPC 2006

Notes:

Cal-IPC Inventory Ratings:

A = Alert – Plants with the potential to spread explosively; infestations currently small and localized.

H = High – These species have severe ecological impacts on physical processes, plant and animal communities, and vegetation structure. Their reproductive biology and other attributes are conducive to moderate to high rates of dispersal and establishment. Most are widely distributed ecologically.

12.1.4 Waters of the United States, Including Wetlands, in Shasta Lake and Vicinity

NSR delineated waters of the United States (wetlands and other waters under Federal jurisdiction) in the impoundment area around the perimeter of Shasta Lake, and on public lands in the relocation areas. Cumulatively, 29,992 acres of Federal jurisdictional waters of the United States occur along the impoundment area, including Shasta Lake at full pool. Wetlands, totaling 25 acres, consist of fresh emergent/riparian wetland, intermittent swale, riparian wetland, seasonal wetland, seep/spring wetland, and vegetated ditch. Other waters, totaling 29,967 acres consist of ephemeral, intermittent, and perennial streams, roadside ditches, seep/spring other waters and lacustrine. Some demolition and construction activities associated with the impoundment area and relocation areas will extend into Shasta Lake below the existing full pool elevation. Therefore, the acreage of the surface of Shasta Lake has been included with the acreage of waters of the United States for the impoundment area. Acreage totals for relocation areas will be provided in the FEIS.

The delineation was conducted in accordance with the routine onsite method identified in the *Corps of Engineers Wetlands Delineation Manual* (Environmental Laboratory 1987) (Corps Manual) and the *Interim Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Arid West Region* (USACE 2006) (Arid West Manual). Each on site wetland determination was based on field observations of soil, vegetation, and hydrologic characteristics. Delineation of "other waters" was based on the presence of an ordinary high-water mark (OHWM) and whether the feature is tributary to waters of the United States. Data points were characterized and documented for 10 percent of all feature types along the perimeter of Shasta Lake. In each relocation area, at least one pair of data points was recorded for each feature type. Soil pits were dug to a depth sufficient to document the presence or confirm the absence of hydric soil or hydrology indicators. Indicator status of wetland plants was determined using the *National List of Plant Species That Occur in Wetlands: California Region 0* (Reed 1988). Positive indicators of hydric soils were observed in the field in accordance with the criteria outlined in *Field Indicators of Hydric Soils in the United States* (NRCS 2006). The hydric status of each soil map unit located in the study area was reviewed using the *Web Soil Survey* (Soil Survey Staff 2010). Indicators of depth and duration of soil saturation, ponding, and drainage patterns and the OHWM were observed in the field. The boundaries of each wetland feature and the three-parameter data points were mapped using rectified color aerial photography. A Trimble Pathfinder Pro XH Global Positioning System capable of sub-foot accuracy was primarily used to delineate features in the relocation areas.

The fieldwork for the impoundment area was conducted in 2004, 2006, and 2010. Along the McCloud Arm, the impoundment area extends beyond the McCloud River Bridge. Fieldwork will be completed in this area during the spring/summer of 2011. The fieldwork in the relocation areas was completed in

early January 2011 and is currently being processed. These data will be provided in the FEIS.

Main Body

The wetland delineation of the impoundment area along the Main Body was conducted from January to April 2010. Delineated waters of the United States consisted of wetlands (seep/spring and riparian wetland, and vegetated ditch) and other waters (ephemeral, intermittent, and perennial streams, seep/spring other waters, and roadside ditch). Table 12-7 specifies the acres of each of the types of jurisdictional waters that occur in the impoundment area.

Table 12-7. Jurisdictional Waters in the Impoundment Area

Jurisdictional Water Type	Area (Acres)					
	Main Body	Big Backbone Arm	Sacramento Arm	McCloud Arm	Squaw Creek Arm	Pit Arm
Wetlands						
Fresh emergent/ riparian wetland	0.00	0.00	3.14	0.00	0.00	0.00
Intermittent swale	0.00	0.002	0.00	0.00	0.00	0.04
Riparian wetland	1.16	1.71	5.42	8.26	1.48	0.82
Seasonal wetland	0.00	0.00	0.18	0.00	0.14	0.02
Seep/spring wetland	0.77	0.23	0.80	0.31	0.13	0.41
Vegetated ditch	0.13	0.00	0.00	0.02	0.00	0.00
Total Wetlands	2.06	1.94	9.54	8.59	1.75	1.29
Other Waters of the United States						
Ephemeral stream	0.28	0.02	0.54	0.26	0.12	0.13
Intermittent stream	1.42	0.25	2.06	0.94	0.8	2.61
Perennial stream	1.53	3.00	8.67	20.27	2.29	1.46
Roadside ditch	0.00	0.00	0.02	0.00	0.00	0.00
Seep/spring other waters	0.03	0.00	0.001	0.01	0.00	0.00
Lacustrine	10,196.88	1,014.12	7,225.14	5,032.68	2,081.60	4,372.80
Total Other Waters	10,200.14	1,017.39	7,236.43	5,054.16	2,084.09	4,375.00
Total Waters of the U.S.	10,202.20	1,019.33	7,245.97	5,062.75	2,085.84	4,376.29

Note:
* Acreage values are approximate

Big Backbone Arm

The wetland delineation along the Big Backbone Arm was conducted during November 2006. Delineated waters of the United States consisted of wetlands

(seep/spring and riparian wetlands) and other waters (ephemeral, intermittent, and perennial streams). Table 12-7 specifies the acres of each of the types of jurisdictional waters occurring along the Big Backbone Arm.

Sacramento Arm

The wetland delineation along the Sacramento Arm was conducted primarily from September through early December 2010 and intermittently in March, April, and June 2010. Delineated waters of the United States consisted of wetlands (seep/spring, riparian, seasonal, and riparian/fresh emergent wetlands) and other waters (ephemeral, intermittent, and perennial streams, seep/spring other waters, and roadside ditch). Table 12-7 specifies the acres of each of the types of jurisdictional waters occurring along the Sacramento Arm.

McCloud Arm

The wetland delineation along the McCloud Arm was conducted primarily during December 2009 and then intermittently in April, June, and November 2010. Delineated waters of the United States consisted of wetlands (seep/spring and riparian wetlands, and vegetated ditch) and other waters (ephemeral, intermittent, and perennial streams, and seep/spring other waters). Table 12-7 specifies the acres of each of the types of jurisdictional waters occurring along the McCloud Arm.

Squaw Creek Arm

The wetland delineation along the Squaw Creek Arm was conducted from late August through September 2004. Delineated waters of the United States include wetlands (seep/spring, riparian wetlands, and seasonal wet meadow) and other waters (ephemeral, intermittent, perennial streams, and seep/spring other waters). Table 12-7 specifies the acres of each of the types of jurisdictional waters occurring along the Squaw Creek Arm.

Pit Arm

The wetland delineation along the Pit Arm was conducted from late November 2006 through April 2007. Delineated waters of the United States consisted of wetlands (riparian, seep/spring, seasonal wetlands, and intermittent swale) and other waters (ephemeral, intermittent, and perennial streams). Table 12-7 specifies the acres of each of the types of jurisdictional waters occurring along the Pit Arm.

Characterization of Features

Wetlands mapped in the Shasta Lake and vicinity portion of the primary study area include fresh emergent/riparian wetland, intermittent swale, riparian wetland, seasonal wetland, seep/spring wetland, and vegetated ditch. The jurisdictional limit of each feature was delineated where all three wetland parameters (wetland vegetation, soils, and hydrology) were met.

One fresh emergent riparian wetland occurs along the Sacramento Arm at the confluence of Salt Creek and Shasta Lake. The Interstate 5 crossing coupled

with USFS attempts to develop the area for recreation has impounded the flows of Salt Creek, resulting in the development of fresh emergent riparian wetlands. Depending on water depths, wooded riparian areas and fresh emergent vegetation have established throughout the feature.

Dominant overstory species include Goodding's black willow (OBL[1]), arroyo willow (FACW), red willow (assume FACW), and shining willow (OBL). Fresh emergent species include pennyroyal (*Mentha pulegium*–OBL), willow dock (*Rumex salicifolius*–OBL), and broadleaf cattail (*Typha latifolia*). Inundation was observed during the field visit on December 16, 2010. Wetland hydrology and hydric soil criteria were met through evidence of frequent flooding, including sediment deposits, watermarks, drift lines, and drainage patterns.

Intermittent swales occur along the Big Backbone and Pit arms. Intermittent swales are characterized as linear, or somewhat linear, drainage features lacking evidence of scour, but where wetland plant species have established as a result of soil saturation. Typical species occurring in this feature include monkey flower (*Mimulus guttatus*–OBL), spiny fruit buttercup (*Ranunculus muricatus*–FACW), slender rush (*Juncus tenuis*–FACW), and centaury (*Centaurium venustum*–NL).

Riparian wetlands generally occur as "stringers," or narrow features found only immediately adjacent to intermittent or perennial streams throughout the primary study area. Typical species found in riparian wetlands in the study area include arroyo willow (FACW), Goodding's black willow (OBL), white alder (FACW), Oregon ash (FACW), Indian rhubarb (*Darmera peltata*-NL), mugwort (*Artemesia douglasiana*-FACW), California wild grape (FACW), and Himalayan blackberry (FACW). Wetland hydrology and hydric soil criteria are met through evidence of frequent flooding, including sediment deposits, watermarks, drift lines, and drainage patterns.

The seasonal wetlands occurring along the Sacramento, Squaw Creek, and Pit arms are influenced by adjacent water features or are depressions that frequently pond. Plant species found in these features include slender rush (FACW), sword leaf rush (*Juncus ensifolius*–FACW), monkey flower (OBL), yampah (*Perideridia californica*–FACW), annual checker bloom (*Sidalcea calycosa*–OBL), little quaking grass (*Briza minor*–FACW), California oatgrass (*Danthonia californica*–FACW), and spiny fruit buttercup (FACW). Wetland hydrology and soils criteria are met through evidence of long-duration saturation, including saturation in the upper 12 inches, aquic moisture regime, and drainage patterns.

[1] OBL = Obligate Wetland Plants—Estimated probability of occurring in wetland >99 percent.
FACW = Facultative Wetland Plants—Estimated probability of occurring in wetland >67 percent to 99 percent.
FAC = Facultative Plants—Estimated probability of occurring in wetland 33 percent to 67 percent.
FACU = Facultative Upland Plants—Estimated probability of occurring in wetland 1 percent to <33 percent.
UPL = Obligate Upland Plants—Estimated probability of occurring in wetland <1 percent.
NI = No Indicator—Plants for which insufficient information was available to determine an indicator status.
NL = Not listed—Plants not listed in Reed 1988.

Seep/spring wetlands are found throughout the primary study area; they form when groundwater flows out of the ground where the aquifer meets the ground surface. Hydrophytic vegetation colonizes the area where water is provided by the seep/spring. Typical species in these features include white alder (FACW), chain fern (*Woodwardia fimbriata*–FACW), goat's beard (*Aruncus dioicus*–FACW), Indian rhubarb (NL), monkey flower (*Mimulus guttatus*–OBL), horsetail (*Equisetum arvense* –FAC), red stem dogwood (*Cornus stolonifera*–FACW), spicebush (NL), Himalayan blackberry (FACW), and western azalea (FAC). The criteria for wetland hydrology and soils are met through evidence of long-duration saturation, including inundation, saturation in the upper 12 inches, watermarks, and drainage patterns.

There are few vegetated ditches in the Shasta Lake and vicinity area; they occur only along the Main Body and the McCloud Arm, and in relocation areas. Vegetated ditches are ditches that have been excavated to drain adjacent uplands, parking areas, roads, or railways. Because the gradients of these features are so slight, pooling and/or saturation occurs, allowing hydrophytic vegetation to colonize. Dominant plant species include nutsedge (*Cyperus eragrostis*-FACW), seep monkey flower (OBL), broadlead cattail, and rush (*Juncus* sp.-assume FACW). Wetland hydrology criteria were met through the observation of surface water on March 19, 2010, and a thin muck surface indicating long-duration inundation. Hydric soil criteria were met through the observation of inundation and 1 centimeter of muck, indicating long-duration saturation. Other waters of the United States mapped in the Shasta Lake and vicinity portion of the primary study area include seep/spring other waters and ephemeral, intermittent, and perennial streams. The jurisdictional limit of each feature was delineated at the OHWM.

Ephemeral streams are characterized by indicators of scour and deposition, minor drift lines, and sediment deposits, but they lack a groundwater component that contributes to their flow. Hydrology is provided by sheet flow. The poorly defined hydrology indicators, proximity to the headwaters, and the small size of the ephemeral drainages indicate short duration of flow lacking a groundwater component.

Intermittent streams are the most abundant jurisdictional feature along the three arms. Intermittent streams range from small, poorly defined tributaries to larger, well-defined streams that flow into the summer. Like ephemeral streams, intermittent streams flow seasonally, but, in addition to precipitation and sheet flow from adjacent slopes, groundwater extends the duration of flow. Intermittent streams were identified as exhibiting the defined characteristics of a stream, generally a bed and bank and scour and depositions. Other characteristics, such as algae growth or hydrophytic vegetation in or adjacent to the stream, indicate inundation for a longer duration. Substrates observed were primarily cobble. Hydrology and hydric soil criteria are met through evidence of frequent flooding, including water marks, algal matting, drift lines, and sediment deposits.

Perennial streams exhibit the same characteristics as intermittent streams, but tend to be larger and to have a consistent source of groundwater. The substrate consists of boulders, bedrock, cobble, sand, and gravel. Riparian features often occur within the OHWM, but evident riparian "stringers" were delineated as wetlands. Hydrology and hydric soil criteria are met through evidence of frequent flooding, including water marks, algal matting, drift lines, and sediment deposits.

Roadside ditches are found along the Sacramento Arm near roadways and railroad tracks. These features have been excavated solely to drain uplands. Boundaries were established at the OHWM as indicated by sediment and drift deposits.

Seep/spring other waters are found along the Main Body, the Sacramento Arm, and the McCloud Arm. They form when groundwater flows out of the ground where the aquifer meets the ground surface. Hydrophytic vegetation is lacking. A channel may form, but in most cases water does not have the velocity to scour a bed and bank. Duff and organic soil substrates absorb the water and slow water movement downslope.

12.2 Regulatory Framework

Biological resources in California are protected and/or regulated by a variety of Federal and State laws and policies. In addition, in many parts of California, there are local or regional habitat and species conservation planning efforts in which a project applicant may participate. Key regulatory and conservation planning issues applicable to the project and alternatives under consideration are discussed below.

12.2.1 Federal

Endangered Species Act

Pursuant to the Federal Endangered Species Act (ESA), USFWS and NMFS have authority over projects that may result in "take" of a Federally listed species. In general, ESA Section 7 prohibits persons (including private parties) from "taking" listed endangered or threatened fish and wildlife species on private property, and from "taking" listed endangered or threatened plant species in areas under Federal jurisdiction or in violation of State law (16 U.S. Code (USC) 1532, 50 Code of Federal Regulations (CFR) 17.3). Under the ESA, the definition of "take" is to "harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct" as part of an intentional or negligent act or omission. The term "harm" includes acts that result in death or injury to wildlife. Such acts may include significant habitat modification or degradation if it results in death or injury to wildlife by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering. Section 7(a) of the ESA, as amended, requires Federal

agencies to evaluate their actions with respect to any species that is proposed for listing or is listed as endangered or threatened. Section 7(a)(2) requires Federal agencies to ensure that activities they authorize, fund, or carry out are not likely to jeopardize the continued existence of a listed species or to destroy or adversely modify its critical habitat. If a Federal action may affect a listed species or its critical habitat, the responsible Federal agency must enter into formal consultation with USFWS.

As defined in the ESA, critical habitat is a specific geographic area that is essential for the conservation of a threatened or endangered species and that may require special management and protection. It may include an area that is not currently occupied by the species but that will be needed for its recovery. Critical habitats are designated to ensure that actions authorized by Federal agencies will not destroy or adversely modify critical habitat, thereby protecting areas necessary for the conservation of the species.

Clean Water Act

The objective of the CWA is to restore and maintain the chemical, physical, and biological integrity of the nation's waters. USACE regulates discharges of fill or dredged materials into waters of the United States under Section 404 of the CWA (33 USC 1251–1376). Waters of the United States include lakes, rivers, streams, and their tributaries and adjacent wetlands. Wetlands are defined under Section 404 as areas that are inundated or saturated by surface water or groundwater at a frequency and duration sufficient to support (and that do support under normal circumstances) a prevalence of vegetation typically adapted for life in saturated soil conditions (33 CFR 328.3, 40 CFR 230.3). Activities that require a permit under Section 404 include, but are not limited to, placing fill or riprap, grading, mechanized land clearing, and dredging. Any activity that results in the deposit of dredged or fill material below the ordinary high-water mark of waters of the Unites States or within a jurisdictional wetland usually requires a Section 404 permit, even if the area is dry at the time the activity takes place. To comply with the Section 404 policy that there be no net loss of wetlands, the project cannot affect the total acreage of wetlands within the project boundary.

Section 401 Water Quality Certification

Under Section 401 of the CWA, an applicant for a Section 404 permit must obtain a certificate from the appropriate State agency stating that the intended dredging or filling activity is consistent with the State's water quality standards and criteria. In California, the authority to grant water quality certification is delegated by the State Water Resources Control Board to the nine Regional Water Quality Control Boards (RWQCB).

Rivers and Harbors Act

USACE regulates the construction of structures in, over, or under; excavation of material from; or deposition of material into "navigable waters of the United States" under Section 10 of the Federal Rivers and Harbors Act (33 USC 401 et

seq.). Navigable waters of the United States are defined as those waters subject to the ebb and flow of the tide shoreward to the mean high-water mark or those that are currently used, have been used in the past, or may be susceptible to use to transport interstate or foreign commerce. A letter of permission or permit from USACE is required before any work may be completed within navigable waters. Projects are permitted under either individual or general (i.e., nationwide) permits. The specific applicability of the permit types is determined by USACE on a case-by-case basis. Based on a preliminary conversation with the USACE (San Francisco District, Eureka Field Office), the project is expected to be permitted under Nationwide Permit Number 27.

U.S. Forest Service Sensitive Species

The National Forest Management Act requires USFS to "provide for a diversity of plant and animal communities" (16 USC 1604(g)(3)(B)) as part of its multiple-use mandate. USFS must maintain "viable populations of existing native and desired nonnative species in the planning area" (36 CFR 219.19). The Sensitive Species program is designed to meet this mandate and to demonstrate USFS's commitment to maintaining biodiversity on National Forest System lands. The program is a proactive approach to conserving species to prevent a trend toward listing under the ESA and to ensure the continued existence of viable, well-distributed populations. A "Sensitive Species" is any species of plant or animal that has been recognized by the Regional Forester to need special management to prevent the species from becoming threatened or endangered.

Shasta-Trinity National Forest Land and Resource Management Plan

The *Shasta-Trinity National Forest Land and Resource Management Plan* (STNF LRMP) contains forest goals, standards, and guidelines designed to guide the management of the Shasta-Trinity National Forest. The following goals, standards, and guidelines related to botanical resource issues associated with the study area were excerpted from the STNF LRMP (USFS 1995a).

U.S. Forest Service Survey and Manage

Standards and Guidelines In 1994, the BLM and USFS adopted standards and guidelines developed as part of the *Northwest Forest Plan*. These standards and guidelines address management of habitat for late-successional and old-growth forest related species within the range of the northern spotted owl. The *Northwest Forest Plan* was designed to address human and environmental needs served by the Federal forests of the western part of the Pacific Northwest and Northern California. The development of the *Northwest Forest Plan* was triggered in the early 1990s by the listing of the northern spotted owl and marbled murrelet as threatened under the ESA.

To mitigate potential impacts on plant and wildlife species that have the potential to occur within the range of the northern spotted owl, surveys are required for species thought to be rare, or whose status is unknown because of a lack of information. These species became known as the Survey and Manage

species. The *Northwest Forest Plan* has gone through several revisions since its implementation in 1994, including the elimination of the Survey and Manage Mitigation Measure Standards and Guidelines in 2004. However, these guidelines were reinstated in January 2006 as the result of a court order.

Biological Diversity

Goals (LRMP, p. 4-4) Integrate multiple resource management on a landscape level to provide and maintain diversity and quality of habitats that support viable populations of plants, fish, and wildlife.

Standards and Guidelines (LRMP, p. 4-14)

- Natural Openings – Management of natural openings will be determined at the project level consistent with desired future conditions.

- Snags – Over time, provide the necessary number of replacement snags to meet density requirements as prescribed for each land allocation and/or management prescription. Live, green culls and trees exhibiting decadence and/or active wildlife use are preferred.

- Hardwood – Apply the following standards in existing hardwood types:

  – Manage hardwood types for sustainability.

  – Conversion to conifers will only take place to meet desired future ecosystem conditions.

  – Where hardwoods occur naturally within existing conifer types on suitable timber lands, manage for a desired future condition for hardwoods as identified during ecosystem analysis consistent with management prescription standards and guidelines. Retain groups of hardwoods over single trees.

Threatened, Endangered, and Sensitive Species (Plants and Animals)

Goals (LRMP, p. 4-5)

Monitor and protect habitat for Federally listed threatened and endangered and candidate species. Assist in recovery efforts for threatened and endangered species. Cooperate with the State to meet objectives for state listed species.

Manage habitat for sensitive plants and animals in a manner that will prevent any species from becoming a candidate for threatened and endangered status.

Botany (Sensitive and Endemic Plants)

Standards and Guidelines (LRMP, pp. 4-14 through 4-16)

Map, record, and protect essential habitat for known and newly discovered sensitive and endemic plant species until conservation strategies are developed.

Analyze the potential effects of all ground-disturbing projects on sensitive and endemic plants and their habitat. Mitigate project effects to avoid a decline in species viability at the Forest level.

Monitor the effects of management activities on sensitive and endemic plants. If monitoring results show a decline in species viability, alter management strategy.

Provide reports of sensitive plant populations to the DFG annually.

Coordinate sensitive plant inventory and protection efforts with the DFG, the USFWS, the Nature Conservancy, the California Native Plant Society, and other concerned agencies, organizations, and adjacent landowners.

Protect type localities of sensitive and endemic plants for their scientific value.

Management Guide for the Shasta and Trinity Units of the Whiskeytown-Shasta-Trinity National Recreation Area

A portion of the Shasta Unit of the Whiskeytown-Shasta-Trinity National Recreation Area is included in the Shasta Lake and vicinity portion of the primary study area. The Management Guide for the Whiskeytown-Shasta-Trinity National Recreation Area, including the Shasta Unit, contains management strategies intended to achieve or maintain a desired condition. These strategies take into account opportunities, management recommendations for specific projects, and mitigation measures needed to achieve specific goals. The following strategies related to botanical and wetland resource issues associated with the Shasta Lake and vicinity portion of the primary study area were excerpted from the Management Guide (USFS 1996).

Vegetation (Management Guide, pp. IV-18 through IV-19)

- Prescribed burning, fuel break construction, and other forms of vegetation manipulation will be used to reduce fire hazards and improve forest health.

- Hazard trees in traditionally high-use recreation areas which pose safety hazards to people or property will be identified and removed.

- Recreation sites will be inventoried and vegetative management plans will be developed to ensure healthy and safe vegetation complexes are maintained over time.

- Protect known populations of Threatened and Endangered Species plant species and their habitat and implement mitigation measures if necessary to maintain or enhance their continued viability. Conservation strategies for Threatened and Endangered Species plant species will be utilized as they are developed.

- Implement management practices which promote restoration of native plant diversity.

- Implement a program to restore native vegetation to highly disturbed or degraded areas using native plants. Local in-kind, on-site seed or other propagation sources will be used in order to maintain genetic integrity.

- Chaparral and woodland habitat management will occur to meet wildlife objectives.

- Interpretive materials will address the need to conserve rare plant communities in accordance with the National Recreation Area Interpretive Plan.

- Rare plants in or near camping areas will be monitored on a regular basis.

- Diversity of native species will be emphasized. Eradication program will be implemented for nonnative, introduced species in areas where healthy, botanically diverse plant communities are necessary to meet ecosystem management objectives.

- Native plants from local gene pools will be utilized when landscaping campgrounds, interpretive facilities, etc.

- Partnerships will be utilized to assist with collection of seed, propagation of seeds/propagules, and planting.

U.S. Forest Service Noxious Weed Management Policy 2081

USFS Manual Policy 2080, Noxious Weed Management (USFS 1995b), includes a policy statement requiring a risk assessment for noxious weeds for every project. Specifically, the manual states:

> *2081.03. When any ground disturbing action or activity is proposed, determine the risk of introducing or spreading noxious weeds associated with the proposed action.*
>
> - *For projects having moderate to high risk of introducing or spreading noxious weeds, the project decision*

document must identify noxious weed control measures that must be undertaken during project implementation.

- *Use contract and permit clauses to prevent the introduction or spread of noxious weeds by contractors and permittees. For example, where determined to be appropriate, use clauses requiring contractors or permittees to clean their equipment prior to entering National Forest System lands.*

2081.2. Determine the factors which favor the establishment and spread of noxious weeds and design management practices or prescriptions to reduce the risk of infestation or spread of noxious weeds.

Where funds and other resources do not permit undertaking all desired measures, address and schedule noxious weed prevention and control in the following order:

- *First Priority: Prevent the introduction of new invaders,*
- *Second Priority: Conduct early treatment of new infestations, and*
- *Third Priority: Contain and control established infestations.*

Executive Order 11990: Protection of Wetlands

Executive Order 11990 established the protection of wetlands and riparian systems as the official policy of the Federal government. It requires all Federal agencies to consider wetland protection as an important part of their policies and take action to minimize the destruction, loss, or degradation of wetlands, and to preserve and enhance the natural and beneficial values of wetlands.

Executive Order 11312: Invasive Species

Executive Order 11312 directs all Federal agencies to prevent and control introductions of invasive nonnative species in a cost-effective and environmentally sound manner to minimize their economic, ecological, and human health impacts. Executive Order 11312 established a national Invasive Species Council made up of Federal agencies and departments and a supporting Invasive Species Advisory Committee composed of State, local, and private entities. The Invasive Species Council and Advisory Committee oversee and facilitate implementation of the Executive Order, including preparation of a National Invasive Species Management Plan.

12.2.2 State

California Endangered Species Act

Under the California Endangered Species Act (CESA), DFG has the responsibility for maintaining a list of endangered and threatened species (California Fish and Game Code, Section 2070). DFG also maintains a list of "candidate species," which are species for which DFG has issued a formal notice that they are under review for addition to the list of endangered or threatened species. Pursuant to the requirements of CESA, an agency reviewing a proposed project within its jurisdiction must determine whether any State-listed endangered or threatened species may be present in the project study area and, if so, whether the proposed project would have a potentially significant impact on any of these species. In addition, DFG encourages informal consultation on any proposed project that may affect a species that is a candidate for state listing.

Project-related impacts on species listed as endangered or threatened under the CESA would be considered significant. "Take" of protected species incidental to otherwise lawful management activities may be authorized under Section 2081 of the California Fish and Game Code. Under the CESA, "take" is defined as an activity that would directly or indirectly kill an individual of a species, but the definition does not include "harm" or "harass," as the Federal act does. Therefore, the threshold for take may be higher under CESA than under ESA because habitat modification is not necessarily considered take under CESA.

Authorization from DFG would be in the form of an incidental take permit or as a consistency determination (Section 2080.1[a] of the Fish and Game Code). Section 2080.1[a] of the Fish and Game Code authorizes DFG to accept a Federal biological opinion as the take authorization for a state-listed species when a species is listed under both the ESA and the CESA.

California Native Plant Protection Act

The Native Plant Protection Act (NPAA) (California Fish and Game Code Sections 1900-1913) prohibits the taking, possessing, or sale within the state of any plants with a State designation of rare, threatened, or endangered, as defined by DFG. The NPPA's definition of "endangered" and "rare" closely parallel the CESA definitions of "endangered" and "threatened" plant species.

Section 1602 of the California Fish and Game Code—Streambed Alteration

Diversions, obstructions, or changes to the natural flow or bed, channel, or bank of any river, stream, or lake in California that supports wildlife resources are subject to regulation by DFG, pursuant to Section 1602 of the California Fish and Game Code. The regulatory definition of stream is a body of water that flows at least periodically or intermittently through a bed or channel that has banks and supports wildlife, fish, or other aquatic life. This includes watercourses that have a surface or subsurface flow that supports or has

supported riparian vegetation. DFG's jurisdiction within altered or artificial waterways is based on the value of those waterways to fish and wildlife. A DFG streambed alteration agreement must be obtained for a project that would result in an impact on a river, stream, or lake.

Porter-Cologne Water Quality Control Act

The Porter-Cologne Water Quality Control Act requires that each of the nine RWQCBs prepare and periodically update basin plans for water quality control. Each basin plan sets forth water quality standards for surface water and groundwater and actions to control nonpoint and point sources of pollution to achieve and maintain these standards. Basin plans offer an opportunity to protect wetlands through the establishment of water quality objectives. The RWQCB's jurisdiction includes Federally protected waters as well as areas that meet the definition of "waters of the state." Waters of the state is defined as any surface water or groundwater, including saline waters, within the boundaries of the state. The RWQCB has the discretion to take jurisdiction over areas not Federally protected under Section 401 provided they meet the definition of waters of the state. Mitigation requiring no net loss of wetlands functions and values of waters of the state is typically required by the RWQCB.

California Department of Fish and Game Species Designations

DFG maintains an informal list of species called "species of special concern." These are broadly defined as plant and wildlife species that are of concern to DFG because of population declines and restricted distributions, and/or because they are associated with habitats that are declining in California. These species are inventoried in the CNDDB regardless of their legal status. Impacts on species of special concern may be considered significant.

California Department of Fish and Game/California Native Plant Society Plant Species Designations

CNPS is a statewide nonprofit organization that seeks to increase understanding of California's native flora and to preserve this rich resource for future generations. DFG and CNPS assign rare plant ranks through the collaborative efforts of the Rare Plant Status Review Group composed of over 300 botanical experts from government, academia, non-government organizations, and the private sector and managed jointly by DFG and CNPS. California native plants meeting the rarity or endangerment criteria are assigned a CRPR. These plants were formerly referred to as CNPS listed species; however, as of March 2010, DFG has adopted the name CRPR for the rarity and endangerment categories to eliminate the false impression that these assignments are the exclusive work of CNPS and that CNPS has had undue influence over the regulatory process. CRPR 1 and 2 species generally qualify as endangered, rare, or threatened within the definition of State CEQA Guidelines CCR Section 15380. In general, CRPR 3 and 4 species do not meet the definition of endangered, rare, or threatened pursuant to CEQA Section 15380; however, these species may be evaluated by the lead agency on a case-by-case basis to determine significance criteria under CEQA.

12.2.3 Local

Shasta, Tehama, Glenn, Sutter, Sacramento, and Yolo counties and the Cities of Redding, Colusa, and Sacramento have established codes and policies that address protection of natural resources, including vegetation, sensitive species, and trees, and are applicable to the project.

Shasta County's general plan emphasizes that the maintenance and enhancement of quality fish and wildlife habitat is critical to the recreation and tourism industry, and acknowledges that any adverse and prolonged decline of these resources could result in negative impacts on an otherwise vibrant industry. The general plan identifies efforts to protect and restore these habitats to sustain the long-term viability of the tourism and recreation industry (Shasta County 2004).

The City of Redding's general plan strives to strike a balance between development and conservation by implementing several measures such as creek-corridor protection, sensitive hillside development, habitat protection, and protection of prominent ridge lines that provide a backdrop to the city (City of Redding 2000).

Tehama County's general plan (Tehama County 2009) update provides an overarching guide to future development and establishes goals, policies, and implementation measures designed to address potential changes in county land use and development. The general plan identifies the importance of retaining agriculture as one of the primary uses of land in Tehama County.

Glenn County's general plan provides a comprehensive plan for growth and development in Glenn County for the next 20 years (2007 to 2027). This plan recognizes that public lands purchased for wildlife preservation generate economic activity as scientists and members of the public come to view and study remnant ecosystems (Glenn County 1993).

The City of Colusa's general plan seeks to promote its natural resources through increased awareness and improved public access (City of Colusa 2007).

Sutter County's general plan contains policies that generally address preservation of natural vegetation, including wetlands. It requires that new development mitigate the loss of Federally protected wetlands to achieve "no net loss," but it does not include any other specific requirements.

Sacramento County's general plan contains policies that promote protection of marsh and riparian areas, including specification of setbacks and "no net loss" of riparian woodland or marsh acreage (Sacramento County 1993). It also addresses the need to conserve vernal pools and ephemeral wetlands to ensure no net loss of vernal pool acreage. Several policies specifically promote protection of native oak trees, and, in some areas of the county, seek to ensure

that there is no net loss of canopy area. The general plan for the County of Sacramento is currently under revision.

The City of Sacramento Municipal Code addresses the protection of trees within the city boundaries, including general protection of all trees on city property and specific protection of heritage trees.

Yolo County's general plan aims to provide an active and productive buffer of farmland and open space separating the Bay Area from Sacramento, and integrating green spaces into its communities.

12.2.4 Federal, State, and Local Programs and Projects

California Bay-Delta Authority

The California Bay-Delta Authority was established as a State agency in 2003 to oversee implementation of CALFED for the 25 Federal and State agencies working cooperatively to improve the quality and reliability of California's water supplies while restoring the Bay-Delta ecosystem. The CALFED Ecosystem Restoration Program has provided a funding source for projects that include those involving acquisition of lands within the Sacramento River Conservation Area, initial baseline monitoring and preliminary restoration planning, and preparation of long-term habitat restoration management and monitoring plans.

Cantara Trustee Council

The Cantara Trustee Council administers a grant program that has provided funding for numerous environmental restoration projects in the primary study area, including programs in the Fall River watershed, Sulphur Creek, the upper Sacramento River, Middle Creek, lower Clear Creek, Battle Creek, Salt Creek, and Olney Creek. The Cantara Trustee Council is a potential local sponsor for future restoration actions in the primary study area. The Cantara Trustee Council includes representatives from DFG, USFWS, the Central Valley Regional Water Quality Control Board, California Sportfishing Protection Alliance, and Shasta Cascade Wonderland Association.

Resource Conservation Districts

There are numerous resource conservation districts (RCD) within the study area. Once known as soil conservation districts, RCDs were established under California law with a primary purpose to implement local conservation measures. Although RCDs are locally governed agencies with locally appointed, independent boards of directors, they often have close ties to county agencies and the National Resources Conservation Service. RCDs are empowered to conserve resources within their districts by implementing projects on public and private lands and to educate landowners and the public about resource conservation. They are often involved in the formation and coordination of watershed working groups and other conservation alliances. In the Shasta Lake and upper Sacramento River vicinity, districts include the

Western Shasta County RCD and the Tehama County RCD. To the east are the Fall River and Pit River RCDs, and to the west and north are the Trinity County and Shasta Valley RCDs.

Riparian Habitat Joint Venture

The Riparian Habitat Joint Venture (RHJV) was initiated in 1994 and includes signatories from 18 Federal, State, and private agencies. The RHJV promotes conservation and the restoration of riparian habitat to support native bird populations through three goals:

- Promote an understanding of the issues affecting riparian habitat through data collection and analysis.
- Double riparian habitat in California by funding and promoting on-the-ground conservation projects.
- Guide land managers and organizations to prioritize conservation actions.

RHJV conservation and action plans are documented in the Riparian Bird Conservation Plan (RHJV 2004). The conservation plan targets 14 "indicator" species of riparian-associated birds and provides recommendations for habitat protection, restoration, management, monitoring, and policy. The report notes habitat loss and degradation as one of the most important factors causing the decline of riparian birds in California. The RHJV has participated in monitoring efforts within the Sacramento National Wildlife Refuge Complex and other conservation areas. The RHJV's conservation plan identifies lower Clear Creek as a prime breeding area for yellow warblers and song sparrows, advocating a continuous riparian corridor along lower Clear Creek. Other recommendations of the conservation plan apply to the North Delta Offstream Storage Investigation study area in general.

Sacramento River Conservation Area Program

Senate Bill 1086 called for a management plan for the Sacramento River and its tributaries to protect, restore, and enhance both fisheries and riparian habitat. The Sacramento River Conservation Area Program has an overall goal of preserving remaining riparian habitat and reestablishing a continuous riparian ecosystem along the Sacramento River between Redding and Chico, and reestablishing riparian vegetation along the river from Chico to Verona. The program is to be accomplished through an incentive-based, voluntary river management plan. The *Upper Sacramento River Fisheries and Riparian Habitat Management Plan*, January 1989 (Resources Agency 1989), identifies specific actions to help restore the Sacramento River fishery and riparian habitat between the Feather River and Keswick Dam. The *Sacramento River Conservation Area Forum Handbook* (Resources Agency 2003) is a guide to implementing the program. The Keswick Dam-to-Red Bluff portion of the conservation area includes areas within the 100-year floodplain, existing

riparian bottomlands, and areas of contiguous valley oak woodland, totaling approximately 22,000 acres. The 1989 fisheries restoration plan recommended several actions specific to the study area:

- Fish passage improvements at RBDD (under way; project final Environmental Impact Statement (EIS)/Environmental Impact Report released May 2008)
- Modification of the Spring Creek Tunnel intake for temperature control (completed)
- Spawning gravel replacement program (ongoing)
- Development of side-channel spawning areas, such as those at Turtle Bay in Redding (ongoing)
- Structural modifications to the Anderson-Cottonwood Irrigation District Dam to eliminate short-term flow fluctuations (completed)
- Maintaining instream flows through coordinated operation of water facilities (ongoing)
- Improvements at the Coleman National Fish Hatchery (partially complete)
- Measures to reduce acute toxicity caused by acid mine drainage and heavy metals (ongoing)
- Various fisheries improvements on Clear Creek (partially complete)
- Flow increases, fish screens, and revised gravel removal practices on Battle Creek (beginning summer 2006)
- Control of gravel mining, improvements of spawning areas, improvements of land management practices in the watershed, and protection and restoration of riparian vegetation along Cottonwood Creek

Sacramento River National Wildlife Refuge

The Sacramento River National Wildlife Refuge (SRNWR) is composed of many units between the cities of Red Bluff and Princeton. The SRNWR along the middle Sacramento River is part of the Sacramento National Wildlife Refuge Complex, consisting of five refuges and three wildlife management areas within the Sacramento Valley. Reaches and subreaches of the river are delineated based generally on transitions in fluvial geomorphic riverine conditions, although county boundaries were considered as well. The middle Sacramento River region between Red Bluff and Colusa includes three units

within the Chico Landing Subreach that contain restoration project sites addressed in the *Sacramento River–Chico Landing Subreach Habitat Restoration Draft Environmental Impact Report* (CBDA 2005). In addition, three areas proposed for restoration in this area occur within the larger SRNWR units that were evaluated in the *Environmental Assessment for Proposed Restoration Activities on the Sacramento River National Wildlife Refuge* (USFWS 2001; CBDA 2005).

In June 2005, USFWS issued the *Sacramento River National Wildlife Refuge Draft Comprehensive Conservation Plan and Environmental Assessment and Finding of No Significant Impact* (USFWS 2005) to serve as an integrated management plan for land that it acquires and manages for inclusion in the SRNWR. The SRNWR final comprehensive conservation plan includes goals, objectives, and strategies to guide management of lands within the SRNWR. It also includes assessments of and establishes parameters for "compatible uses," which are uses that are considered compatible with the primary purposes for which the area was established. Riparian habitat restoration projects are being implemented under cooperative agreements between USFWS and other entities such as The Nature Conservancy (TNC) in accordance with the SRNWR final comprehensive conservation plan.

Sacramento River Preservation Trust

The Sacramento River Preservation Trust is a private, nonprofit organization active in environmental education and advocacy to preserve the natural environmental values of the Sacramento River. The trust has participated in various conservation and land acquisition projects, including securing lands for the SRNWR. The group is pursuing designation of a portion of the Sacramento River between Redding and Red Bluff as a national conservation area.

Sacramento River Watershed Program

The Sacramento River Watershed Program is an effort to bring stakeholders together to share information and work together to address water quality and other water-related issues within the Sacramento River watershed. The group is funded congressionally through the U.S. Environmental Protection Agency. The program's primary goal is "to ensure that current and potential uses of Sacramento River watershed resources are sustained, restored, and where possible, enhanced while promoting the long-term social and economic vitality of the region." The Sacramento River Watershed Program manages grants for the Sacramento River Toxic Pollutants Control Program; performs extensive water quality monitoring, data collection, and data management for the watershed; and is instrumental in the study and monitoring of toxic pollutants. Although the program does not implement restoration projects, it is a potential partner for coordinating research and monitoring through consensus-based collaborative partnerships and promoting mutual education among the stakeholders of the Sacramento River watershed.

Sacramento Watersheds Action Group

The Sacramento Watersheds Action Group is a nonprofit corporation that secures funding for, designs, and implements projects that provide watershed restoration, streambank and slope stabilization, erosion control, watershed analysis, and road removal. Sacramento Watersheds Action Group has successfully worked with local groups, agencies, and organizations to fund and complete restoration projects on the Sacramento River and tributaries downstream from Keswick Dam. Their projects include development of the *Sulphur Creek Watershed Analysis and Action Plan*, the Whiskeytown Lake Shoreline Erosion Control Project, the Sulphur Creek Crossing Restoration Project, and the Lower Sulphur Creek Realignment and Riparian Habitat Enhancement Project. Sacramento Watersheds Action Group is a potential local sponsor for watershed restoration actions in the study area.

Shasta Land Trust

The Shasta Land Trust is a regional, nonprofit organization dedicated to conserving open space, wildlife habitat, and agricultural land. The trust works with public agencies and private landowners and is funded primarily through membership dues and donations. It employs various voluntary programs to protect and conserve valuable lands using conservation easements, land donations, and property acquisitions. The trust is a potential local partner for restoration activities in the Shasta Dam-to-Red Bluff area.

The Nature Conservancy

TNC is a private, nonprofit organization involved in environmental restoration and conservation throughout the United States and the world. TNC approaches environmental restoration primarily through strategic land acquisition from willing sellers and obtaining conservation easements. Some of the lands are retained by TNC for active restoration, research, or monitoring activities, while others are turned over to government agencies such as USFWS or DFG for long-term management. Lower in the Sacramento River basin, TNC has been instrumental in acquiring and restoring lands in the SRNWR and managing several properties along the Sacramento River. It also has pursued conservation easements on various properties at tributary confluences, including Cottonwood and Battle creeks.

The Trust for Public Land

The Trust for Public Land is a national, nonprofit organization involved in preserving lands with natural, historic, cultural, or recreational value, primarily through conservation real estate. The trust's Western Rivers Program has been involved in conservation efforts along the Sacramento River between Redding and Red Bluff (the BLM's Sacramento River Bend Management Area), Battle Creek, Paynes Creek, Inks Creek, and Fenwood Ranch in Shasta County. The group promotes public ownership of conservation lands to ensure public access and enjoyment.

12.3 Environmental Consequences and Mitigation Measures

This section describes the methods of environmental evaluation, assumptions, and specific criteria used to determine significance for each resource area, then discusses effects of the project and proposes mitigation where necessary.

12.3.1 Methods and Assumptions

The following sections describe the methods, processes, procedures, and assumptions used to formulate and conduct the environmental impact analysis. Data for the following analysis were taken from the use of modeling, existing reports on local and site-specific biology, and on site assessments during field reviews.

CalSim Modeling

The CalSim-II computer model was used to aid in the evaluation of potential impacts of the project alternatives on water-related resources, including riparian habitats along the upper and lower Sacramento River and in the Delta. This computer modeling used historical data on California hydrology to represent the variety of weather and hydrologic patterns, including wet periods and droughts, under which water storage and conveyance facilities would be operated. Two scenarios (base cases) of demands for, and storage and conveyance of, water were used in model runs: 2005 facilities and demands ("existing conditions") and forecasted 2030 demands and reasonably foreseeable projects and facilities ("future conditions"). A model run was conducted for each of these base cases combined with each alternative, so that the effects of the No-Action Alternative and other alternatives could be evaluated relative to both existing and future conditions. CalSim-II is a useful tool for this type of comparative analysis where the model is run twice, once to represent a base condition (no action) and a second time with a specific change (action) to assess the change in the outcome due to the input change.

The hydrologic analysis conducted for this EIS used the Common Assumptions Common Modeling Package Version 8D CalSim-II models, which are the best available hydrological modeling tools, to approximate system-wide changes in storage, flow, salinity, and reservoir system reoperation associated with the SLWRI alternatives. The historical flow record of October 1921 to September 2003, adjusted for the influences of land use changes and upstream flow regulation, is used to represent the possible range of water supply conditions. Major Central Valley rivers, reservoirs, and CVP/SWP facilities are represented by a network of arcs and nodes. CalSim-II uses a mass balance approach to route water through this network. Simulated flows are mean flows for the month; reservoir storage volumes correspond to end-of-month storage. A more detailed description of the CalSim-II model, the modeling methodology used to evaluate this project, and key assumptions are provided in the Modeling Appendix. Summaries of the analysis and modeling results are provided in Chapter 6, "Hydrology, Hydraulics, and Water Management."

Vegetation and Habitat Types

The effects of construction-related activities are evaluated in the sections addressing Shasta Lake and its vicinity. Besides construction-related activities, the project could potentially affect vegetation and habitat types through any of the following impact mechanisms:

- Increased inundated width of the river during the active growing season
- Reduced frequency and/or magnitude of peak flows
- Altered geomorphic processes (e.g., meander, channel avulsion) along rivers
- Altered availability of groundwater
- Altered rates of stage decline during seed dispersal or germination-establishment

For each vegetation type, environmental effects potentially resulting from each of these impact mechanisms were assessed. This assessment was based on a review of the results of CalSim simulations of mean monthly flows, aerial photographs, background information on the upper Sacramento River and adjacent uplands, and scientific literature on the ecology of each vegetation type. Results of hydraulic modeling of the project's potential effects on peak flows and analyses of the project's potential effects on geomorphic processes along the Sacramento River were not available to support this analysis.

In addition to these impact mechanisms, increased water supplies or increased supply reliability also could reduce a limitation on urban growth and development or on other activities that could affect vegetation in the primary and extended study areas, resulting in potentially significant impacts. The effects of this growth would be analyzed in general plan environmental impact reports and in project-level CEQA compliance documents for the local jurisdictions in which the growth would occur. Mitigation of these impacts would be the responsibility of these local jurisdictions, and not Reclamation. The expected increase in water yield relative to the entire CVP would be small, however, and assuming that this new yield could be provided to any number of geographic areas within the CVP service area (and in part would substitute for ongoing groundwater pumping), the project's impact on urban growth and development that could affect vegetation would be minor.

Similarly, projects potentially affecting streambeds, wetlands, and listed species would require permits from the DFG, USACE, and USFWS, respectively; it is anticipated that impacts on these resources would be avoided, minimized, and/or mitigated during those agency consultations.

Because the extent, location, and timing of induced growth are currently highly uncertain, and in the future the impacts of this growth would be analyzed and mitigated during land use planning and environmental review for specific projects, growth-inducing effects on vegetation and habitat types are not discussed further in this section. However, additional discussion of growth-inducing effects specific to the alternatives is provided in the EIS.

For the purposes of this impact analysis on the loss of general habitats in the Shasta Lake and vicinity portion of the primary study area, California Wildlife Habitat Relationship (CWHR) types will be used to describe habitats for special-status plants affected. Table 12-8 lists the cross references between MCV and CWHR habitat types.

Special-Status Species

The project could affect special-status plant species through the same impact mechanisms potentially affecting vegetation and habitat types, and also by altering the structure and species composition of vegetative communities, particularly within river corridors.

Potential impacts resulting from these impact mechanisms were assessed for special-status plant species that may occur in the project area. This assessment was based on the potential impacts on vegetation and habitat types for each alternative, and available information on the distribution, ecology, and reproductive biology of each special-status species.

Assumptions

The following assumptions have been made for the purposes of the impact analysis:

- Activity areas (construction areas for infrastructure and relocation areas) would be completely cleared.
- Mechanized equipment would be used for discrete areas where total clearing would occur.
- All trees would be removed along other areas of the lake, including those that could be considered a hazard in coves used by houseboats for moorage; other vegetation would be left.

Trees would be removed using helicopters and barges.

Table 12-8. Cross Reference of MCV Vegetation Types and CWHR Habitat Types

MCV Type	CWHR Type
Barren	Barren
Birch-leaf mountain-mahogany chaparral	Mixed chaparral
Black willow thicket	Montane riparian
Blue oak woodland	Blue oak woodland
Brewer oak scrub	Mixed chaparral
Buck brush chaparral	Mixed chaparral
California annual grassland	Annual grassland
California ash chaparral	Mixed chaparral
California black oak forest	Montane hardwood
California buckeye groves	Mixed chaparral
California yerba santa scrub	Mixed chaparral
Canyon live oak forest	Montane hardwood
Deer brush chaparral	Mixed chaparral
Douglas-fir	Douglas-fir
Fremont cottonwood	Montane riparian
Ghost pine woodland	Montane hardwood–conifer, Blue oak–foothill pine
Himalayan blackberry brambles	Montane riparian
Interior live oak chaparral	Mixed chaparral
Interior live oak woodland	Montane hardwood
Knobcone pine forest	Closed-cone pine–cypress
Lacustrine	Lacustrine
Mixed willow	Montane riparian
Oregon ash groves	Montane riparian
Oregon white oak woodland	Montane hardwood
Ponderosa pine–Douglas-fir forest	Montane hardwood–conifer
Ponderosa pine forest	Ponderosa pine
Red osier thickets	Montane riparian
Riverine	Riverine
Sandbar willow thickets	Montane riparian
Spicebush thickets	Montane riparian
Valley oak woodland	Montane hardwood
Urban	Urban
White alder groves	Montane riparian
White leaf manzanita chaparral	Mixed chaparral

12.3.2 Criteria for Determining Significance of Effects

An environmental document prepared to comply with NEPA must consider the context and intensity of the environmental effects that would be caused by, or result from, the proposed action. Under NEPA, the significance of an effect is used solely to determine whether an environmental impact statement must be prepared. An environmental document prepared to comply with CEQA must identify the potentially significant environmental effects of a proposed project. A "[s]ignificant effect on the environment" means a substantial, or potentially substantial, adverse change in any of the physical conditions within the area affected by the project" (State CEQA Guidelines, Section 15382). CEQA also requires that the environmental document propose feasible measures to avoid or substantially reduce significant environmental effects (State CEQA Guidelines, Section 15126.4(a)).

Vegetation and Habitat Types

The following significance criteria were developed based on guidance provided by the State CEQA Guidelines, and consider the context and intensity of the environmental effects as required under NEPA. Impacts of an alternative on vegetation and habitat types would be significant if project implementation would do any of the following:

- Result in a substantial adverse effect on any riparian vegetation or habitat, oak woodlands or savannas, or other sensitive natural community identified in local or regional plans, policies, regulations, or by DFG or USFWS
- Conflict with a local policy or ordinance that protects vegetation resources, such as a tree preservation policy or ordinance
- Conflict with or violate the provisions of an adopted habitat conservation plan, natural community conservation plan, or other approved local, regional, State, or Federal habitat conservation plan relating to the protection of plant resources
- Result in the potential for spread of nonnative and invasive plant species

Special-Status Species

Impacts of an alternative on special-status species would be significant if project implementation would do any of the following:

- Result in a substantial adverse effect, either directly or through habitat modifications, on any plant species identified as a candidate, sensitive, or special-status species in local or regional plans, policies, or regulations or by DFG or USFWS

- Have the potential to substantially reduce the number or restrict the range of an endangered or threatened plant species or a plant species that is a candidate for State listing or proposed for Federal listing as endangered or threatened

- Have the potential for substantial reductions in the habitat of an endangered or threatened plant species or a plant species that is a candidate for State listing or proposed for Federal listing as endangered or threatened

- Substantially reduce the number or restrict the range of an endangered, rare, or threatened species, cause a native plant population to drop below self-sustaining levels, or threaten to eliminate a plant community

- Have the potential to cause a native plant population to drop below self-sustaining levels

Wetlands

Impacts of an alternative on wetlands would be significant if project implementation would do any of the following:

- Have a substantial adverse effect on Federally protected wetlands as defined by Section 404 of the CWA (including, but not limited to, marsh, vernal pool, etc.) through direct removal, filling, hydrological interruption, or other means

- Conflict with any State or local policies or ordinances protecting wetland and/or riparian resources

- Conflict with or violate the provisions of an adopted habitat conservation plan, natural community conservation plan, or other approved local, regional, State, or Federal habitat conservation plan relating to the protection of wetland resources

Shasta-Trinity National Forest Land and Resource Management Plan

In addition to the above significance criteria, the *Shasta-Trinity National Forest Land and Resource Management Plan* (USFS 1995a) contains forest goals, standards, and guidelines designed to guide the management of the biological resources within the Shasta-Trinity National Forest, located in the Shasta Lake and vicinity portion of the primary study area. To comply with NEPA, this assessment of impacts evaluates the project's compliance with the STNF LRMP forest goals, standards, and guidelines listed in the "Regulatory Framework" section listed above. Mitigation measures are provided (as needed) to move project actions toward compliance with the STNF LRMP.

12.3.3 Topics Eliminated from Further Consideration

No topics related to botanical resources that are included in the significance criteria listed above were eliminated from further consideration. All relevant topics are analyzed below.

12.3.4 Direct and Indirect Effects

This section identifies how specific vegetation types could be affected by the project. The project could affect vegetation by doing any of the following:

- Causing construction-related effects at Shasta Dam and around Shasta Lake
- Altering flow regimes downstream from Shasta Lake and downstream from other reservoirs with altered operations
- Increasing water supply reliability that, in turn, could contribute to growth or changes in agricultural land uses in the CVP and SWP service areas

By altering storage and reservoir operations, the project would change flow regimes in downstream waterways. In turn, these alterations to the flow regime could affect vegetation, particularly riparian and wetland vegetation along several waterways.

No-Action Alternative

Under the No-Action Alternative, Reclamation would not pursue an action to enlarge Shasta Dam. No new facilities would be constructed at Shasta Dam; thus there would be no construction-related impacts. In addition, there would be no changes in releases from Shasta Dam or other CVP reservoirs as a result of a Shasta Dam enlargement.

Shasta Lake and Vicinity

Impact Bot-1 (No-Action): Loss of Federally or State Listed Plant Species Habitat for Federally or State-listed plant species does not occur at Shasta Lake or in the vicinity. No species are known or expected to occur. Therefore, no impact would occur. Mitigation is not required for the No-Action Alternative.

Impact Bot-2 (No-Action): Loss of MSCS Covered Species Species covered by the MSCS would not be lost as a result of inundation, vegetation removal, or construction activities. Therefore, no impact would occur. Mitigation is not required for the No-Action Alternative.

Impact Bot-3 (No-Action): Loss of USFS sensitive, BLM sensitive, or CRPR Species USFS sensitive, BLM sensitive or CRPR listed species would not be lost as a result of inundation, vegetation removal, or construction activities. Therefore, no impact would occur. Mitigation is not required for the No-Action Alternative.

Impact Bot-4 (No-Action): Loss of Jurisdictional Waters Waters of the United States would not be lost as a result of inundation, vegetation removal, or construction activities. Therefore, no impact would occur. Mitigation is not required for the No-Action Alternative.

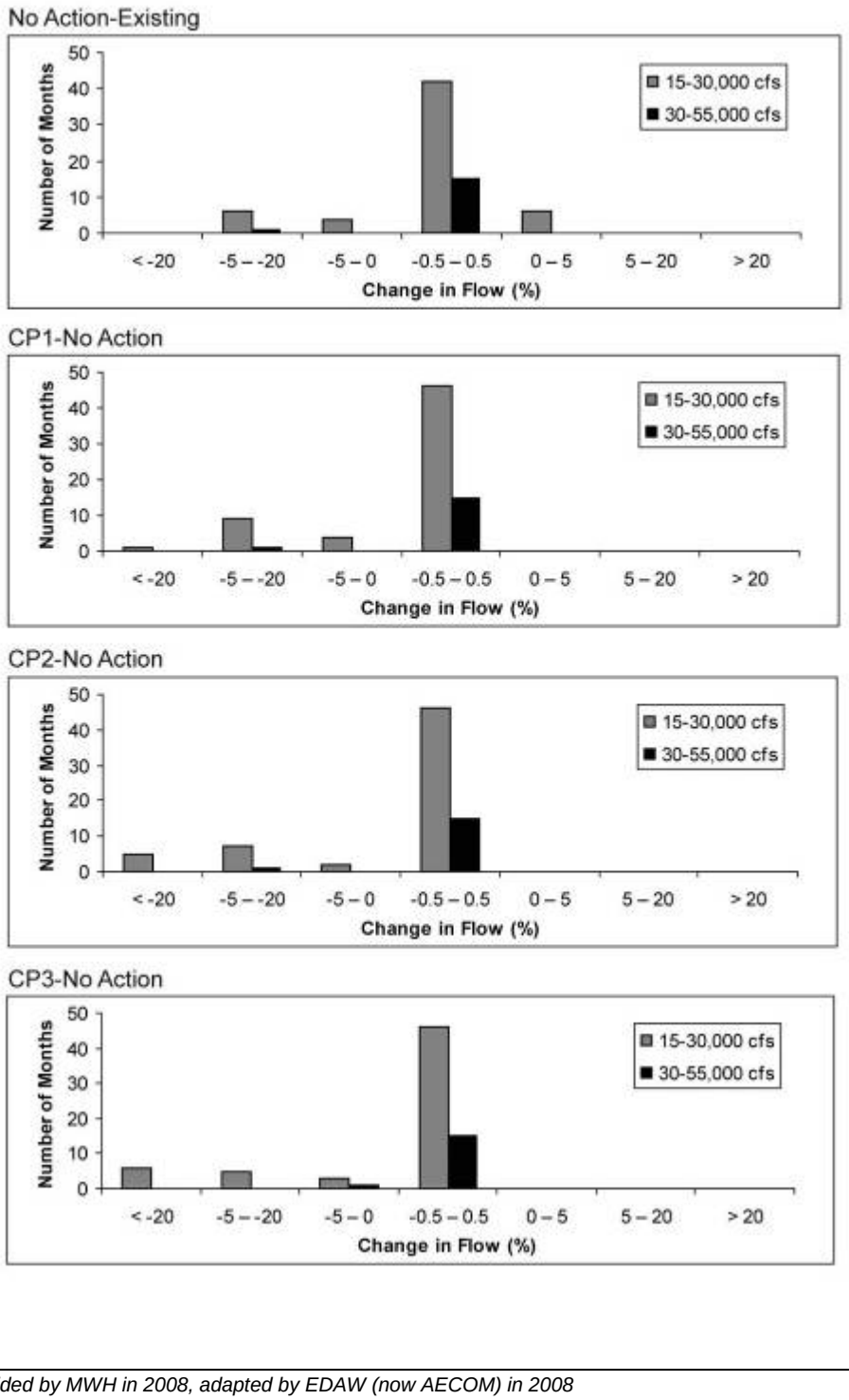
Impact Bot-5 (No-Action): Loss of General Vegetation Habitats General vegetation habitats would not be lost as a result of inundation, vegetation removal, or construction activities. Therefore, no impact would occur. Mitigation is not required for the No-Action Alternative.

Impact Bot-6 (No-Action): Spread of Noxious and Invasive Weeds Noxious and invasive weeds would not be spread as a result of inundation, vegetation removal, or construction activities. Therefore, no impact would occur. Mitigation is not required for the No-Action Alternative..

Upper Sacramento River (Shasta Dam to Red Bluff)

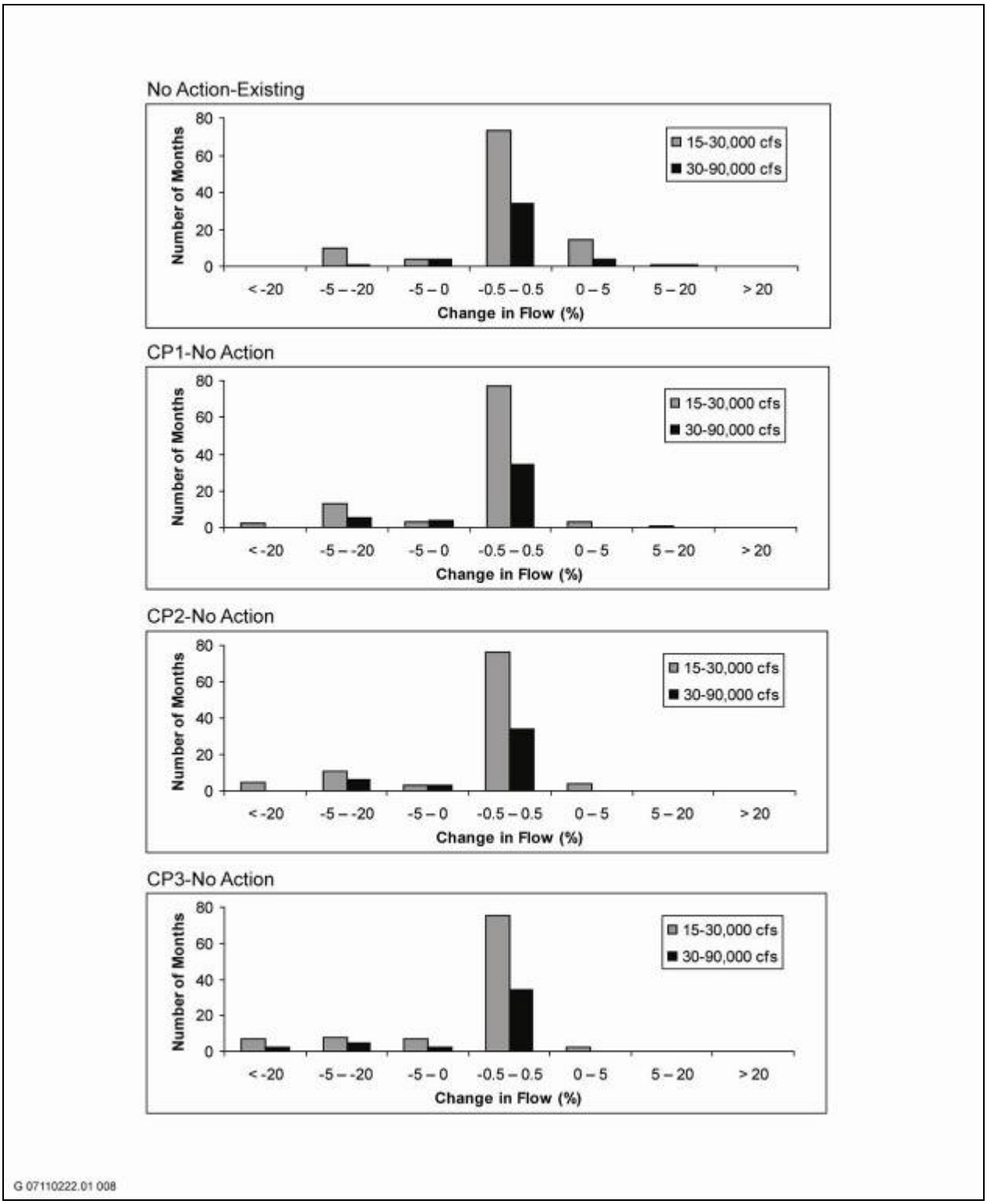
Impact Bot-7 (No-Action): Altered Structure and Species Composition and Loss of Sensitive Plant Communities and Special-Status Plant Species Resulting from Altered Flow Regimes Altered flow regimes associated with the No-Action Alternative could alter the structure and species composition or cause the loss of riparian, wetland, and oak communities along the upper Sacramento River, and of habitat for special-status plant species. Vernal pool plant communities and associated special-status species likely would not be affected. Effects on oak communities and upland habitats for special-status plants may not all be adverse. Adverse effects on riparian and wetland communities and associated special-status plants would be small, and beneficial effects are also anticipated to result from other management and restoration actions. Thus, this impact would be less than significant.

Although Shasta Dam would not be altered under the No-Action Alternative, CVP and SWP water storage, conveyance, and deliveries would change because of several reasonably foreseeable actions that would occur with or without enlarging Shasta Dam. As a consequence of these actions, the flow regime of the upper Sacramento River would change between 2005 and 2030. The CalSim-II modeling results that simulate these changes are provided in the *Hydrology, Hydraulics, and Water Management Technical Report* and the simulated discharges below Keswick Dam and above Red Bluff are summarized on Figures 12-5 and 12-6, respectively. Overall, these modeling results suggest there would be only a very small decrease in flows of 15,000 to 55,000 cubic feet per second (cfs). Flows of this magnitude strongly affect bank erosion and meander migration, and are related to other geomorphic processes affecting the extent of different riparian communities. These relationships are described in greater detail under CP1.



Source: Data provided by MWH in 2008, adapted by EDAW (now AECOM) in 2008

Figure 12-5. Simulated Changes in Larger Mean Monthly Flows of the Sacramento River Below Keswick Dam



Source: Data provided by MWH in 2008, adapted by EDAW (now AECOM) in 2008

Figure 12-6. Simulated Changes in Larger Mean Monthly Flows of the Sacramento River Above Red Bluff

This change might not be sufficient to cause significant effects on riparian and wetland communities, or on associated special-status species.

In addition to causing small changes in flow regime, the No-Action Alternative would continue to alter the structure and species composition of riparian and wetland vegetation resulting from continued operation of Shasta Dam. Before the construction of Shasta Dam, river flow and stage would decrease gradually during the period of cottonwood and willow seed dispersal. In many years, this flow pattern would facilitate establishment of these early-successional species along the Sacramento River throughout the primary study area.

Operation of Shasta Dam has increased flow volumes from mid-spring to early summer. Consequently, in most years, operation of the dam precludes or substantially reduces opportunities for establishment of cottonwoods and opportunities for willow establishment. As a result of this (and other alterations to the flow regime of the Sacramento River), the structure and species composition of riparian vegetation has been changing within the primary study area (Fremier 2003, Roberts et al. 2002). The extent of early-successional riparian communities (e.g., cottonwood forest) has been decreasing while the extent of mid-successional communities (e.g., mixed riparian forest) has been increasing. Such changes would continue under the No-Action Alternative for several decades, but would diminish with time.

However, under the No-Action Alternative a number of management and restoration plans and programs would be implemented. These actions are described in Section 12.2, “Regulatory Setting,” of this EIS. These actions would cause beneficial effects that would likely be of similar magnitude as the anticipated adverse effects of small changes in flow regime and of continued effects from past actions, and thus would largely offset those adverse effects.

For the reasons described above, this impact would be less than significant. Mitigation is not required for the No-Action Alternative.

Impact Bot-8 (No-Action): Conflict with Approved Local or Regional Plans with Objectives of Riparian Habitat Protection or Watershed Management
Numerous local and regional plans promote the conservation of riparian vegetation and associated habitats along the upper Sacramento River. Expected future effects of the No-Action Alternative on riparian communities have largely been considered in the existing plans. The No-Action Alternative would not conflict with approved local or regional plans. This impact would be less than significant**.**

Numerous local and regional plans address and promote the conservation of riparian vegetation and associated habitats along the upper Sacramento River in the primary study area. These plans, which are discussed in more detail in the “Regulatory Setting” section of this EIS, include the Sacramento River Conservation Area Program, which promotes the conservation and the

restoration of riparian habitat. Under the No-Action Alternative, adverse effects would result from the continued consequences of past actions (e.g., construction of Shasta Dam and the introduction of nonnative species) and from the effects of reasonably foreseeable actions. Most adverse effects that are the continued consequences of past actions have been considered in the development of existing local and regional plans. In addition, foreseeable water resources and levee actions are expected to be consistent with local and regional plans, and anticipated adverse effects are likely to be fully mitigated and not conflict with a local or regional plan. Therefore, the No-Action Alternative would not conflict with approved local or regional plans with objectives of riparian habitat protection or watershed management. This impact would be less than significant**.** Mitigation is not required for the No-Action Alternative.

Impact Bot-9 (No-Action): Disturbance or Removal of Designated Critical Habitat for Special-Status Species Designated critical habitat for vernal pool species in the upper Sacramento River area is not expected to be adversely affected. This impact would be less than significant.

Designated critical habitat for four vernal pool special-status plant species exists in the upper Sacramento River portion of the primary study area: slender orcutt grass, Hoover's spurge, hairy orcutt grass, and Greene's tuctoria. Critical habitat for these species in the primary study area is confined to vernal pool communities (USFWS 2006). Vernal pools are generally not present within the active floodplain. However, if vernal pool habitats for these special-status species are present in the active floodplain of the upper Sacramento River, they could be affected by the small reduction in the frequency and magnitude of overbank flows. It is not known if this would be an adverse or beneficial effect. Because this effect of the No-Action Alternative is somewhat speculative and not necessarily adverse, this impact would be less than significant. Mitigation is not required for the No-Action Alternative.

Impact Bot-10 (No-Action): Loss of Sensitive Plant Communities and Special-Status Plant Species Resulting from Induced Growth Although Shasta Dam would not be altered, water storage, conveyance, and deliveries to water districts would likely increase because of reasonably foreseeable projects. However, environmental regulations would continue to provide protection for botanical resources, and the effects of future growth would be analyzed and mitigated during land use planning and environmental review for specific projects. Therefore, this impact would be less than significant.

Although Shasta Dam would not be altered under the No-Action Alternative, CVP and SWP water storage, conveyance, and deliveries would change because of several reasonably foreseeable projects that would occur with or without enlarging Shasta Dam. Consequently, deliveries to water districts along the upper Sacramento River in the primary study area would likely increase between now and 2030, and this could reduce a limitation on urban growth and development. However, environmental regulations would continue to protect wetlands, riparian

habitats, other sensitive botanical communities, and special-status plant species, and the effects of future growth would be analyzed and mitigated during land use planning and environmental review for specific projects. Furthermore, CVP water delivered in this area would primarily be for agricultural purposes, and agricultural acreages are not expected to expand. For the reasons described above, this impact would be less than significant. Mitigation is not required for the No-Action Alternative.

Lower Sacramento River and Delta

Impact Bot-11 (No-Action): Loss of Sensitive Natural Communities or Habitats Resulting from Implementing the Gravel Augmentation Program or the Reading Island Restoration Plan, Rehabilitating the Reading Island Boat Ramp, or Constructing a Handicap Fishing Access Area The proposed gravel augmentation program and Reading Island restoration and construction activities would not be implemented under the No-Action Alternative. Therefore, no impact would occur. Mitigation is not required for the No-Action Alternative.

Impact Bot-12 (No-Action): Loss of Special-Status Plants Resulting from Implementing the Gravel Augmentation Program, Restoring Sacramento River Flow Through Anderson Slough, Rehabilitating the Reading Island Boat Ramp, or Constructing a Handicap Fishing Access Area The proposed gravel augmentation program and Reading Island restoration and construction activities would not be implemented under the No-Action Alternative. Therefore, no impact would occur. Mitigation is not required for the No-Action Alternative.

Impact Bot-13 (No-Action): Spread of Noxious and Invasive Weeds Resulting from Implementing the Gravel Augmentation Program, Restoring Sacramento River Flow Through Anderson Slough, Rehabilitating the Reading Island Boat Ramp, or Constructing a Handicap Fishing Access Area The proposed gravel augmentation program and Reading Island restoration and construction activities would not be implemented under the No-Action Alternative. Therefore, no impact would occur. Mitigation is not required for the No-Action Alternative.

Impact Bot-14 (No-Action): Altered Structure and Species Composition and Loss of Sensitive Plant Communities and Special-Status Plant Species Resulting from Altered Flow Regimeson the Lower Sacramento River Altered flow regimes associated with the No-Action Alternative could alter the structure and species composition or cause the loss of riparian, wetland, and oak communities along the lower Sacramento River and in the Delta, and of habitat for special-status plant species. Vernal pool plant communities and associated special-status plant species likely would not be affected. Effects on oak communities and upland habitats for special-status plants may not all be adverse. Adverse effects on riparian and wetland communities and associated special-status plants would be small, and beneficial effects are also anticipated to result from

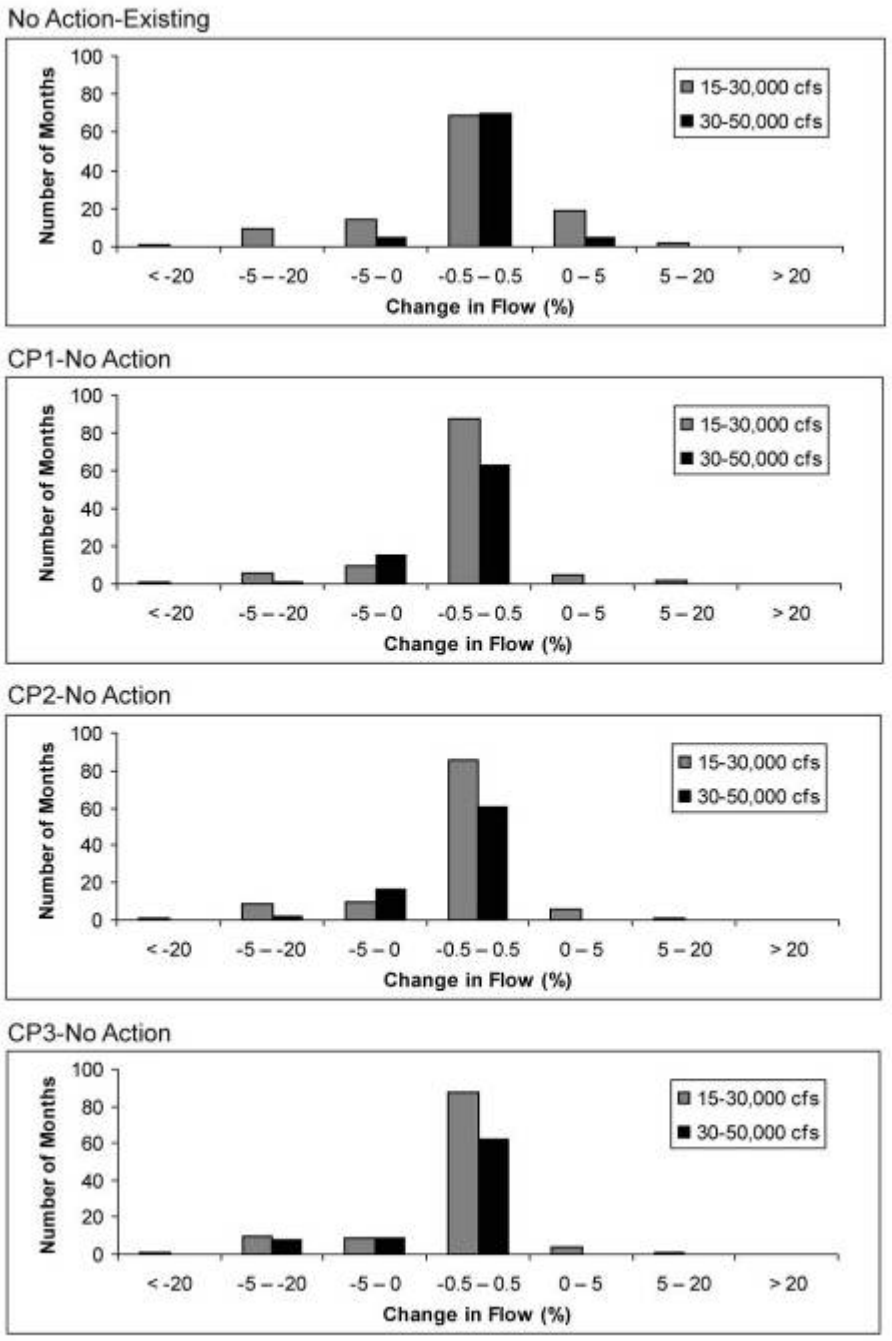
management and restoration actions. Thus, this impact would be less than significant.

Although Shasta Dam would not be altered under the No-Action Alternative, CVP and SWP water storage, conveyance, and deliveries would change because of several reasonably foreseeable actions that would occur with or without enlarging Shasta Dam. As a consequence of these actions, the flow regime of the lower Sacramento River could change between 2005 and 2030. The CalSim-II modeling results that simulate these changes are provided in the *Hydrology, Hydraulics, and Water Management Technical Report* and the larger simulated discharges above Red Bluff and at Wilkins Slough and Freeport are summarized on Figures 12-6, 12-7, and 12-8, respectively. (These locations are shown on Figure 12-9.) Overall, these modeling results suggest only a very small decrease in flows greater than 15,000 cfs along the uppermost portion of the lower Sacramento River. This change might not be sufficient to cause significant effects on riparian and wetland communities, or on associated special-status species.

However, besides causing additional, very small changes in flow regime, the No-Action Alternative would continue to alter the structure and species composition of riparian and wetland vegetation along the lower Sacramento River resulting from the continued operation of Shasta Dam. Before the construction of Shasta Dam, flow volume would decrease gradually during the period of cottonwood and willow seed dispersal. In many years, this flow pattern would facilitate establishment of these early- successional species along the Sacramento River throughout the extended study area. As described for the upper Sacramento River above, along the lower Sacramento River, the extent of early-successional riparian communities would continue decreasing while the extent of mid-successional communities would continue increasing under the No-Action Alternative.

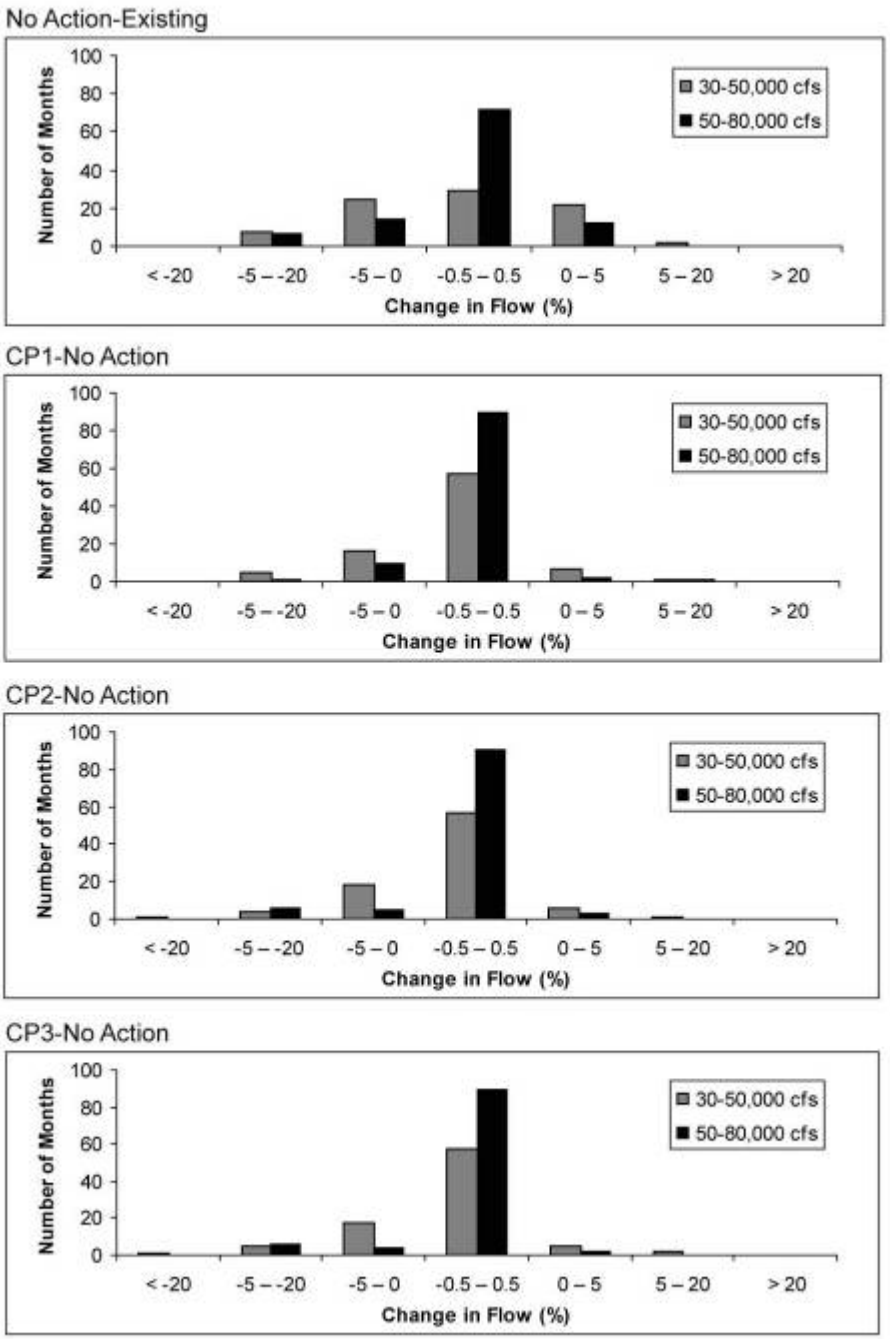
However, under the No-Action Alternative, a number of management and restoration plans and programs carried out by a large number of agencies would be implemented. These actions are described in the “Regulatory Setting” section of this EIS. These actions would cause beneficial effects that would likely be of similar magnitude as the anticipated adverse effects of small changes in flow regime and of continued effects from past actions, and thus would largely offset those adverse effects.

For the reasons described above, this impact would be less than significant. Mitigation is not required for the No-Action Alternative.



Source: Common Assumptions Common Modeling Package Version 8D. CALSIM II. 2005 and 2030 Simulation (NODE 129).

Figure 12-7. Simulated Changes in Larger Mean Monthly Flows of the Sacramento River at Wilkins Slough



Source: Common Assumptions Common Modeling Package Version 8D. CALSIM II. 2005 and 2030 Simulation (NODE 169).

Figure 12-8. Simulated Changes in Larger Mean Monthly Flows of the Sacramento River at Freeport

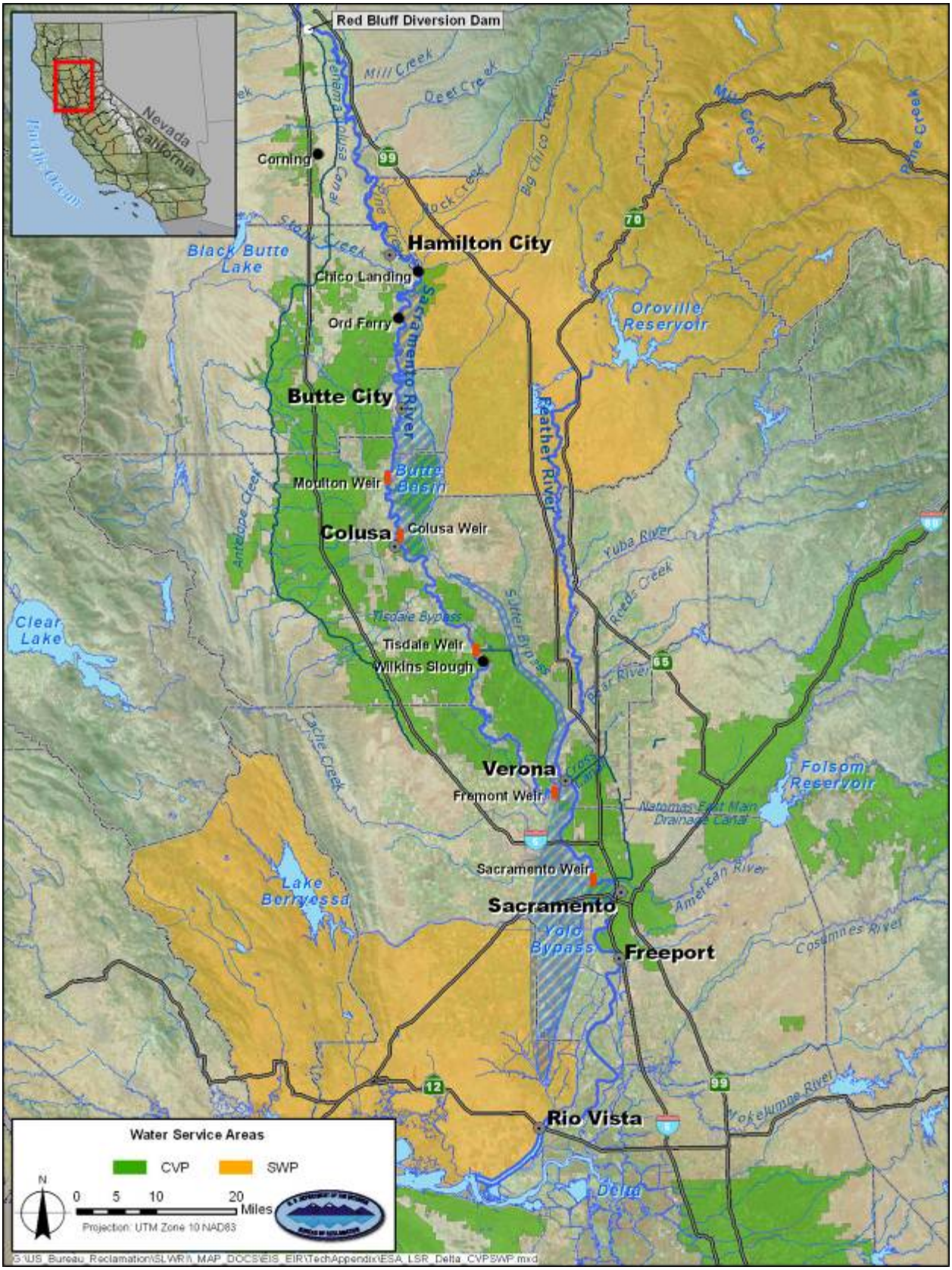


Figure 12-9. Locations along Lower Sacramento River

Impact Bot-15 (No-Action): Conflict with Approved Local or Regional Plans with Objectives of Riparian Habitat Protection or Watershed Management Along the Lower Sacramento River Adopted local and regional plans address and promote the conservation of riparian vegetation and associated habitats along the lower Sacramento River and in the Delta. In the development of regional and local plans, most on-going adverse effects of past actions were considered, but not all effects of reasonably forseeable actions. Unmitigated effects from these actions could be sufficient to conflict with these plans. Therefore, the No-Action Alternative could conflict with approved local or regional plans. This impact would be potentially significant.

There are adopted local and regional plans that address and promote the conservation of riparian vegetation and associated habitats along the lower Sacramento River and in the Delta in the extended study area. These plans, which are discussed in more detail in the "Regulatory Framework" section of this EIS, include the Sacramento River Conservation Area Program and the CALFED Ecosystem Restoration Program, both of which promote the conservation and the restoration of riparian habitat. Under the No-Action Alternative, adverse effects would result from the continued consequences of past actions (e.g., construction of Shasta Dam and the introduction of nonnative species) and from the effects of foreseeable actions. Most adverse effects that are the continued consequences of past actions have been considered in the development of existing local and regional plans. However, the adverse effects of all foreseeable water resource and levee actions were not considered in the development of local and regional plans, and these adverse effects are not likely to be completely avoided or fully mitigated. The unmitigated effects of these actions could be sufficient overall to conflict with a local or regional plan. Therefore, the No-Action Alternative could conflict with approved local or regional plans with objectives of riparian habitat protection or watershed management. This impact would be potentially significant**.** Mitigation is not required for the No-Action Alternative.

Impact Bot-16 (No-Action): Loss of Sensitive Plant Communities and Special-Status Plant Species Resulting from Induced Growth Along the Lower Sacramento River and in the Delta Although Shasta Dam would not be altered, water storage, conveyance, and deliveries to water districts would likely increase because of reasonably foreseeable actions. However, environmental regulations would continue to provide protection for botanical resources, and the effects of future growth would be analyzed and mitigated during land use planning and environmental review for site-specific projects. Therefore, this impact would be less than significant.

Although Shasta Dam would not be altered under the No-Action Alternative, CVP and SWP water storage, conveyance, and deliveries would likely increase because of several reasonably foreseeable actions that would occur with or without enlarging Shasta Dam. Thus, deliveries to water districts in the extended study area along the lower Sacramento River and in the Delta would likely

increase between now and 2030, and this could reduce a limitation on urban growth and development. However, environmental regulations would continue to protect wetlands, riparian habitats, other sensitive botanical communities, and special-status plant species, and the effects of future growth would be analyzed and mitigated during land use planning and environmental review for site-specific projects. Therefore, this impact would be less than significant. Mitigation is not required for the No-Action Alternative.

CVP/SWP Service Areas

Impact Bot-17 (No-Action): Altered Structure and Species Composition and Loss of Sensitive Plant Communities and Special-Status Plant Species Resulting from Altered Flow Regimes in the CVP/SWP Service Areas Altered flow regimes associated with the No-Action Alternative could alter the structure and species composition or cause the loss of riparian, wetland, and oak communities in the CVP and SWP service areas, and of habitat for special-status plant species. However, alteration of flow regimes below CVP and SWP reservoirs would be less than below Shasta Dam along the Sacramento River, and may not be sufficient to alter the distribution of plant communities, or the extent or quality of associated special-status species habitat. Therefore, this impact would be less than significant.

Altered flow regimes associated with the No-Action Alternative could alter the structure and species composition or cause the loss of riparian, wetland, and oak communities, and of habitat for special-status plant species. Vernal pool plant communities and associated special-status plant species likely would not be affected by the altered flow regime. Effects on oak communities and upland habitats for special-status plants would be somewhat speculative and may not all be adverse; thus, on oak communities and special-status plants of upland habitats, this impact would be less than significant. Although riparian and wetland communities could be affected, alteration of flow regimes below CVP and SWP reservoirs in the extended study area would be less than below Shasta Dam along the upper and lower Sacramento River. Below CVP and SWP reservoirs, these alterations may not be sufficient to alter the extent of early-successional riparian and wetland communities, or the extent or quality of associated special-status species habitat. Therefore, this impact would be less than significant below CVP and SWP reservoirs in the extended study area. Mitigation is not required for the No-Action Alternative.

Impact Bot-18 (No-Action): Conflict with Approved Local or Regional Plans with Objectives of Riparian Habitat Protection or Watershed Management in the CVP/SWP Service Areas The No-Action Alternative would not have substantial effects on riparian vegetation and habitats, and thus, would not conflict with existing local and regional plans in the CVP and SWP service areas. This impact would be less than significant.

There are adopted local and regional plans that address and promote the conservation of riparian vegetation and associated habitats along rivers below

reservoirs in the CVP and SWP service areas. However, implementation of the No-Action Alternative would not have substantial effects on riparian vegetation and habitats. Therefore, implementation of this alternative would not conflict with existing local and regional plans focused on preserving riparian habitats. Thus, this impact in the CVP and SWP service areas would be less than significant. Mitigation is not required for the No-Action Alternative.

Impact Bot-19 (No-Action): Loss of Sensitive Plant Communities and Special-Status Plant Species Resulting from Induced Growth in the CVP/SWP Service Areas Although Shasta Dam would not be altered, water storage, conveyance, and deliveries to the CVP and SWP service areas would likely increase because of reasonably foreseeable actions. However, environmental regulations would continue to protect botanical resources, and the effects of future growth would be analyzed and mitigated during land use planning and environmental review for specific projects. Therefore, this impact would be less than significant.

Although Shasta Dam would not be altered under the No-Action Alternative, CVP and SWP water storage, conveyance, and deliveries to the CVP and SWP service areas would likely increase because of several reasonably foreseeable actions that would occur with or without enlarging Shasta Dam. Thus, CVP and SWP deliveries would likely increase between now and 2030, and this could reduce a limitation on growth. However, environmental regulations would continue to protect wetlands, riparian habitats, other sensitive botanical communities, and special-status plant species, and the effects of future growth would be analyzed and mitigated during land use planning and environmental review for specific projects. Therefore, this impact would be less than significant. Mitigation is not required for the No-Action Alternative.

CP1 – 6.5-Foot Dam Raise, Anadromous Fish Survival and Water Supply Reliability

CP1 focuses on increasing water supply reliability while contributing to increased survival of anadromous fish, actions that are consistent with the 2000 CALFED Record of Decision (ROD) (CALFED 2000b). In addition to the features common to all comprehensive plans, CP1 consists primarily of raising Shasta Dam 6.5 feet, an elevation change that would increase the reservoir's full pool by 8.5 feet and enlarge the total storage space in the reservoir by 256,000 acre-feet. Under this plan, operational guidelines for Shasta Dam would continue unchanged, with the additional storage retained for water supply reliability and increased survival of anadromous fish.

Shasta Lake and Vicinity

Impact Bot-1 (CP1): Loss of Federally or State-Listed Plant Species Habitat for Federally or State-listed plant species does not occur at Shasta Lake or in the vicinity. No species are known or expected to occur. Therefore, no impact on Federally listed, State-listed, or candidate plant species would occur under CP1. Mitigation for this impact is not needed, and thus not proposed.

Impact Bot-2 (CP1): Loss of MSCS Covered Species Implementation of the project could result in the loss of MSCS covered species as a result of inundation, vegetation removal, or construction activities. Therefore, this impact would be significant.

The only MSCS species known to occur in the project area is Shasta snow-wreath. Inundation caused by a 6.5-foot dam raise could impact all or portions of 12 (52 percent) of the Shasta snow-wreath populations found on the Sacramento River, McCloud River, and Pit River arms and the Main Body of the lake. Within its range (the Shasta Lake region), there are 23 known populations.

Portions of two Shasta snow-wreath populations are found within one relocation area at Ellery Creek. Activities to decommission the campground could impact the Shasta snow-wreath populations present.

Because complete surveys have not been conducted in the entire impoundment area, other MSCS plant species may be present. In these areas, all or portions of MSCS plant populations could be inundated. This would be a potentially significant impact.

Additional analysis of impacts will be conducted in relation to suitable habitats present in the Shasta Lake watershed. An analysis of indirect impacts and temporary impacts will be provided in the FEIS. Potential mitigation lands containing comparable habitat have been identified adjacent to the project. Additional discussion of how these lands may be applied as mitigation and at what ratios will be provided in the FEIS.

This loss of MSCS covered species and their habitat would be significant. Mitigation for this impact is proposed in Section 12.3.5.

Impact Bot-3 (CP1): Loss of USFS sensitive, BLM sensitive, or CRPR Species Implementation of the project could result in the loss of USFS sensitive, BLM sensitive, or CRPR species as a result of inundation, vegetation removal, or construction activities. Therefore, this impact would be potentially significant.

For areas where botanical surveys have been conducted, direct impacts have been determined using geographic information systems to ascertain the populations within the impoundment area, relocation areas, and construction footprints.

Based on results of surveys to date, special-status plant species known to occur in the primary study area include Shasta County arnica, northern clarkia, Butte County fritillary, Cantelow’s lewisia, Shasta snow-wreath, slender false lupine, Shasta huckleberry, and oval-leaved viburnum.

Direct impacts on Shasta snow-wreath caused by CP1 are addressed in Impact Bot-2 (CP1). As a Forest Service sensitive species, the Shasta snow-wreath is

recognized by the Forest Service to need special management to prevent the species from becoming threatened or endangered. Because the snow-wreath is a local Shasta County endemic species, the impacts are likely to result in a decline in habitat and result in a trend towards listing.

Inundation caused by a 6.5-foot dam raise and vegetation removal could impact all or portions of Shasta County arnica, northern clarkia, Butte County fritillary, Cantelow's lewisia, slender false lupine, Shasta huckleberry, and oval-leaved viburnum populations occurring in the impoundment and relocation areas. Potential populations occurring in the unsurveyed portions of the impoundment area could be flooded and would result in a potentially significant impact. Impacts on known populations are provided below.

Inundation of the impoundment area would impact all or portions of the Shasta arnica population south of Bridge Bay Resort on the Main Body of the lake and the population north of Slaughterhouse Island on the Sacramento Arm. Vegetation removal may impact the Shasta arnica population near the privately owned cabins on National Forest System lands on the Salt Creek inlet on the Sacramento Arm.

Inundation of the impoundment area and vegetation removal in the relocation areas would impact all or portions of northern clarkia populations in Bailey Cove (McCloud Arm) and in Sugarloaf Cove west of Beehive Point (Sacramento Arm).

Inundation of the impoundment area may impact all or portions of populations of Butte County fritillary located on Flat and Ripgut creeks on the Pit Arm.

Inundation of the impoundment area would impact all or portions of the Cantelow's lewisia population on a rock outcrop on the right bank of the Upper Sacramento River riverine reach near the Shasta Lake/upper Sacramento River transition zone. Inundation may also impact populations found along the Sacramento Arm near Elmore Mountain.

Inundation of the impoundment area and vegetation removal in the relocation areas would impact all or portions of slender false lupine populations throughout the impoundment area and relocation areas.

Within its range (the Shasta Lake region), there are 12 known populations Shasta huckleberry. Inundation caused by a 6.5-foot dam raise could impact portions of the 12 (100 percent) Shasta huckleberry populations on the Squaw Creek Arm and the Main Body. The populations extend beyond the project boundary at each location and no population will be completely lost as a result of CP1.

Portions of one Shasta huckleberry population occur within one relocation area at in the Bully Hill area. Construction activities in this area could impact the Shasta huckleberry population present.

Because complete surveys have not been conducted in the entire impoundment area, other of USFS sensitive, BLM sensitive, and CRPR species plant species may be present. In these areas, all or portions of USFS sensitive, BLM sensitive, and CRPR species plant populations could be inundated. This would be a potentially significant impact.

Collectively, the loss of USFS sensitive, BLM sensitive, and CRPR species and their habitat would therefore be potentially significant. Mitigation for this impact is proposed in Section 12.3.5.

Impact Bot-4 (CP1): Loss of Jurisdictional Waters Implementation of the project may result in the loss of jurisdictional waters caused by flooding the impoundment area and discharge of fill associated with the relocation of facilities and dam construction. Flooding caused by implementation of the project would result in the conversion of jurisdictional water types (e.g., wetlands and streams to lacustrine). Therefore, this impact would be significant.

Direct impacts would incur with the conversion of jurisdictional waters (e.g., wetlands and streams) to lacustrine with implementation of CP1. All features within the impoundment area would be converted to lacustrine. Under CP1, 11 acres of wetlands and 18 acres of other waters would be converted to lacustrine (Table 12-9). This will result in a net loss of 11 acres to wetlands and a no net loss to other waters. This is considered a significant impact.

Direct impacts on jurisdictional waters (e.g., intermittent and perennial streams) that will be filled as a result of relocation of facilities or dam construction will be determined. Additionally, some fill may be placed in the existing full pool of Shasta Lake for restoration and enhancement activities. An analysis of impacts on jurisdictional waters in the full pool, relocation areas, indirect impacts, and temporary impacts will be provided in the FEIS. Additional analysis of impacts will be conducted in relation to waters of the United States present in the Shasta Lake watershed. Mitigation for this impact is proposed in Section 12.3.5.

Impact Bot-5 (CP1): Loss of General Vegetation Habitats Implementation of the project would result in a loss of general vegetation habitats because of inundation, vegetation removal, or construction activities. Therefore, this impact would be potentially significant.

Under CP1, 1,221 acres of general vegetation habitat will be directly impacted by the inundation of the impoundment area and 3,127 acres of general vegetation habitat will be impacted by vegetation removal in the construction footprints of the relocation areas (Table 12-10 and Table 12-11). This impact is considered significant.

Table 12-9. Impacts to Jurisdictional Waters (Acres*) in the Impoundment Area (6.5-Foot Dam Raise)

Jurisdictional Water Type	Main Body	Big Backbone Arm	Sacramento Arm	McCloud Arm	Squaw Creek Arm	Pit Arm
Wetlands						
Fresh emergent/ riparian wetland	0.00	0.00	3.00	0.00	0.00	0.00
Intermittent swale	0.00	0.001	0.00	0.00	0.00	0.02
Riparian wetland	0.44	0.47	2.85	1.82	0.35	0.47
Seasonal wetland	0.00	0.00	0.14	0.00	0.00	0.02
Seep/spring wetland	0.43	0.14	0.45	0.16	0.05	0.25
Vegetated ditch	0.00	0.00	0.00	0.002	0.00	0.00
Total Wetlands	0.87	0.61	6.44	1.98	0.40	0.76
Other Waters of the United States						
Ephemeral stream	0.13	0.01	0.27	0.12	0.07	0.05
Intermittent stream	0.65	0.12	0.91	0.42	0.35	1.22
Perennial stream	0.81	1.00	4.25	5.77	1.05	0.75
Roadside ditch	0.00	0.00	0.01	0.00	0.00	0.00
Seep/spring other waters	0.01	0.00	0.001	0.01	0.00	0.00
Total Other Waters	1.60	1.13	5.44	6.32	1.47	2.02
Total Waters of the U.S	2.47	1.74	11.88	8.30	1.87	2.78

Note: *Acreage values are approximate.

Table 12-10. Impacts to CWHR Habitats in the Impoundment Area (6.5-Foot Dam Raise)

Habitat	Area (Acres*)					
	Main Body	Big Backbone Creek	Sacramento Arm	McCloud Arm	Squaw Creek Arm	Pit Arm
Annual grassland	0.07	0	0.96	0.37	0	0
Barren	0.57	0.00	0.25	0.00	0.00	0.00
Blue oak–foothill pine	4.96	0	0	0	1.40	4.04
Blue oak woodland	0	0	0	0	0	1.32
Closed-cone pine–cypress	17.75	0	6.30	10.74	23.95	188.29
Douglas-fir	0	0	0	0.01	0	0
Mixed chaparral	14.83	6.83	80.01	7.28	5.43	27.73
Montane hardwood	39.08	18.13	86.75	32.23	9.44	1.28
Montane hardwood–conifer	34.65	0.50	69.23	68.73	55.70	5.68
Montane riparian	1.54	2.48	15.92	4.60	0.58	0.80
Ponderosa pine	108.93	15.36	84.75	81.24	25.06	29.93
Riverine	0	0.35	2.30	3.81	0.59	0
Urban	10.95	0	1.37	4.74	0	0.75
Total	233.33	43.65	347.84	213.75	122.14	259.82

Note:
*Acreage values are approximate.

Table 12-11. Impacts to CWHR Habitats in the Relocation Areas

Habitat	Area (Acres*)					
	Main Body	Big Backbone Creek	Sacramento Arm	McCloud Arm	Squaw Creek Arm	Pit Arm
Annual grassland	5.05	0.00	29.02	10.65	1.29	1.25
Barren	0.00	0.00	0.00	0.82	0.00	0.00
Blue oak–foothill pine	3.61	0.00	0	0	0	13.74
Blue oak woodland	0	0.00	0	3.89	0	2.28
Closed-cone pine–cypress	0.11	0.00	56.90	8.95	1.94	33.72
Douglas-fir	0	0.00	0	3.18	0	0
Lacustrine	0	0.00	0	32.64	0	0
Mixed chaparral	25.68	0.00	120.00	46.36	4.44	134.82
Montane hardwood	48.21	0.00	198.56	214.87	6.34	3.44
Montane hardwood–conifer	121.63	0.00	205.41	316.45	42.22	42.28
Montane riparian	0.34	0.00	4.72	8.02	0.23	1.45
Ponderosa pine	185.06	0.00	466.94	406.43	43.08	45.30
Riverine	0	0.00	0.39	3.75	0	0
Urban	21.05	0.00	230.58	0.48	0	2.49
Total	410.74	0.00	1,312.51	1,023.85	99.53	280.48

Note:
*Acreage values are approximate.

Additional analysis of impacts will be conducted in relation to suitable habitats in the Shasta Lake watershed. An analysis of indirect impacts and temporary impacts will be provided in the FEIS. Mitigation for this impact is proposed in Section 12.3.5.

Impact Bot-6 (CP1): Spread of Noxious and Invasive Weeds Implementation of the project could result in the spread of noxious and invasive weeds as a result of ground-disturbing activities during construction and an increased number of vectors (means of dispersal). Therefore, this impact would be potentially significant.

Noxious and invasive weeds are abundant around Shasta Lake specifically in the relocation areas. Vectors that would increase as a result of project implementation include weed seed and seed parts brought in on tools, vehicles, and workers' clothing and boots. The extent of the risk would depend on the construction methods used and site-specific actions implemented to complete the project. As access into specific project areas is improved, road construction, temporary roads, and road maintenance would increase the number of vectors in an area. As traffic along new and existing corridors increases, the risk for weed dispersal would increase. Seed mixtures and mulches may be used during erosion control efforts and revegetation of areas. These mixtures and mulches are potential vectors for noxious weed and invasive plant dispersal.

Construction of the dam would result in inundation of shoreline habitat. Depending on the extent of colonization, many populations of noxious weeds

could be inundated. However, there would be no increase in vector traffic and no soil disturbance due to inundation. Therefore, the risk of weed spread from the inundation of habitat is low.

However, vegetation removal in areas to be inundated may increase risk of weed spread. Habitat vulnerability and project-associated vectors in inundation zones would be variable, based on the extent of the vegetation removal and the location of the proposed activity. All habitats are vulnerable when canopies are opened and soil is disturbed. Increased traffic and soil disturbance coupled with an adjacent, high-ranking noxious weed may result in a moderate to high risk of weed spread.

Because of the dam expansion, other ground-disturbing projects would be implemented to relocate displaced roads, railways, utilities, homes, and recreation facilities. The potential for disturbance of noxious weeds is highly variable, based on the proposed activity and the abundance of weeds present. Depending on the location of high-ranking noxious weeds, the extent of ground-disturbing activities, and the amount of traffic entering a project site, the risk of noxious weed infestation would vary.

This impact would be potentially significant. Mitigation for this impact is proposed in Section 12.3.5.

Upper Sacramento River (Shasta Dam to Red Bluff)
Impact Bot-7 (CP1): Altered Structure and Species Composition and Loss of Sensitive Plant Communities and Special-Status Plant Species Resulting from Altered Flow Regimes Altered flow regimes associated with project implementation under CP1 could alter the structure and species composition or cause the loss of riparian, wetland, and oak communities, and of habitat for special-status plant species. Vernal pool plant communities and associated special-status species likely would not be affected. Effects on oak communities and upland habitats for special-status plants may not all be adverse. Adverse effects on riparian and wetland communities and associated special-status plants could be substantial; thus, this impact would be significant.

Potential impacts on flow and stages of the upper Sacramento River from CP1 would be small. On average, in each month, changes in mean monthly flow would be reductions or increases of several percent. Generally, these effects diminish with distance downstream because of the influence of inflows from tributaries and of diversions and flood bypasses.

In average and wet years, river flows would decrease during the November through February period of some years. This would be because of the increased storage space that could be filled in some years, usually following dry or critically dry water years. During these years, mean monthly flow November through February could be reduced by 10 percent or more.

During the June through August period of some years, flow and stage would increase. This increase would be most pronounced during some dry and critical years as more water is released from Shasta Dam for water supply reliability purposes. During May through August in different types of water years, the average changes in mean monthly flow would be reductions or increases of several percent (generally less than 2 percent), although the changes in mean monthly flow would be greater in some years. (September through October and March through April flows would be transitional and intermediate between those described for November through February and for May through August.)

Northern hardpan vernal pools and Northern volcanic mudflow vernal pools are not present at Shasta Dam and are generally not present within the active floodplain immediately adjacent to the channel of the upper Sacramento River or its tributaries in the primary study area. Therefore, northern hardpan vernal pools and associated special-status plant species would likely not be affected by the altered flows in the primary study area downstream from Shasta Dam.

The altered flow regime of the upper Sacramento River associated with implementation of CP1 could affect oak communities and upland habitat for special-status plant species by prolonging inundation and changing the availability of soil moisture. Prolonged inundation during the growing season kills most upland plants. This effect would occur during years when mean monthly stage during March – October is greater than in preceding years. Interannual fluctuations in stage during the growing season already cause upland vegetation to become removed from (or prevent its establishment within) a zone along rivers downstream from Shasta Dam. CP1 could increase the average elevation of this zone slightly (by, on average, increasing stage during the growing season of most years), but it would not increase the zone's elevational range. For some upland vegetation, greater summer flows in some years also could increase summer soil moisture, and reduced intermediate and large flows during winter in some years could reduce spring soil moisture. Because of the important influence of water availability on plant growth and survival, these changes in the availability of moisture could change the structure and species composition of oak communities or affect special-status plants of upland habitats.

These effects, however, are speculative, and may not all prove to be adverse with project implementation and operation. For example, greater summer flows in some years could increase summer soil moisture; in dry years, increased soil moisture could sustain plants that otherwise would be damaged or die. Therefore, the impact on oak communities and on upland habitat for special-status plants resulting from altered flow regimes on the upper Sacramento River within the primary study area would be less than significant.

The flow regime of a river or stream strongly influences the structure and species composition of the riparian and wetland communities associated with it.

For this reason, the altered flow regimes resulting from project implementation would affect riparian and wetland vegetation. These effects are described below.

River flows strongly affect the growth and survival of riparian plants. Riparian plants are strongly affected by the timing and duration of inundation; abrasion and burial by water-borne sediment; and by water table fluctuations (Toner and Keddy 1997; Friedman and Auble 1999; Karrenberg et al. 2002; Bagstad et al. 2005; Lite and Stromberg 2005; Williams and Cooper 2005). As a result, riparian communities often differ in structure and species composition along gradients of elevation or flooding frequency and intensity (Conard et al. 1977; Harris 1987; Toner and Keddy 1997; Bagstad et al. 2005; Vaghti and Greco 2007).

River flows not only affect the survival and growth of established riparian vegetation, but also create sites for establishment of early-successional vegetation. The geomorphic processes of channel meander migration, avulsion, and deposition of sediment on floodplains, which result primarily from intermediate and large flows, bury and uproot herbaceous vegetation and uproot or undercut trees and shrubs. These disturbances also create opportunities for early-successional vegetation to establish, including willow and cottonwood seedlings that grow to form willow scrub and Great Valley cottonwood riparian forest.

Early successional riparian communities change rapidly in structure and species composition (Tu 2000; Fremier 2003; Vaghti and Greco 2007). Over several decades, early-successional vegetation develops into mid- and late-successional vegetation with less willow and cottonwood and a greater abundance of other trees including box-elder, Oregon ash, black walnut, and valley oak (e.g., Great Valley mixed riparian forest) (Fremier 2003).

Thus, for riparian vegetation, the rates of geomorphic processes strongly affect the extent of different riparian communities; and, these rates are strongly related to flow regime. For example, bank erosion, and the average rate of meander migration are closely related to the cumulative portion of flow above a threshold volume. On portions of the Sacramento River, this threshold may be around 30,000 cfs (Larsen et al. 2006; Stillwater Sciences 2007), which is well below the bankfull discharge but well above flows during spring and summer. However, other important thresholds for bank erosion and channel avulsion along the Sacramento River have been estimated within the range from 10,000 to 80,000 cfs (Stillwater Sciences 2007). (For additional discussion of the relationship of geomorphic processes to flow along the Sacramento River, see the *Fisheries and Aquatic Ecosystem Technical Report*.)

Flow regimes during the period of seed dispersal also strongly influence establishment of seedlings of riparian trees and shrubs, particularly willows and cottonwoods. In general, seeds of riparian plants can only successfully germinate and establish on exposed surfaces; prolonged inundation of a surface

during the growing season prevents establishment. Willows and cottonwoods have very small, short-lived seed and are shade-intolerant plants; thus, their seeds must disperse to exposed, moist surfaces that are largely free of vegetation. Such surfaces are often created by channel migration, avulsion, and sediment deposition during larger winter and spring flows. They are then exposed by declining flows during the seed dispersal period of willow and cottonwood species. These seed dispersal periods are staggered across spring and summer; for example, March through April for arroyo willow, April–June for cottonwood, and May through August for black willow. Once willow and cottonwood seeds germinate, slowly declining flows are necessary to maintain their roots in contact with saturated soils, which in turn is necessary for establishment. Rapidly declining flows (i.e., those greater than 1 to 1.5 inches per day) result in desiccation and mortality of seedlings (Mahoney and Rood 1998; Stillwater Sciences 2007). Conversely, flows that increase during the growing season bury, uproot, or scour many seedlings.

Consequently, reductions in the magnitude, duration, and frequency of intermediate and large flows could reduce opportunities for cottonwood and willow species to establish and thus limit the extent of early and mid-successional riparian communities. The absence of slowly declining spring flows also would reduce cottonwood establishment.

The operation of Shasta Dam has limited the frequency, magnitude, and duration of intermediate and larger flows during fall and winter, since the dam's construction, and flow volumes have been greater during the growing season. The operation of Shasta Dam also produces increasing flow volumes during the period of cottonwood seed dispersal (rather than flow volume decreasing during this period), largely precluding establishment of cottonwoods (and to a lesser extent willows) throughout much of the riparian zone (Roberts et al. 2002). The combined effect of these changes in flow regime has been a decrease in early- and mid-successional communities along the Sacramento River that is still ongoing (Fremier 2003).

CP1 would lead to a further reduction in the magnitude, duration, and frequency of intermediate and large flows, but it would not alter the general annual pattern of flows increasing during the cottonwood seed dispersal period. However, CP1's effects on larger flows could further reduce the frequency or extent of suitable conditions for cottonwoods to establish from seed. Overall, the project would increase the existing, ongoing impacts on riparian vegetation resulting from the operation of Shasta Dam. This could reduce the area of riparian vegetation slightly, and reduce the proportion of riparian vegetation that is in early- and mid-successional stages (e.g., willow- and cottonwood-dominated communities) while increasing the extent of mid-successional communities (e.g., mixed riparian forest). This would be an exacerbation of an ongoing transition (which is described under Impact Bot-7 (No-Action)).

These effects would likely occur along the upper Sacramento River throughout the primary study area. Reductions in the magnitude of intermediate and large flows would likely be sufficient to alter the dynamics and structure of the riparian corridor along the upper Sacramento River, downstream from Shasta Dam, throughout the primary study area. These effects on larger flows downstream from Keswick Dam and above Red Bluff are shown on Figures 12-5 and 12-6, respectively. On average, mean monthly flows greater than 15,000 cfs would be reduced only slightly; however, this average reduction reflects a combination of many months with little change in flow and other months with larger changes. For example, at Red Bluff, 142 months had mean monthly flows greater than 15,000 cfs. On average, CP1 would result in a reduction in these flows of less than 2 percent; but in 16 (11 percent) of these months, flows would be reduced by more than 5 percent versus only 1 month with a simulated increase of greater than 5 percent.

Although the establishment of most wetland plants is less strongly influenced by specific attributes of the flow regime than willows and cottonwoods, flow regime still plays an important role in wetland communities. In general, wetland communities on floodplains are strongly influenced by timing and duration of inundation, scour and deposition of sediment, and fluctuations in water table elevations within and among years (Keddy 2000; Leyer 2005; van Eck et al. 2006). Changes in flow during some years would change the extent of some wetland communities (e.g., seeps, seasonal wetlands) during that year and/or subsequent years, and thus the average extent of those communities. Overall, wetland communities could experience effects similar to those described for riparian communities.

For the reasons outlined above, and because riparian and wetland communities are sensitive natural communities, this impact would be significant. Mitigation for this impact is proposed in Section 12.3.5.

Eleven special-status plant species could occur in riparian or wetland habitats in the primary study area (including mesic upland-associated species; Table 12-4). Of these, within the primary study area and nearby counties (Butte and Glenn), four are known to occur along the edge of the Sacramento River channel, or along a Sacramento River tributary within 0.2 mile of the river proper, and their establishment and reproduction could potentially be affected by changes in flow regime: fox sedge (CNPS list 2), silky cryptantha (CNPS list 1B), rose mallow (CNPS list 2), and Ahart's paronychia (CNPS list 1B) (CNDDB 2007; University of California 2011). Because altered flow regimes associated with the project could modify habitat for these special-status species, this impact would be significant.

Impact Bot-8 (CP1): Conflict with Approved Local or Regional Plans with Objectives of Riparian Habitat Protection or Watershed Management
Numerous local and regional plans promote the conservation of riparian vegetation and associated habitats along the upper Sacramento River. Because

CP1 would adversely affect riparian communities, this alternative could conflict with existing local and regional plans focused on preserving riparian habitats. Therefore, this impact would be potentially significant**.**

Local and regional plans addressing riparian habitats in the primary study area are discussed in more detail in the "Regulatory Setting" section of this EIS and include the RHJV and the Sacramento River Conservation Area Program, both of which promote the conservation and the restoration of riparian habitat. As described for Impact Bot-7 (CP1), implementation of this alternative could cause substantial adverse effects on riparian and wetland communities by altering the flow regime of the upper Sacramento River and could, therefore, conflict with existing local and regional plans that aim to conserve riparian habitats. Therefore, this impact would be potentially significant. Mitigation for this impact is proposed in Section 12.3.5.

Impact Bot-9 (CP1): Disturbance or Removal of Designated Critical Habitat for Special-Status Species Designated critical habitat for four vernal pool special-status plant species exists within the primary study area. However, such critical habitat is not expected to be adversely affected by CP1. This impact would be less than significant.

Critical habitat for four special-status species – slender orcutt grass, Hoover's spurge, hairy orcutt grass, and Greene's tuctoria – exists within the primary study area. Critical habitat for these species in the primary study areas is confined to vernal pool communities (USFWS 2006). Vernal pools are generally not present within the active floodplain. However, if vernal pool habitats for these special-status species are present in the active floodplain of the upper Sacramento River, they could be affected by the small reduction in the frequency and magnitude of overbank flows. It is not known if this would be an adverse or beneficial effect. Because this effect of CP1 is somewhat speculative and not necessarily adverse, this impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact Bot-10 (CP1): Loss of Sensitive Plant Communities and Special-Status Plant Species Resulting from Induced Growth Implementing CP1 could increase water yield for water districts in the primary study area along the upper Sacramento River. This increase in water yield could reduce a limitation on urban growth and development that could affect sensitive plant communities and special-status plant species. However, this increase in water yield for growth that could affect these resources would be small, and in the future the effects of this growth would be analyzed and mitigated during land use planning and environmental review for specific projects. For these reasons, this impact would be less than significant.

Along the upper Sacramento River, the CVP and SWP service areas contain wetland, riparian, oak, and other sensitive plant communities, and a large number of special-status plant species (Attachment 4). Increased water supplies

or increased supply reliability could reduce a limitation on urban growth and development or on other activities that could affect sensitive plant communities or special-status plants in the primary and extended study areas, potentially resulting in significant effects.

The expected increase in water yield relative to the entire CVP and SWP service areas would be small (i.e., less than 1 percent), however, and this new yield would be provided to a number of geographic areas within the CVP and SWP service areas. (In the portions of the CVP service area in the upper Sacramento River region, total agricultural water supplies would increase in some years but by less than 1 percent.) Also, a substantial portion of this water would substitute for groundwater pumping, allow for changes in agricultural irrigation practices, or return idle cropland to production. Consequently, this alternative's effect on growth that could affect vegetation would be minor.

Furthermore, the effects of this growth would be analyzed in general plan Environmental Impact Reports and in project-level CEQA compliance documents for the local jurisdictions in which the growth would occur. Mitigation of these effects would be the responsibility of these local jurisdictions, and not of Reclamation. Similarly, projects potentially affecting riparian and wetland habitats and listed species would require permits from DFG, USACE, and USFWS; it is anticipated that effects on these resources would be avoided, minimized, and/or mitigated during those agency consultations.

The extent of induced growth that could affect botanical resources would likely be minor, and in the future the effects of this growth would be analyzed and mitigated during land use planning and environmental review for specific projects. Therefore, this impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact Bot-11 (CP1): Loss of Sensitive Natural Communities or Habitats Resulting from Implementing the Gravel Augmentation Program or the Reading Island Restoration Plan, Rehabilitating the Reading Island Boat Ramp, or Constructing a Handicap Fishing Access Area The proposed gravel augmentation program and Reading Island restoration and construction activities would not be implemented under CP1. Therefore, no impact would occur. Mitigation for this impact is not needed, and thus not proposed.

Impact Bot-12 (CP1): Loss of Special-Status Plants Resulting from Implementing the Gravel Augmentation Program, Restoring Sacramento River Flow Through Anderson Slough, Rehabilitating the Reading Island Boat Ramp, or Constructing a Handicap Fishing Access Area The proposed gravel augmentation program and Reading Island restoration and construction activities would not be implemented under CP1. Therefore, no impact would occur. Mitigation for this impact is not needed, and thus not proposed.

Impact Bot-13 (CP1):Spread of Noxious and Invasive Weeds Resulting from Implementing the Gravel Augmentation Program, Restoring Sacramento River Flow Through Anderson Slough, Rehabilitating the Reading Island Boat Ramp, or Constructing a Handicap Fishing Access Area The proposed gravel augmentation program and Reading Island restoration and construction activities would not be implemented under CP1. Therefore, no impact would occur. Mitigation for this impact is not needed, and thus not proposed.

Lower Sacramento River and Delta

Impact Bot-14 (CP1): Altered Structure and Species Composition and Loss of Sensitive Plant Communities and Special-Status Plant Species Resulting from Altered Flow Regimes on the Lower Sacramento River Altered flow regimes associated with project implementation under CP1 could alter the structure and species composition or cause the loss of riparian, wetland, and oak communities, and loss of habitat for special-status plant species. Vernal pool plant communities and associated special-status plant species likely would not be affected. Effects on oak communities and upland habitats for special-status plants may not all be adverse. Adverse effects on riparian and wetland communities and associated special-status plants could be substantial on the lower Sacramento River, but these effects are unlikely to extend to the Delta; thus, this impact would be significant on the lower Sacramento River, and less than significant in the Delta.

This impact would be similar to Impact Bot-7 (CP1) for the upper Sacramento River, but alteration of the Sacramento River's flow regime would be attenuated in the lower river by the effects of inflows from tributaries and of diversions and flood bypasses. Measurable effects on riparian and wetland plant communities are unlikely to extend as far downstream as the Delta, in part because releases from Shasta Dam account for a smaller fraction of total flow with increasing distance downstream as tributaries cumulatively add to the Sacramento River's flow.

Nonetheless, significant impacts on riparian and wetland communities, and associated special-status plants, would be caused on the lower Sacramento River, particularly near the upper Sacramento River. South of RBDD, the portion of the Sacramento River's total annual flow that is accounted for by flows greater than 30,000 cfs would still be reduced, and also the frequency of flows greater than 60,000 to 80,000 cfs (i.e., roughly the size of the current 1.5- to 2-year events) would be reduced. For Red Bluff, Wilkins Slough, and Freeport, these changes are summarized on Figures 12-6, 12-7, and 12-8, respectively. (These three locations are shown on Figure 12-9.) As described for Impact Bot-7 (CP1) (and in the *Fisheries and Aquatic Ecosystem Technical Report*), flows above about 30,000 cfs and 1.5- to 2-year events cause substantial changes in riparian ecosystems. These changes indicate that although they would be small, the alterations to the lower Sacramento River's flow regime could be sufficient to cause significant impacts in the Red Bluff-to-Chico Landing reach. This reach is immediately downstream from the primary

study area but upstream from the flood bypasses and the Feather and American rivers, which substantially attenuate the effects of flows released from Shasta Dam. This reach is mostly unleveed and has few other constraints to channel movement, river meander, and flooding; consequently, it has an extensive acreage of early-, mid-, and late-successional riparian communities (Resources Agency 2003).

Effects are unlikely to extend to the Delta because the flood bypasses and the Feather and American rivers attenuate the effects of flows released from Shasta Dam. In addition, much of the Sacramento River's length south of Colusa, and almost all Delta sloughs, are leveed (often close to the channel), restricting channel movement, river meander and flooding. Further; the acreage of early-, mid-, and late-successional riparian communities is much less extensive along the Sacramento River south of Colusa and in the Delta.

Effects of flow alterations are also unlikely to extend to the Delta because the Central Valley's reservoirs and diversions are managed as a single integrated system (consisting of the CVP and SWP). The guidelines for this management, which are described in the CVP Operations Criteria and Plan, have been designed to maintain standards for Delta inflow. CVP and SWP operations must be consistent with the Operations Criteria and Plan to allow coverage by the Operations Criteria and Plan biological opinion. Thus, implementation of CP1 is not anticipated to alter Sacramento River flows to the Delta sufficiently to alter the dynamics or structure of vegetation in the Delta. Thus, impacts on the Delta portion of the extended study area would be less than significant.

This impact would be significant along the lower Sacramento River and less than significant in the Delta. Mitigation for this impact along the lower Sacramento River is proposed in Section 12.3.5.

Impact Bot-15 (CP1): Conflict with Approved Local or Regional Plans with Objectives of Riparian Habitat Protection or Watershed Management Along the Lower Sacramento River Adopted local and regional plans address and promote the conservation of riparian vegetation and associated habitats along the lower Sacramento River. Because CP1 would adversely affect riparian communities, this alternative could conflict with existing local and regional plans focused on preserving riparian habitats. Therefore, this impact on the lower Sacramento River would be potentially significant**.**

Numerous local and regional plans address and promote the conservation of riparian vegetation and associated habitats along the lower Sacramento River and in the Delta. These plans, which are discussed in more detail in the "Regulatory Framework" of this EIS, include the Riparian Habitat Joint Venture and the Sacramento River Conservation Area Program, both of which promote the conservation and the restoration of riparian habitat. As described for Impact Bot-14 (CP1), implementation of this alternative could cause substantial adverse effects on riparian and wetland communities along a portion of the lower

Sacramento River by altering its flow regime, but such effects would not occur in the Delta. Because the project has the potential to result in substantial adverse effects on riparian communities, it could conflict with existing local and regional plans. Therefore, on the lower Sacramento River, this impact would be potentially significant, but in the Delta this impact would be less than significant. Mitigation for this impact on the lower Sacramento River is proposed in Section 12.3.5.

Impact Bot-16 (CP1): Loss of Sensitive Plant Communities and Special-Status Plant Species Resulting from Induced Growth Along the Lower Sacramento River and in the Delta Implementation of CP1 could increase water yield for water districts in the extended study area along the lower Sacramento River. This increase in water yield could reduce a limitation on urban growth and development that could affect sensitive plant communities and special-status plant species. However, this increase in water yield for growth that could affect these resources would be small, and in the future the effects of this growth would be analyzed and mitigated during land use planning and environmental review for specific projects. For these reasons, this impact would be less than significant.

This impact would be similar to Impact Bot-10 (CP1) for the upper Sacramento River, but the increased water yield available along the lower Sacramento River would differ from that along the upper Sacramento River. However, this impact would also be less than significant. Mitigation for this impact is not needed, and thus not proposed.

CVP/SWP Service Areas

Impact Bot-17 (CP1): Altered Structure and Species Composition and Loss of Sensitive Plant Communities and Special-Status Plant Species Resulting from Altered Flow Regimes in the CVP/SWP Service Areas Altered flow regimes associated with project implementation under CP1 could alter the structure and species composition or cause the loss of sensitive plant communities and of habitat for special-status plant species. However, alteration of flow regimes below CVP and SWP reservoirs in the extended study area would be less than below Shasta Dam along the upper and lower Sacramento River. These alterations may not be sufficient to alter the extent of early successional riparian and wetland communities or of associated habitat for special-status species. Therefore, this impact would be less than significant below CVP and SWP reservoirs in the extended study area.

This impact would be similar to Impact Bot-7 (CP1) for the upper Sacramento River. However, flow changes below CVP and SWP reservoirs are anticipated to be smaller than along the Sacramento River. These alterations may not be sufficient to alter the extent of early successional riparian and wetland communities or of associated habitat for special-status species. Therefore, this impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact Bot-18 (CP1): Conflict with Approved Local or Regional Plans with Objectives of Riparian Habitat Protection or Watershed Management in the CVP/SWP Service Areas Adopted local and regional plans address and promote the conservation of riparian vegetation and associated habitats along rivers below reservoirs in the CVP and SWP service areas. However, implementing CP1 would not cause a significant impact on riparian vegetation and habitats. Therefore, CP1 would not conflict with existing local and regional plans focused on preserving riparian habitats. Thus, this impact in the CVP and SWP service areas would be less than significant.

Local and regional plans address and promote the conservation of riparian vegetation and associated habitats in the CVP and SWP service areas. (These plans are discussed in more detail in the "Regulatory Setting" section of this EIS.) However, as described for Impact Bot-17 (CP1), implementation of CP1 would not cause significant impacts on riparian and wetland communities in the CVP and SWP service areas. Therefore, CP1 would not conflict with existing local and regional plans. This impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact Bot-19 (CP1): Loss of Sensitive Plant Communities and Special-Status Plant Species Resulting from Induced Growth in the CVP/SWP Service Areas Implementation of CP1 could increase water yield for water districts in the CVP and SWP service areas. This increase in water yield could reduce a limitation on urban growth and development that could affect sensitive plant communities and special-status plant species. However, this increase in water yield for growth that could affect these resources would be small, and in the future the effects of this growth would be analyzed and mitigated during land use planning and environmental review for specific projects. For these reasons, this impact would be less than significant.

This impact would be similar to Impact Bot-10 (CP1) for the upper Sacramento River, but the increased water yield available in the CVP and SWP service areas would differ from that along the upper Sacramento River. However, this impact would also be less than significant. Mitigation for this impact is not needed, and thus not proposed.

CP2 – 12.5-Foot Dam Raise, Anadromous Fish Survival and Water Supply Reliability

Like CP1, this comprehensive plan focuses on enlarging Shasta Dam and Shasta Lake consistent with the goals of the 2000 CALFED ROD (CALFED 2000b), and was formulated for the primary purposes of increasing water supply reliability and survival of anadromous fish. In addition to the features common to all comprehensive plans, CP2 consists of raising Shasta Dam 12.5 feet, an elevation change that would increase the reservoir's full pool by 14.5 feet and enlarge the total storage space in the reservoir by 443,000 acre-feet. This alternative would help reduce future shortages by increasing water supply reliability in drought and average years. The increased cold-water pool also

would contribute to improved seasonal water temperatures for anadromous fish on the upper Sacramento River.

Shasta Lake and Vicinity

Impact Bot-1 (CP2): Loss of Federally or State-Listed Plant Species Habitat for Federally or State-listed plant species does not occur at Shasta Lake or in the vicinity. No species are known or expected to occur. Therefore, no impact on Federally listed, State-listed, or candidate plant species would occur under CP2. Mitigation for this impact is not needed, and thus not proposed.

Impact Bot-2 (CP2): Loss of MSCS Covered Species Implementation of the project could result in the loss of MSCS covered species because of inundation, vegetation removal, or construction activities. Therefore, this impact would be significant.

Impacts related to dam construction and vegetation clearing within the relocation areas would be similar to CP1. However, inundation caused by a 12.5-foot raise of Shasta Dam could result in the loss of more individual plants. Therefore, this impact would be significant.

Additional analysis of impacts will be conducted in relation to suitable habitats in the Shasta Lake watershed. An analysis of indirect impacts and temporary impacts will be provided in the FEIS. Potential mitigation lands containing comparable habitat have been identified adjacent to the project. Additional discussion of how these lands may be applied as mitigation and at what ratios will be provided in the FEIS. Mitigation for this impact is proposed in Section 12.3.5.

Impact Bot-3 (CP2): Loss of USFS Sensitive, BLM Sensitive, or CRPR Species Implementation of the project could result in the loss of USFS sensitive, BLM sensitive, or CRPR species as a result of inundation, vegetation removal, or construction activities. Therefore, this impact would be potentially significant.

Impacts related to dam construction and vegetation clearing within the relocation areas would be similar to CP1. However, inundation caused by a 12.5-foot raise of Shasta Dam could result in the loss of more individual plants and their suitable habitat. Therefore, this impact would be potentially significant.

Additional analysis of impacts will be conducted in relation to suitable habitats in the Shasta Lake watershed. An analysis of indirect impacts and temporary impacts will be provided in the FEIS. Potential mitigation lands containing comparable habitat have been identified adjacent to the project. Additional discussion of how these lands may be applied as mitigation and at what ratios will be provided in the FEIS. Mitigation for this impact is proposed in Section 12.3.5.

Impact Bot-4 (CP2): Loss of Jurisdictional Waters Implementation of the project may result in the loss of jurisdictional waters caused by flooding the impoundment area and discharge of fill associated with the relocation of facilities and dam construction. Flooding caused by implementation of the project would result in the conversion of jurisdictional water types (e.g., wetlands and streams to lacustrine). Therefore, this impact would be significant.

Direct impacts would incur with the conversion of jurisdictional waters (e.g., wetlands and streams) to lacustrine with implementation of CP2. All features within the impoundment area would be converted to lacustrine. Under CP2, 15 acres of wetlands and 25 acres of other waters would be converted to lacustrine (Table 12-12). This will result in a net loss of 15 acres to wetlands and a no net loss to other waters. This is considered a significant impact.

Table 12-12. Impacts to Jurisdictional Waters (Acres*) in the Impoundment Area (12.5-Foot Dam Raise)

Jurisdictional Water Type	Main Body	Big Backbone Arm	Sacramento Arm	McCloud Arm	Squaw Creek Arm	Pit Arm
Wetlands						
Fresh emergent/ riparian wetland	0.00	0.00	3.13	0.00	0.00	0.00
Intermittent swale	0.00	0.001	0.00	0.00	0.00	0.03
Riparian wetland	0.79	0.66	4.40	2.79	0.67	0.69
Seasonal wetland	0.00	0.00	0.14	0.00	0.08	0.02
Seep/spring wetland	0.57	0.17	0.59	0.21	0.07	0.34
Vegetated ditch	0.08	0.00	0	0.01	0.00	0.00
Total Wetlands	1.44	0.84	8.26	3.01	0.82	1.08
Other Waters of the United States						
Ephemeral stream	0.19	0.01	0.37	0.17	0.09	0.08
Intermittent stream	1.00	0.15	1.34	0.61	0.55	1.70
Perennial stream	1.14	1.32	6.57	7.55	1.52	0.88
Roadside ditch	0.00	0.00	0.01	0.00	0.00	0.00
Seep/spring other waters	0.02	0.00	0.001	0.01	0.00	0.00
Total Other Waters	2.39	1.48	8.29	8.34	2.16	2.66
Total Waters of the U.S.	3.83	2.32	16.55	11.35	2.98	3.74

Note:
*Acreage values are approximate.

Direct impacts on jurisdictional waters (e.g., intermittent and perennial streams) that will be filled as a result of relocation of facilities or dam construction will be determined. Additionally, some fill may be placed in the existing full pool of Shasta Lake for restoration and enhancement activities. An analysis of impacts

on jurisdictional waters in the full pool, relocation areas, indirect impacts, and temporary impacts will be provided in the FEIS. Additional analysis of impacts will be conducted in relation to waters of the United States present in the Shasta Lake watershed. Mitigation for this impact is proposed in Section 12.3.5.

Impact Bot-5 (CP2): Loss of General Vegetation Habitats Implementation of the project would result in a loss of general vegetation habitats because of inundation, vegetation removal, or construction activities. Therefore, this impact would be potentially significant.

Under CP2, a total of 1,715 acres of general vegetation habitats will be directly impacted by the inundation of the impoundment area (Table 12-13).

Table 12-13. Impacts to CWHR Habitats (Acres*) in the Impoundment Area (12.5-Foot Dam Raise)

Habitat	Area (Acres*)					
	Main Body	Big Backbone Creek	Sacramento Arm	McCloud Arm	Squaw Creek Arm	Pit Arm
Annual grassland	0.36	0	1.53	0.53	0	0
Barren	0.77	0	0.36	0.00	0	0.00
Blue oak – foothill pine	7.05	0	0	0	2.46	5.27
Blue oak woodland	0	0	0	0	0	1.65
Closed-cone pine – cypress	24.40	0	8.95	14.89	32.72	262.31
Douglas-fir	0	0	0	0.06	0	0
Mixed chaparral	20.58	9.56	112.76	10.97	7.35	40.11
Montane hardwood	53.30	25.75	120.48	45.31	13.31	1.77
Montane hardwood – conifer	48.77	0.70	99.06	97.70	78.41	7.73
Montane riparian	2.72	3.23	20.57	6.12	1.00	1.19
Ponderosa pine	152.04	21.54	123.71	114.78	35.08	40.92
Riverine	0	0.42	4.02	4.51	0.84	0
Urban	16.65	0	1.63	6.42	0	1.24
Total	326.64	61.20	492.71	301.28	171.18	362.19

Note:
*Acreage values are approximate.

Additional analysis of impacts will be conducted in relation to suitable habitats in the Shasta Lake watershed. An analysis of indirect impacts and temporary impacts will be provided in the FEIS. Potential mitigation lands containing comparable habitat have been identified adjacent to the project. Additional

discussion of how these lands may be applied as mitigation and at what ratios will be provided in the FEIS. Mitigation for this impact is proposed in Section 12.3.5.

Impact Bot-6 (CP2): Spread of Noxious and Invasive Weeds Implementation of the project could result in the spread of noxious and invasive weeds as a result of ground-disturbing activities during construction and an increased number of vectors (means of dispersal). Therefore, this impact would be potentially significant.

Impacts resulting from the spread of noxious weeds under CP2 are anticipated to be similar to, but greater than, those described for CP1. This impact would be potentially significant. Mitigation for this impact is proposed in Section 12.3.5.

Upper Sacramento River (Shasta Dam to Red Bluff)

Impact Bot-7 (CP2): Altered Structure and Species Composition and Loss of Sensitive Plant Communities and Special-Status Plant Species Resulting from Altered Flow Regimes Altered flow regimes associated with project implementation under CP2 could alter the structure and species composition or cause the loss of riparian, wetland, and oak communities, and of habitat for special-status plant species. Vernal pool plant communities and associated special-status species likely would not be affected. Effects on oak communities and upland habitats for special-status plants may not all be adverse. For example, greater summer flows in some years could increase summer soil moisture, especially during some dry and critical years as more water is released from Shasta Dam for water supply reliability purposes. This increased soil moisture in dry years could reduce losses of upland vegetation during drought years. Adverse effects on riparian and wetland communities and associated special-status plants could be substantial; thus, this impact would be significant.

This impact would be similar to Impact Bot-7 (CP1). The extent of the impact under CP2 would be greater than that under CP1, but less than that under CP3, which would entail more substantial alterations of flow regimes. (The relative magnitude of changes to larger flows (which are most important for riparian and wetland vegetation) simulated for each alternative below Keswick Dam and above Red Bluff are summarized on Figures 12-5 and 12-6, respectively.) This impact would be significant for riparian and wetland plant communities and associated special-status plants. Mitigation for this impact is proposed in Section 12.3.5.

Impact Bot-8 (CP2): Conflict with Approved Local or Regional Plans with Objectives of Riparian Habitat Protection or Watershed Management
Numerous local and regional plans promote the conservation of riparian vegetation and associated habitats along the upper Sacramento River. Because CP2 would adversely affect riparian communities, this alternative could conflict with existing local and regional plans focused on preserving riparian habitats. Therefore, this impact would be potentially significant.

This impact would be similar to Impact Bot-8 (CP1). The extent of the impact under CP2 would be greater than that under CP1 but less than that under CP3, and would be potentially significant. Mitigation for this impact is proposed in Section 12.3.5.

Impact Bot-9 (CP2): Disturbance or Removal of Designated Critical Habitat for Special-Status Species Designated critical habitat for four vernal pool special-status plant species exists within the primary study area. However, critical habitat for vernal pool species is not expected to be adversely affected by CP2 because vernal pools are generally not present within the active floodplain. For this reason, this impact would be less than significant.

This impact would be similar to Impact Bot-9 (CP1). The extent of the impact under CP2 would be greater than that under CP1 but less than that under CP3, and would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact Bot-10 (CP2): Loss of Sensitive Plant Communities and Special-Status Plant Species Resulting from Induced Growth Implementation of CP2 could increase water yield for water districts in the primary study area along the upper Sacramento River. This increase in water yield could reduce a limitation on urban growth and development that could affect sensitive plant communities and special-status plant species. However, this increase in water yield for growth that could affect these resources would be small, and in the future the effects of this growth would be analyzed and mitigated during land use planning and environmental review for specific projects. For these reasons, this impact would be less than significant.

This impact would be similar to Impact Bot-10 (CP1). In the portions of the CVP service area in the upper Sacramento River region, total agricultural water supplies would increase in some years by up to 1 percent. The extent of the impact under CP2 would be greater than that under CP1 but less than that under CP3, which would entail more substantial alterations of flow regimes. This impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact Bot-11 (CP2): Loss of Sensitive Natural Communities or Habitats Resulting from Implementing the Gravel Augmentation Program or the Reading Island Restoration Plan, Rehabilitating the Reading Island Boat Ramp, or Constructing a Handicap Fishing Access Area The proposed gravel augmentation program and Reading Island restoration and construction activities would not be implemented under CP2. Therefore, no impact would occur. Mitigation for this impact is not needed, and thus not proposed.

Impact Bot-12 (CP2): Loss of Special-Status Plants Resulting from Implementing the Gravel Augmentation Program, Restoring Sacramento River Flow Through Anderson Slough, Rehabilitating the Reading Island Boat Ramp,

or Constructing a Handicap Fishing Access Area The proposed gravel augmentation program and Reading Island restoration and construction activities would not be implemented under CP2. Therefore, no impact would occur. Mitigation for this impact is not needed, and thus not proposed.

Impact Bot-13 (CP2):Spread of Noxious and Invasive Weeds Resulting from Implementing the Gravel Augmentation Program, Restoring Sacramento River Flow Through Anderson Slough, Rehabilitating the Reading Island Boat Ramp, or Constructing a Handicap Fishing Access Area The proposed gravel augmentation program and Reading Island restoration and construction activities would not be implemented under CP2. Therefore, no impact would occur. Mitigation for this impact is not needed, and thus not proposed.

Lower Sacramento River and Delta

Impact Bot-14 (CP2): Altered Structure and Species Composition and Loss of Sensitive Plant Communities and Special-Status Plant Species Resulting from Altered Flow Regimes on the Lower sacramento River Altered flow regimes associated with project implementation under CP2 could alter the structure and species composition or cause the loss of riparian, wetland, and oak communities, and of habitat for special-status plant species. Vernal pool plant communities and associated special-status plant species likely would not be affected. Effects on oak communities and upland habitats for special-status plants may not all be adverse. Adverse effects on riparian and wetland communities and associated special-status plants could be substantial on the lower Sacramento River, but these effects are unlikely to extend to the Delta; thus, for riparian and wetland communities and special-status plants, this impact would be significant on the lower Sacramento River, and less than significant in the Delta.

This impact would be similar to Impact Bot-14 (CP1). The extent of the impact under CP2 would be greater than that under CP1, but less than that under CP3, which would entail more substantial alterations of flow regimes. (The relative magnitude of changes to larger flows (which are most important for riparian and wetland vegetation) simulated for each alternative above Red Bluff and at Wilkins Slough and Freeport are summarized on Figures 12-6, 12-7, and 12-8, respectively.) This impact would be significant on the lower Sacramento River for riparian and wetland plant communities and associated special-status plant species. Mitigation for this impact is proposed in Section 12.3.5.

Impact Bot-15 (CP2): Conflict with Approved Local or Regional Plans with Objectives of Riparian Habitat Protection or Watershed Management Along the Lower Sacramento River Adopted local and regional plans address and promote the conservation of riparian vegetation and associated habitats along the lower Sacramento River. Because CP2 would adversely affect riparian communities, this alternative could conflict with existing local and regional plans focused on preserving riparian habitats. Therefore, this impact on the lower Sacramento River would be potentially significant.

This impact would be the same as Impact Bot-15 (CP1) and would be potentially significant. Mitigation for this impact is proposed in Section 12.3.5.

Impact Bot-16 (CP2): Loss of Sensitive Plant Communities and Special-Status Plant Species Resulting from Induced Growth Along the Lower Sacramento River and in the Delta Implementation of CP2 could increase water yield for water districts in the extended study area along the lower Sacramento River. This increase in water yield could reduce a limitation on urban growth and development that could affect sensitive plant communities and special-status plant species. However, this increase in water yield for growth that could affect these resources would be small, and in the future the effects of this growth would be analyzed and mitigated during land use planning and environmental review for specific projects. For these reasons, this impact would be less than significant.

This impact would be similar to Impact Bot-16 (CP1). The extent of the impact under CP2 would be greater than that under CP1 but less than that under CP3, which would result in greater increases in water yield. This impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

CVP/SWP Service Areas

Impact Bot-17 (CP2): Altered Structure and Species Composition and Loss of Sensitive Plant Communities and Special-Status Plant Species Resulting from Altered Flow Regimes in the CVP/SWP Service Areas Altered flow regimes associated with project implementation under CP2 could alter the structure and species composition or cause the loss of sensitive plant communities and of habitat for special-status plant species. However, alteration of flow regimes below CVP and SWP reservoirs in the extended study area would be less than below Shasta Dam along the upper and lower Sacramento River. These alterations may not be sufficient to affect the extent of early-successional riparian and wetland communities or of associated habitats for special-status plant species. Therefore, this impact would be less than significant below CVP and SWP reservoirs in the extended study area.

This impact would be similar to Impact Bot-17 (CP1). The extent of the impact under CP2 would be greater than that under CP1 but less than that under CP3, which would entail more substantial alterations of flow regimes. This impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact Bot-18 (CP2): Conflict with Approved Local or Regional Plans with Objectives of Riparian Habitat Protection or Watershed Management in the CVP/SWP Service Areas Adopted local and regional plans address and promote the conservation of riparian vegetation and associated habitats along rivers below reservoirs in the CVP and SWP service areas. However, implementation of CP2 would not cause a significant impact on riparian vegetation and habitats.

Therefore, CP2 would not conflict with existing local and regional plans focused on preserving riparian habitats. Thus, this impact in the CVP and SWP service areas would be less than significant.

This impact would be to the same as Impact Bot-18 (CP1). The extent of the impact under CP2 would be greater than that under CP1 but less than that under CP3, and would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact Bot-19 (CP2): Loss of Sensitive Plant Communities and Special-Status Plant Species Resulting from Induced Growth in the CVP/SWP Service Areas Implementation of CP2 could increase water yield to water districts in the CVP and SWP service areas. This increase in water yield could reduce a limitation on growth that could affect sensitive plant communities and special-status plant species. However, this increase in water yield for growth that could affect these resources would be small, and in the future the effects of this growth would be analyzed and mitigated during land use planning and environmental review for specific projects. For these reasons, this impact would be less than significant.

This impact would be similar to Impact Bot-19 (CP1). The extent of the impact under CP2 would be greater than that under CP1 but less than that under CP3, which would result in greater increases in water yield. This impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

CP3 – 18.5-Foot Dam Raise, Anadromous Fish Survival and Water Supply

CP3 is similar to CP1 and CP2. It focuses on the greatest practical enlargement of Shasta Dam and Shasta Lake consistent with the goals of the 2000 CALFED ROD (CALFED 2000b), and was formulated for the primary purposes of increasing water supply reliability and survival of anadromous fish. In addition to the features common to all comprehensive plans, CP3 consists of raising Shasta Dam 18.5 feet, an elevation change that would increase the reservoir's full pool by 20.5 feet and enlarge the reservoir's total storage space by 634,000 acre-feet to 5.19 million acre-feet.

The botany and wetland impact analysis for CP1 assumes maximum vegetation clearing within the relocation areas. Therefore, vegetation clearing impacts within the relocation areas would be identical for CP1 through CP5.

Shasta Lake and Vicinity

Impact Bot-1 (CP3): Loss of Federally or State-Listed Plant Species Habitat for Federally or State-listed plant species does not occur at Shasta Lake or in the vicinity. No species are known or expected to occur. Therefore, no impact on Federally listed, State-listed, or candidate plant species would occur under CP3. Mitigation for this impact is not needed, and thus not proposed.

Impact Bot-2 (CP3): Loss of MSCS Covered Species Implementation of the project could result in the loss of MSCS covered species as a result of inundation, vegetation removal, or construction activities. Therefore, this impact would be significant.

Impacts related to dam construction and vegetation clearing within the relocation areas would be similar to CP1. However, inundation caused by a 18.5-foot raise of Shasta Dam could result in the loss of more individual plants. This impact would be significant.

Additional analysis of impacts will be conducted in relation to suitable habitats in the Shasta Lake watershed. An analysis of indirect impacts and temporary impacts will be provided in the FEIS. Potential mitigation lands containing comparable habitat have been identified adjacent to the project. Additional discussion of how these lands may be applied as mitigation and at what ratios will be provided in the FEIS. Mitigation for this impact is proposed in Section 12.3.5.

Impact Bot-3 (CP3): Loss of USFS Sensitive, BLM Sensitive, or CRPR Species Implementation of the project could result in the loss of USFS sensitive, BLM sensitive, or CRPR species because of inundation, vegetation removal, or construction activities. Therefore, this impact would be potentially significant.

Impacts related to dam construction and vegetation clearing within the relocation areas would be similar to CP1. However, inundation caused by a 18.5-foot raise of Shasta Dam could result in the loss of more individual plants. This impact would be potentially significant.

Additional analysis of impacts will be conducted in relation to suitable habitats in the Shasta Lake watershed. An analysis of indirect impacts and temporary impacts will be provided in the FEIS. Potential mitigation lands containing comparable habitat have been identified adjacent to the project. Additional discussion of how these lands may be applied as mitigation and at what ratios will be provided in the FEIS. Mitigation for this impact is proposed in Section 12.3.5.

Impact Bot-4 (CP3): Loss of Jurisdictional Waters Implementation of the project may result in the loss of jurisdictional waters caused by flooding the impoundment area and discharge of fill associated with the relocation of facilities and dam construction. Flooding caused by implementation of the project would result in the conversion of jurisdictional water types (e.g., wetlands and streams to lacustrine). Therefore, this impact would be significant.

Direct impacts would incur with the conversion of jurisdictional waters (e.g., wetlands and streams) to lacustrine with implementation of CP3. All features within the impoundment area would be converted to lacustrine. Under CP3, 25 acres of wetlands and 47 acres of other waters would be converted to lacustrine

(Table 12-14). This will result in a net loss of 25 acres to wetlands and a no net loss to other waters. This is considered a significant impact.

Table 12-14. Impacts to Jurisdictional Waters (Acres*) in the Impoundment Area (18.5-Foot Dam Raise)

Jurisdictional Water Type	Main Body	Big Backbone Arm	Sacramento Arm	McCloud Arm	Squaw Creek Arm	Pit Arm
Wetlands						
Fresh emergent/ riparian wetland	0.00	0.00	3.14	0.00	0.00	0.00
Intermittent swale	0.00	0.002	0.00	0.00	0.00	0.04
Riparian wetland	1.16	1.71	5.42	8.26	1.48	0.82
Seasonal wetland	0.00	0.00	0.18	0.00	0.14	0.02
Seep/spring wetland	0.77	0.23	0.80	0.31	0.13	0.41
Vegetated ditch	0.13	0.00	0.00	0.02	0.00	0.00
Total Wetlands	2.06	1.94	9.54	8.59	1.75	1.29
Other Waters of the United States						
Ephemeral stream	0.28	0.02	0.54	0.26	0.12	0.13
Intermittent stream	1.42	0.25	2.06	0.94	0.84	2.61
Perennial stream	1.53	3.00	8.67	20.27	2.29	1.46
Roadside ditch	0.00	0.00	0.02	0.00	0.00	0.00
Seep/spring other waters	0.03	0.00	0.001	0.01	0.00	0.00
Total Other Waters	3.26	3.27	11.29	21.48	3.25	4.20
Total	5.32	5.21	20.83	30.07	5.00	5.49

Note:
*Acreage values are approximate.

Direct impacts on jurisdictional waters (e.g., intermittent and perennial streams) that will be filled as a result of relocation of facilities or dam construction will be determined. Additionally, some fill may be placed in the existing full pool of Shasta Lake for restoration and enhancement activities. An analysis of impacts on jurisdictional waters in the full pool, relocation areas, indirect impacts, and temporary impacts will be provided in the FEIS. Additional analysis of impacts will be conducted in relation to waters of the United States present in the Shasta Lake watershed. Mitigation for this impact is proposed in Section 12.3.5.

Impact Bot-5 (CP3): Loss of General Vegetation Habitats Implementation of the project would result in a loss of general vegetation habitats because of inundation, vegetation removal, or construction activities. Therefore, this impact would be potentially significant.

Under CP3, 2,472 acres of general vegetation habitats will be directly impacted by the inundation of the impoundment area (Table 12-15).

Table 12-15. Impacts to CWHR Habitats (Acres*) in the Impoundment Area (18.5-Foot Dam Raise)

Habitat	Area (Acres*)					
	Main Body	Big Backbone Creek	Sacramento Arm	McCloud Arm	Squaw Creek Arm	Pit Arm
Annual grassland	0.44	0	3.10	0.70	0	0
Barren	1.05	0.00	0.55	0.00	0.00	0.00
Blue oak – foothill pine	10.36	0	0	0	4.29	1.94
Blue oak woodland	0	0	0	0	0	6.81
Closed-cone pine – cypress	32.68	0	12.95	20.79	44.72	373.48
Douglas-fir	0	0	0	0.36	0	0
Mixed chaparral	29.19	13.64	161.04	15.06	10.35	59.50
Montane hardwood	73.49	38.76	171.01	66.06	19.43	2.49
Montane hardwood – conifer	70.68	0.99	150.42	140.93	111.63	10.55
Montane riparian	4.16	6.67	26.16	13.91	1.53	1.57
Ponderosa pine	215.11	30.72	188.19	161.74	49.56	57.50
Riverine	0	0.88	5.24	15.43	1.41	0
Urban	21.95	0	1.95	7.96	0	1.92
Total	459.11	91.67	720.06	442.93	242.92	515.77

Note:
*Acreage values are approximate.

Additional analysis of impacts will be conducted in relation to suitable habitats in the Shasta Lake watershed. An analysis of indirect impacts and temporary impacts will be provided in the FEIS. Mitigation for this impact is proposed in Section 12.3.5.

Impact Bot-6 (CP3): Spread of Noxious and Invasive Weeds Implementation of the project could result in the spread of noxious and invasive weeds because of ground-disturbing activities during construction and an increased number of vectors (means of dispersal). Therefore, this impact would be potentially significant.

Impacts resulting from the spread of noxious weeds under CP3 are anticipated to be similar to, but greater than, those described for CP1. Therefore, this impact would be potentially significant. Mitigation for this impact is proposed in Section 12.3.5.

Upper Sacramento River (Shasta Dam to Red Bluff)

Impact Bot-7 (CP3): Altered Structure and Species Composition and Loss of Sensitive Plant Communities and Special-Status Plant Species Resulting from Altered Flow Regimes Altered flow regimes associated with project implementation under CP3 could alter the structure and species composition or cause the loss of riparian, wetland, and oak communities, and of habitat for special-status plant species. Vernal pool plant communities and associated special-status species likely would not be affected. Effects on oak communities

and upland habitats for special-status plants may not all be adverse. Adverse effects on riparian and wetland communities and associated special-status plants could be substantial; thus, this impact would be significant.

This impact would be similar to Impact Bot-7 (CP1). The extent of the impact would be greater under CP3 than under CP1 and CP2 because it would entail more substantial alterations of flow regimes. (The relative magnitude of changes to larger flows (which are most important for riparian and wetland vegetation) simulated for each alternative below Keswick Dam and above Red Bluff are summarized on Figures 12-5 and 12-6, respectively.) This impact would be significant. Mitigation for this impact is proposed in Section 12.3.5.

Impact Bot-8 (CP3): Conflict with Approved Local or Regional Plans with Objectives of Riparian Habitat Protection or Watershed Management
Numerous local and regional plans address and promote the conservation of riparian vegetation and associated habitats along the upper Sacramento River. Because CP3 would adversely affect riparian communities, this alternative could conflict with existing local and regional plans focused on preserving riparian habitats. Therefore, this impact would be potentially significant.

This impact would be similar to Impact Bot-8 (CP1). The extent of the impact would be greater under CP3 than under CP1 and CP2 because it would result in a greater increase in water yield. This impact would be potentially significant. Mitigation for this impact is proposed in Section 12.3.5.

Impact Bot-9 (CP3): Disturbance or Removal of Designated Critical Habitat for Special-Status Species Designated critical habitat for four vernal pool special-status plant species exists within the primary study area. However, such critical habitat is not expected to be adversely affected by CP3. For this reason, this impact would be less than significant.

This impact would be similar to Impact Bot-9 (CP1). The extent of the impact would be greater under CP3 than under CP1 and CP2 because it would result in a greater increase in water yield. This impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact Bot-10 (CP3): Loss of Sensitive Plant Communities and Special-Status Plant Species Resulting from Induced Growth Implementation of CP3 could increase water yield for water districts in the primary study area along the upper Sacramento River. This increase in water yield could reduce a limitation on growth that could affect sensitive plant communities and special-status plant species. However, this increase in water yield for growth that could affect these resources would be small, and in the future the effects of this growth would be analyzed and mitigated during land use planning and environmental review for specific projects. For these reasons, this impact would be less than significant.

This impact would be similar to Impact Bot-10 (CP1). In the portions of the CVP service area in the upper Sacramento River region, total agricultural water supplies would increase in some years by up to 2 percent. The extent of the impact would be greater under CP3 than under CP1 and CP2 because it would result in a greater increase in water yield. This impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact Bot-11 (CP3): Loss of Sensitive Natural Communities or Habitats Resulting from Implementing the Gravel Augmentation Program or the Reading Island Restoration Plan, Rehabilitating the Reading Island Boat Ramp, or Constructing a Handicap Fishing Access Area The proposed gravel augmentation program and Reading Island restoration and construction activities would not be implemented under CP3. Therefore, no impact would occur. Mitigation for this impact is not needed, and thus not proposed.

Impact Bot-12 (CP3): Loss of Special-Status Plants Resulting from Implementing the Gravel Augmentation Program, Restoring Sacramento River Flow Through Anderson Slough, Rehabilitating the Reading Island Boat Ramp, or Constructing a Handicap Fishing Access Area The proposed gravel augmentation program and Reading Island restoration and construction activities would not be implemented under CP3. Therefore, no impact would occur. Mitigation for this impact is not needed, and thus not proposed.

Impact Bot-13 (CP3):Spread of Noxious and Invasive Weeds Resulting from Implementing the Gravel Augmentation Program, Restoring Sacramento River Flow Through Anderson Slough, Rehabilitating the Reading Island Boat Ramp, or Constructing a Handicap Fishing Access Area The proposed gravel augmentation program and Reading Island restoration and construction activities would not be implemented under CP3. Therefore, no impact would occur. Mitigation for this impact is not needed, and thus not proposed.

Lower Sacramento River and Delta

Impact Bot-14 (CP3): Altered Structure and Species Composition and Loss of Sensitive Plant Communities and Special-Status Plant Species Resulting from Altered Flow Regimes on the Lower Sacramento River Altered flow regimes associated with project implementation under CP3 could alter the structure and species composition or cause the loss of riparian, wetland, and oak communities, and of habitat for special-status plant species. Vernal pool plant communities and associated special-status plant species likely would not be affected. Effects on oak communities and upland habitats for special-status plants may not all be adverse. Adverse effects on riparian and wetland communities and associated special-status plants could be substantial on the lower Sacramento River, but these effects are unlikely to extend to the Delta; thus, for riparian and wetland communities and special-status plants, this impact would be significant on the lower Sacramento River, and less than significant in the Delta.

This impact would be similar to Impact Bot-14 (CP1). The extent of the impact would be greater under CP3 than under CP1 and CP2 because it would entail more substantial alterations of flow regimes. (The relative magnitude of changes to larger flows (which are most important for riparian and wetland vegetation) simulated for each alternative above Red Bluff and at Wilkins Slough and Freeport are summarized on Figures 12-6, 12-7, and 12-8, respectively.) This impact would be significant on the lower Sacramento River and less than significant in the Delta. Mitigation for this impact on the lower Sacramento River is proposed in Section 12.3.5.

Impact Bot-15 (CP3): Conflict with Approved Local or Regional Plans with Objectives of Riparian Habitat Protection or Watershed Management Along the Lower Sacramento River Adopted local and regional plans address and promote the conservation of riparian vegetation and associated habitats along the lower Sacramento River in the extended study area. Because CP3 would adversely affect riparian communities, this alternative could conflict with existing local and regional plans focused on preserving riparian habitats. Therefore, this impact on the lower Sacramento River would be potentially significant.

This impact would be the same as Impact Bot-15 (CP1) and would be potentially significant. Mitigation for this impact is proposed in Section 12.3.5.

Impact Bot-16 (CP3): Loss of Sensitive Plant Communities and Special-Status Plant Species Resulting from Induced Growth Along the Lower Sacramento River and in the Delta Implementation of CP3 could increase water for water districts in the extended study area along the lower Sacramento River. This increase in water yield could reduce a limitation on growth that could affect sensitive plant communities and special-status plant species. However, this increase in water yield for growth that could affect these resources would be small, and in the future the effects of this growth would be analyzed and mitigated during land use planning and environmental review for specific projects. For these reasons, this impact would be less than significant.

This impact would be similar to Impact Bot-16 (CP1). The extent of the impact under CP2 would be similar to that under CP1 but less than that under CP3, which would result in a greater increase in water yield. This impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

CVP/SWP Service Areas

Impact Bot-17 (CP3): Altered Structure and Species Composition and Loss of Sensitive Plant Communities and Special-Status Plant Species Resulting from Altered Flow Regimes in the CVP/SWP Service Areas Altered flow regimes associated with project implementation under CP3 could alter the structure and species composition or cause the loss of sensitive plant communities and of habitat for special-status plant species. However, alteration of flow regimes

below CVP and SWP reservoirs in the extended study area would be less than below Shasta Dam along the upper and lower Sacramento River. These alterations may not be sufficient to alter the extent of early-successional riparian and wetland communities or associated habitats for special-status plant species. Therefore, this impact would be less than significant below CVP and SWP reservoirs in the extended study area.

This impact would be similar to Impact Bot-17 (CP1). The extent of the impact would be greater under CP3 than under CP1 and CP2. Nonetheless, this impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact Bot-18 (CP3): Conflict with Approved Local or Regional Plans with Objectives of Riparian Habitat Protection or Watershed Management in the CVP/SWP Service Areas Adopted local and regional plans address and promote the conservation of riparian vegetation and associated habitats along rivers below reservoirs in the CVP and SWP service areas. However, implementation of CP3 would not cause a significant impact on riparian vegetation and habitats. Therefore, CP3 would not conflict with existing local and regional plans focused on preserving riparian habitats. Thus, this impact in the CVP and SWP service areas would be less than significant.

This impact would be the same as Impact Bot-18 (CP1) and would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact Bot-19 (CP3): Loss of Sensitive Plant Communities and Special-Status Plant Species Resulting from Induced Growth in the CVP/SWP Service Areas Implementation of CP3 could increase water yield to water districts in the extended study area in the CVP and SWP service areas. This increase in water yield could reduce a limitation on growth that could affect sensitive plant communities and special-status plant species. However, this increase in water yield for growth that could affect these resources would be small, and in the future the effects of this growth would be analyzed and mitigated during land use planning and environmental review for specific projects. For these reasons, this impact would be less than significant.

This impact would be similar to Impact Bot-19 (CP1). The extent of the impact under CP2 would be similar to that under CP1 but less than that under CP3, which would result in a greater increase in water yield. This impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

CP4 – 18.5-Foot Dam Raise, Anadromous Fish Focus with Water Supply Reliability

The primary function of CP4 is to address the survival of anadromous fish while still improving water supply reliability. It focuses on increasing the volume of cold water available to the temperature control device through reservoir

reoperations, and on raising Shasta Dam by 18.5 feet. As with CP3 and the common features above, this raise would increase the full pool by 20.5 feet and enlarge total reservoir storage space by 634,000 acre-feet. This additional storage space would expand Shasta Lake's cold-water supply available to the temperature control device by 378,000 acre-feet.

In addition to the activities common to CP1 – CP3, CP4 includes augmenting locations along the Upper Sacramento River segment of the study area with gravel to increase spawning habitat for anadromous fish. Gravel placement would occur at one or more sites per year over a 10-year period and would be accomplished by one of three methods; lateral berms, talus cone, direct placement in river; as appropriate depending on specific conditions, including geomorphology, of the augmentation site. To the extent available, existing river access points would be used to deliver gravel to the river; however, temporary new access roads would be needed in some cases, mostly adjacent to the river.

In addition, under CP4, riparian, floodplain, and side channel habitat restoration would be constructed at Reading Island to restore habitat for anadromous salmonids in the Anderson Creek Slough. This Reading Island project could involve some vegetation clearing.

The botany and wetland impact analysis for CP1 assumes maximum vegetation clearing within the relocation areas. Therefore, vegetation clearing impacts within the relocation areas would be identical for CP1 thorugh CP5. However, greater vegetation clearing would result under CP4 as a result of clearing to access gravel augmentation sites and to allow gravel to fall easily into the river from adjacent banks or terraces.

Shasta Lake and Vicinity

Impact Bot-1 (CP4): Loss of Federally or State-Listed Plant Species Habitat for Federally or State-listed plant species does not occur at Shasta Lake or in the vicinity. No species are known or expected to occur. Therefore, no impact on Federally listed, State-listed, or candidate plant species would occur under CP4. Mitigation for this impact is not needed, and thus not proposed.

Impact Bot-2 (CP4): Loss of MSCS Covered Species Implementation of the project could result in the loss of MSCS covered species as a result of inundation, vegetation removal, or construction activities. Therefore, this impact would be significant.

This impact would be similar to Impact Bot-2 (CP3) and would be significant. Mitigation for this impact is proposed in Section 12.3.5.

Impact Bot-3 (CP4): Loss of USFS Sensitive, BLM Sensitive, or CRPR Species Implementation of the project could result in the loss of USFS sensitive, BLM sensitive, or CRPR species as a result of inundation, vegetation removal, or construction activities. Therefore, this impact would be potentially significant.

This impact would be similar to Impact Bot-3 (CP3) and would be potentially significant. Mitigation for this impact is proposed in Section 12.3.5.

Impact Bot-4 (CP4): Loss of Jurisdictional Waters Implementation of the project may result in the loss of jurisdictional waters because of flooding the impoundment area and fill associated with the relocation of facilities and dam construction. Flooding caused by implementation of the project would result in the conversion of jurisdictional water types (e.g., wetlands and streams to lacustrine). Therefore, this impact would be significant.

This impact would be similar to Impact Bot-4 (CP3) and would be significant. Mitigation for this impact is proposed in Section 12.3.5.

Impact Bot-5 (CP4): Loss of General Vegetation Habitats Implementation of the project would result in a loss of general vegetation habitats because of inundation, vegetation removal, or construction activities.

This impact would be similar to Impact Bot-5 (CP3) and would be potentially significant. Mitigation for this impact is proposed in Section 12.3.5.

Impact Bot-6 (CP4): Spread of Noxious and Invasive Weeds Implementation of the project could result in the spread of noxious and invasive weeds as a result of ground-disturbing activities during construction and an increased number of vectors (means of dispersal). This impact would be potentially significant.

Impacts resulting from the spread of noxious weeds under CP4 are anticipated to be similar to those described for CP3. This impact would be potentially significant. Mitigation for this impact is proposed in Section 12.3.5.

Upper Sacramento River (Shasta Dam to Red Bluff)

Impact Bot-7 (CP4): Altered Structure and Species Composition and Loss of Sensitive Plant Communities and Special-Status Plant Species Resulting from Altered Flow Regimes Altered flow regimes associated with project implementation under CP4 could alter the structure and species composition or cause the loss of riparian, wetland, and oak communities, and of habitat for special-status plant species. Vernal pool plant communities and associated special-status species likely would not be affected. Effects on oak communities and upland habitats for special-status plants may not all be adverse. Adverse effects on riparian and wetland communities and associated special-status plants could be substantial; thus, for riparian and wetland communities and special-status plants, this impact would be significant.

This impact would be the same as Impact Bot-7 (CP1) and would be significant. Mitigation for this impact is proposed in Section 12.3.5.

Impact Bot-8 (CP4): Conflict with Approved Local or Regional Plans with Objectives of Riparian Habitat Protection or Watershed Management

Numerous local and regional plans address and promote the conservation of riparian vegetation and associated habitats along the upper Sacramento River. Because CP4 would adversely affect riparian communities, this alternative could conflict with existing local and regional plans focused on preserving riparian habitats. Therefore, this impact would be potentially significant**.**

This impact would be the same as Impact Bot-8 (CP1) and would be potentially significant. Mitigation for this impact is proposed in Section 12.3.5.

Impact Bot-9 (CP4): Disturbance or Removal of Designated Critical Habitat for Special-Status Species Designated critical habitat for four vernal pool special-status plant species exists within the primary study area. However, such critical habitat is not expected to be adversely affected by CP4. This impact would be less than significant.

This impact would be the same as Impact Bot-9 (CP1) and would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact Bot-10 (CP4): Loss of Sensitive Plant Communities and Special-Status Plant Species Resulting from Induced Growth Implementation of CP4 could increase water yield for water districts in the primary study area along the upper Sacramento River. This increase in water yield could reduce a limitation on growth that could affect sensitive plant communities and special-status plant species. However, this increase in water yield for growth that could affect these resources would be small, and in the future the effects of this growth would be analyzed and mitigated during land use planning and environmental review for specific projects. For these reasons, this impact would be less than significant.

This impact would be the same as Impact Bot-10 (CP1) and would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact Bot-11 (CP4): Loss of Sensitive Natural Communities or Habitats Resulting from Implementing the Gravel Augmentation Program or the Reading Island Restoration Plan, Rehabilitating the Reading Island Boat Ramp, or Constructing a Handicap Fishing Access Area Implementing the gravel augmentation program could result in the removal of riparian and wetland vegetation or the degradation of riparian and wetland habitats, including wetlands qualifying as waters of the United States. In addition, habitat restoration, boat ramp rehabilitation, and fishing area construction at Reading Island could remove riparian vegetation, or result in discharge of fill material into waters of the United States. This impact would be potentially significant.

A gravel augmentation program would be implemented under CP4, as described in Chapter 2, “Alternatives.” Gravel placement falls under Nationwide Permit (NWP) 27, “Aquatic Habitat Restoration, Establishment, and Enhancement.” Activities qualifying for NWPs have been determined by USACE to have no more than minimal adverse effects on the aquatic environment (72 Federal

Register 11092). Therefore, the direct placement of gravel into the Sacramento River would not be considered a significant impact on waters of the United States. There are no vernal pools or other seasonal wetlands present at any of the proposed augmentation sites. However, gravel augmentation could result in removal of riparian vegetation during construction of access routes to the gravel placement sites. To the extent feasible, existing access roads would be used, but access to some of the proposed placement sites does not currently exist. Clearing and grubbing would be needed to create access to these gravel placement sites, and in some areas, vegetation clearing along banks would be used to allow gravel to fall easily from the banks into the river. These activities could result in removal of riparian vegetation.

In addition, actions would be implemented to restore connectivity between the Sacramento River and the Reading Island side channel, to restore floodplain and riparian habitat in the Reading Island side channel, to rehabilitate the boat ramp at Reading Island, and to create a handicap fishing access area at Reading Island, as described in Chapter 2, "Alternatives."

Breaching or creating an engineered opening in the levee at Reading Island to restore flow from the Sacramento River to Anderson Slough would fall under NWP 27, "Aquatic Habitat Restoration, Establishment, and Enhancement." Rehabilitation of the existing boat ramp and construction of fishing access would also qualify for an NWP. Activities qualifying for NWPs have been determined by USACE to have no more than minimal adverse effects on the aquatic environment (72 Federal Register 11092). Therefore, these activities would not be considered to have a significant impact on waters of the United States. The Reading Island Restoration Plan would involve acquiring and revegetating floodplain terraces and adjacent riparian areas with native riparian vegetation. This is expected to provide a beneficial effect on floodplain and riparian habitat in the side channel. However, construction activities associated with restoring river connectivity, rehabilitating the boat ramp, or creating handicap fishing access could result in removal of riparian vegetation.

With implementation of the gravel augmentation program and habitat restoration, boat ramp rehabilitation, and fishing area construction at Reading Island, the impact on sensitive natural communities would be potentially significant. Mitigation for this impact is proposed in Section 12.3.5.

Impact Bot-12 (CP4): Loss of Special-Status Plants Resulting from Implementing the Gravel Augmentation Program, Restoring Sacramento River Flow Through Anderson Slough, Rehabilitating the Reading Island Boat Ramp, or Constructing a Handicap Fishing Access Area Vegetation removal and gravel placement could result in the loss of special-status plants if they are present, and implementing the Reading Island projects could result in the removal of riparian vegetation. This impact would be potentially significant.

Special-status plant species could be killed during vegetation clearing and grubbing or gravel placement if they are present at the gravel placement sites or areas that would be cleared for access. In addition, actions would be implemented to restore connectivity between the Sacramento River and the Reading Island side channel, to restore floodplain and riparian habitat in the Reading Island side channel, to rehabilitate the boat ramp at Reading Island, and to create a handicap fishing access area at Reading Island, as described in Chapter 2, "Alternatives." Special-status plants are not likely to be affected by rehabilitation of the boat ramp because it is an existing structure that would be accessed through existing paved surfaces. However, if special-status plant species are present on the levee or elsewhere on Reading Island, they could be killed during construction to restore connectivity between the Sacramento River and Anderson Slough or during construction of the handicap fishing access area.

Direct loss of special-status plants would be a potentially significant impact. Mitigation for this impact is proposed in Section 12.3.5.

Impact Bot-13 (CP4): Spread of Noxious and Invasive Weeds Resulting from Implementing the Gravel Augmentation Program, Restoring Sacramento River Flow Through Anderson Slough, Rehabilitating the Reading Island Boat Ramp, or Constructing a Handicap Fishing Access Area Implementing the gravel augmentation program could result in the spread of noxious and invasive weeds as a result of vegetation clearing and grubbing and an increased number of vectors. In addition, at Reading Island, actions would be implemented to restore connectivity between the Sacramento River and the Reading Island side channel, to restore floodplain and riparian habitat, to rehabilitate the boat ramp, and to create a handicap fishing access area at Reading Island. The activities at Reading Island could also result in the spread of noxious and invasive weeds as a result of vegetation clearing and grubbing and an increased number of vectors. This impact would be potentially significant.

Vegetation removal and grubbing at gravel placement sites and access routes could result in increased risk of introduction and spread of noxious and invasive weeds. The risk of introducing or spreading noxious weeds would vary depending on the proximity of existing noxious weed infestations, extent of ground-disturbing activities, and the amount of traffic entering a project site. Vectors that would increase as a result of project implementation include weed seed and seed parts brought in on tools, vehicles, and workers' clothing and boots. Vegetation clearing and construction of temporary access routes would increase the number of weed vectors in an area. As traffic along new and existing corridors increases, the risk for weed dispersal would increase. Seed mixtures and mulches may be used during erosion control efforts and revegetation of disturbed areas. These mixtures and mulches are potential vectors for noxious weed and invasive plant dispersal.

Reading Island restoration activities would include use of a mechanical harvester to remove invasive aquatic vegetation from the side channel and

Anderson Slough. This aspect of the restoration plan is expected to result in a beneficial effect by reducing the existing population of invasive aquatic plants. However, vegetation removal at the levee, boat ramp, and handicap fishing access construction sites and along 0.8 mile of the channel for conveyance could result in increased risk of introduction and spread of noxious and invasive weeds on Reading Island. The risk of introducing or spreading noxious weeds would vary depending on the proximity of existing noxious weed infestations, extent of ground-disturbing activities, and the amount of traffic entering a project site. Vectors that would increase as a result of project implementation include weed seed and seed parts brought in on tools, vehicles, and workers' clothing and boots. Vegetation clearing from the levee or for fishing access would increase the number of weed vectors in an area. As traffic along existing corridors increases, the risk for weed dispersal would increase. Seed mixtures and mulches used during erosion control efforts and revegetation of riparian areas are potential vectors for noxious weed and invasive plant dispersal.

Spread and introduction of noxious and invasive weeds would be a potentially significant impact. Mitigation for this impact is proposed in Section 12.3.5.

Lower Sacramento River and Delta

Impact Bot-14 (CP4): Altered Structure and Species Composition and Loss of Sensitive Plant Communities and Special-Status Plant Species Resulting from Altered Flow Regimes on the Lower Sacramento River Altered flow regimes associated with project implementation under CP4 could alter the structure and species composition or cause the loss of riparian, wetland, and oak communities, and of habitat for special-status plant species. Vernal pool plant communities and associated special-status plant species likely would not be affected. Effects on oak communities and upland habitats for special-status plants may not all be adverse. Adverse effects on riparian and wetland communities and associated special-status plants could be substantial on the lower Sacramento River, but these effects are unlikely to extend to the Delta; thus, this impact would be significant on the lower Sacramento River, and less than significant in the Delta.

This impact would be the same as Impact Bot-14 (CP1) and would be significant on the lower Sacramento River and less than significant in the Delta. Mitigation for this impact on the lower Sacramento River is proposed in Section 12.3.5.

Impact Bot-15 (CP4): Conflict with Approved Local or Regional Plans with Objectives of Riparian Habitat Protection or Watershed Management Along the Lower Sacramento River Adopted local and regional plans address and promote the conservation of riparian vegetation and associated habitats along the lower Sacramento River. Because CP4 would adversely affect riparian communities, this alternative could conflict with existing local and regional plans focused on preserving riparian habitats. Therefore, this impact on the lower Sacramento River would be potentially significant.

This impact would be the same as Impact Bot-15 (CP1) and would be potentially significant. Mitigation for this impact is proposed in Section 12.3.5.

Impact Bot-16 (CP4): Loss of Sensitive Plant Communities and Special-Status Plant Species Resulting from Induced Growth Along the Lower Sacrramento River and in the Delta Implementation of CP4 could increase water yield to water districts in the extended study area along the lower Sacramento River. This increase in water yield could reduce a limitation on growth that could affect sensitive plant communities and special-status plant species. However, this increase in water yield for growth that could affect these resources would be small, and in the future the effects of this growth would be analyzed and mitigated during land use planning and environmental review for specific projects. For these reasons, this impact would be less than significant.

This impact would be the same as Impact Bot-16 (CP1) and would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

CVP/SWP Service Areas

Impact Bot-17 (CP4): Altered Structure and Species Composition and Loss of Sensitive Plant Communities and Special-Status Plant Species Resulting from Altered Flow Regimes in the CVP/SWP Service Areas Altered flow regimes associated with implementation of CP4 could alter the structure and species composition or cause the loss of sensitive plant communities and of habitat for special-status plant species. However, alteration of flow regimes below CVP and SWP reservoirs in the extended study area would be less than below Shasta Dam along the upper and lower Sacramento River. These alterations may not be sufficient to alter the extent of early-successional riparian and wetland communities or associated habitats for special-status plant species. Therefore, this impact would be less than significant below CVP and SWP reservoirs in the extended study area.

This impact would be the same as Impact Bot-17 (CP1) and would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact Bot-18 (CP4): Conflict with Approved Local or Regional Plans with Objectives of Riparian Habitat Protection or Watershed Management in the CVP/SWP Service Areas Adopted local and regional plans address and promote the conservation of riparian vegetation and associated habitats along rivers below reservoirs in the CVP and SWP service areas. However, implementation of CP4 would not cause a significant impact on riparian vegetation and habitats. Therefore, CP4 would not conflict with existing local and regional plans focused on preserving riparian habitats. Thus, this impact in the CVP and SWP service areas would be less than significant.

This impact would be the same as Impact Bot-18 (CP1) and would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact Bot-19 (CP4): Loss of Sensitive Plant Communities and Special-Status Plant Species Resulting from Induced Growth in the CVP/SWP Service Areas Implementation of CP4 could increase water yield for water districts in the extended study area along the lower Sacramento River. This increase in water yield could reduce a limitation on growth that could affect sensitive plant communities and special-status plant species. However, this increase in water yield for growth that could affect these resources would be small, and in the future the effects of this growth would be analyzed and mitigated during land use planning and environmental review for specific projects. For these reasons, this impact would be less than significant.

This impact would be the same as Impact Bot-19 (CP1) and would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

CP5 – 18.5-Foot Dam Raise, Combination Plan

CP5 would address both the primary and secondary planning objectives. In addition to the features common to all comprehensive plans, CP5 includes enlarging Shasta Dam 18.5 feet, which is consistent with the objectives of the 2000 CALFED ROD. CP5 also involves (1) implementing environmental restoration features along the lower reaches of major tributaries to Shasta Lake, (2) constructing shoreline fish habitat around Shasta Lake, and (3) constructing either additional or improved recreation features at various locations around Shasta Lake to increase the value of the recreational experience. Formulation of specific environmental restoration features and increased recreation components is included in the Draft Feasibility Report.

CP5 would also include implementing the same gravel augmentation program and the same riparian, floodplain, and side channel habitat restoration at Reading Island as described for CP4.

Shasta Lake and Vicinity

Impact Bot-1 (CP5): Loss of Federally or State-Listed Plant Species Habitat for Federally or State-listed plant species does not occur at Shasta Lake or in the vicinity. No species are known or expected to occur. Therefore, no impact on Federally listed, State-listed, or candidate plant species would occur under CP5. Mitigation for this impact is not needed, and thus not proposed.

Impact Bot-2 (CP5): Loss of MSCS Covered Species Implementation of the project could result in the loss of MSCS covered species as a result of ground-disturbing construction activities or inundation. Therefore, this impact would be significant.

This impact would be similar to Impact Bot-2 (CP3) and would therefore be significant.

Additional impacts may occur depending on specific restoration and recreation enhancement details. These impacts will be quantified when the details of the

proposed actions are developed. Mitigation for this impact is proposed in Section 12.3.5.

Impact Bot-3 (CP5): Loss of USFS Sensitive, BLM Sensitive, or CRPR Species Implementation of the project could result in the loss of USFS Sensitive, BLM Sensitive, or CRPR species as a result of inundation, vegetation removal, or construction activities. Therefore, this impact would be potentially significant.

This impact would be similar to Impact Bot-3 (CP3) and would be potentially significant.

Additional impacts may occur depending on specific restoration and recreation enhancement details. These impacts will be quantified when the details of the proposed actions are developed. Mitigation for this impact is proposed in Section 12.3.5.

Impact Bot-4 (CP5): Loss of Jurisdictional Waters Implementation of the project may result in the loss of jurisdictional waters because of flooding the impoundment area and fill associated with the relocation of facilities and dam construction. Flooding caused by implementation of the project would result in the conversion of jurisdictional water types (e.g., wetlands and streams to lacustrine). This impact would be significant.

This impact would be similar to Impact Bot-4 (CP3) and would be significant.

Additional impacts may occur depending on specific restoration and recreation enhancement details. These impacts will be quantified when the details of the proposed actions are developed. Mitigation for this impact is proposed in Section 12.3.5.

Impact Bot-5 (CP5): Loss of General Vegetation Habitats Implementation of the project would result in a loss of general vegetation habitats because of inundation, vegetation removal, or construction activities. This impact would be potentially significant.

This impact would be similar to Impact Bot-5 (CP3) and would be potentially significant.

Additional impacts may occur depending on specific restoration and recreation enhancement details. These impacts will be quantified when the details of the proposed actions are developed. Mitigation for this impact is proposed in Section 12.3.5.

Impact Bot-6 (CP5): Spread of Noxious and Invasive Weeds Implementation of the project could result in the spread of noxious and invasive weeds because of ground-disturbing activities during construction and an increased number of vectors (means of dispersal). This impact would be potentially significant.

Impacts resulting from the spread of noxious weeds under CP5 are anticipated to be similar to those described for CP3. This impact would be potentially significant.

Additional impacts may occur depending on specific restoration and recreation enhancement details. These impacts will be quantified when the details of the proposed actions are developed. Mitigation for this impact is proposed in Section 12.3.5.

Upper Sacramento River (Shasta Dam to Red Bluff)

Impact Bot-7 (CP5): Altered Structure and Species Composition and Loss of Sensitive Plant Communities and Special-Status Plant Species Resulting from Altered Flow Regimes Altered flow regimes associated with project implementation under CP5 could alter the structure and species composition or cause the loss of riparian, wetland, and oak communities, and of habitat for special-status plant species. Vernal pool plant communities and associated special-status species likely would not be affected. Effects on oak communities and upland habitats for special-status plants may not all be adverse. Adverse effects on riparian and wetland communities and associated special-status plants could be substantial; thus, this impact would be significant.

This impact would be the same as Impact Bot-7 (CP3) and would be significant. Mitigation for this impact is proposed in Section 12.3.5.

Impact Bot-8 (CP5): Conflict with Approved Local or Regional Plans with Objectives of Riparian Habitat Protection or Watershed Management Numerous local and regional plans address and promote the conservation of riparian vegetation and associated habitats along the upper Sacramento River. Because CP5 would adversely affect riparian communities, this alternative could conflict with existing local and regional plans focused on preserving riparian habitats. Therefore, this impact would be potentially significant.

This impact would be the same as Impact Bot-8 (CP3) and would be potentially significant. Mitigation for this impact is proposed in Section 12.3.5.

Impact Bot-9 (CP5): Disturbance or Removal of Designated Critical Habitat for Special-Status Species Designated critical habitat for four vernal pool special-status plant species exists within the primary study area. However, such critical habitat is not expected to be adversely affected by CP5. This impact would be less than significant.

This impact would be the same as Impact Bot-9 (CP3) and would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact Bot-10 (CP5): Loss of Sensitive Plant Communities and Special-Status Plant Species Resulting from Induced Growth Implementation of CP5 could increase water yield to water districts in the primary study area along the upper Sacramento River. This increase in water yield could reduce a limitation on

growth that could affect sensitive plant communities and special-status plant species. However, this increase in water yield for growth that could affect these resources would be small, and in the future the effects of this growth would be analyzed and mitigated during land use planning and environmental review for specific projects. For these reasons, this impact would be less than significant.

This impact would be the same as Impact Bot-10 (CP3) and would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact Bot-11 (CP5): Loss of Sensitive Natural Communities or Habitats Resulting from Implementing the Gravel Augmentation Program or the Reading Island Restoration Plan, Rehabilitating the Reading Island Boat Ramp, or Constructing a Handicap Fishing Access Area Implementing the gravel augmentation program could result in the removal of riparian and wetland vegetation or the degradation of riparian and wetland habitats, including wetlands qualifying as waters of the United States. Habitat restoration, boat ramp rehabilitation, and fishing area construction at Reading Island could remove riparian vegetation, or result in discharge of fill material into waters of the United States. This impact would be potentially significant.

This impact would be the same as Impact Bot-11 (CP4) and would be potentially significant. Mitigation for this impact is proposed in Section 12.3.5.

Impact Bot-12 (CP5): Loss of Special-Status Plants Resulting from Implementing the Gravel Augmentation Program, Restoring Sacramento River Flow Through Anderson Slough, Rehabilitating the Reading Island Boat Ramp, or Constructing a Handicap Fishing Access Area Vegetation removal and gravel placement could result in the loss of special-status plants if they are present, and implementing the Reading Island projects could result in the removal of riparian vegetation. This impact would be potentially significant.

This impact would be the same as Impact Bot-12 (CP4) and would be potentially significant. Mitigation for this impact is proposed in Section 12.3.5.

Impact Bot-13 (CP5): Spread of Noxious and Invasive Weeds Resulting from Implementing the Gravel Augmentation Program, Restoring Sacramento River Flow Through Anderson Slough, Rehabilitating the Reading Island Boat Ramp, or Constructing a Handicap Fishing Access Area Implementing the gravel augmentation program could result in the spread of noxious and invasive weeds as a result of vegetation clearing and grubbing and an increased number of vectors. In addition, at Reading Island, actions would be implemented to restore connectivity between the Sacramento River and the Reading Island side channel, to restore floodplain and riparian habitat, to rehabilitate the boat ramp, and to create a handicap fishing access area at Reading Island. The activities at Reading Island could also result in the spread of noxious and invasive weeds as a result of vegetation clearing and grubbing and an increased number of vectors. This impact would be potentially significant.

This impact would be the same as Impact Bot-13 (CP4) and would be potentially significant. Mitigation for this impact is proposed in Section 12.3.5.

Lower Sacramento River and Delta

Impact Bot-14 (CP5): Altered Structure and Species Composition and Loss of Sensitive Plant Communities and Special-Status Plant Species Resulting from Altered Flow Regimes on the Lower Sacramento River Altered flow regimes associated with project implementation under CP1 could alter the structure and species composition or cause the loss of riparian, wetland, and oak communities, and of habitat for special-status plant species. Vernal pool plant communities and associated special-status plant species likely would not be affected. Effects on oak communities and upland habitats for special-status plants may not all be adverse. Adverse effects on riparian and wetland communities and associated special-status plants could be substantial on the lower Sacramento River, but these effects are unlikely to extend to the Delta; thus, this impact would be significant on the lower Sacramento River, and less than significant in the Delta.

This impact would be the same as Impact Bot-14 (CP3) and would be significant on the lower Sacramento River and less than significant in the Delta. Mitigation for this impact on the lower Sacramento River is proposed in Section 12.3.5.

Impact Bot-15 (CP5): Conflict with Approved Local or Regional Plans with Objectives of Riparian Habitat Protection or Watershed Management Along the Lower Sacramento River Adopted local and regional plans address and promote the conservation of riparian vegetation and associated habitats along the lower Sacramento River. Because CP5 would adversely affect riparian communities, this alternative could conflict with existing local and regional plans focused on preserving riparian habitats. Therefore, this impact on the lower Sacramento River would be potentially significant.

This impact would be the same as Impact Bot-15 (CP1) and would be potentially significant. Mitigation for this impact is proposed in Section 12.3.5.

Impact Bot-16 (CP5): Loss of Sensitive Plant Communities and Special-Status Plant Species Resulting from Induced Growth Along the Lower Sacramento River and in the Delta Implementation of CP5 could increase water yield for water districts in the extended study area along the lower Sacramento River. This increase in water yield could reduce a limitation on growth that could affect sensitive plant communities and special-status plant species. However, this increase in water yield for growth that could affect these resources would be small, and in the future the effects of this growth would be analyzed and mitigated during land use planning and environmental review for specific projects. For these reasons, this impact would be less than significant.

This impact would be the same as Impact Bot-16 (CP3) and would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

CVP/SWP Service Areas

Impact Bot-17 (CP5): Altered Structure and Species Composition and Loss of Sensitive Plant Communities and Special-Status Plant Species Resulting from Altered Flow Regimes in the CVP/SWP Service Areas Altered flow regimes associated with project implementation under CP5 could alter the structure and species composition or cause the loss of sensitive plant communities and of habitat for special-status plant species. However, alteration of flow regimes below CVP and SWP reservoirs in the extended study area would be less than below Shasta Dam along the upper and lower Sacramento River. These alterations may not be sufficient to alter the extent of early-successional riparian and wetland communities or associated habitats for special-status plant species. Therefore, this impact would be less than significant below CVP and SWP reservoirs in the extended study area.

This impact would be the same as Impact Bot-17 (CP3) and would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact Bot-18 (CP5): Conflict with Approved Local or Regional Plans with Objectives of Riparian Habitat Protection or Watershed Management in the CVP/SWP Service Areas Adopted local and regional plans address and promote the conservation of riparian vegetation and associated habitats along rivers below reservoirs in the CVP and SWP service areas. However, implementation of CP5 would not cause a significant impact on riparian vegetation and habitats. Therefore, CP5 would not conflict with existing local and regional plans focused on preserving riparian habitats. Thus, this impact in the CVP and SWP service areas would be less than significant.

This impact would be the same as Impact Bot-18 (CP1) and would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact Bot-19 (CP5): Loss of Sensitive Plant Communities and Special-Status Plant Species Resulting from Induced Growth in the CVP/SWP Service Areas Implementation of CP5 could increase water yield for water districts in the CVP and SWP service areas. This increase in water yield could reduce a limitation on growth that could affect sensitive plant communities and special-status plant species. However, this increase in water yield for growth that could affect these resources would be small, and in the future the effects of this growth would be analyzed and mitigated during land use planning and environmental review for specific projects. For these reasons, this impact would be less than significant.

This impact would be the same as Impact Bot-19 (CP3) and would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

12.3.5 Mitigation Measures

Table 12-16 presents a summary of mitigation measures for botanical resources and wetlands.

Table 12-16. Summary of Mitigation Measures for Botanical Resources

Impact		No-Action Alternative	CP1	CP2	CP3	CP4	CP5
Impact Bot-1: Loss of Federally or State Listed Plant Species	LOS before Mitigation	NI	NI	NI	NI	NI	NI
	Mitigation Measure	None required.	None needed; thus, none proposed.				
	LOS after Mitigation	NI	NI	NI	NI	NI	NI
Impact Bot-2: Loss of MSCS Covered Species	LOS before Mitigation	NI	S	S	S	S	S
	Mitigation Measure	None required.	Mitigation Measure Bot-2: Acquire and Preserve Mitigation Lands; Avoid Populations; Relocate MSCS Plants; and Revegetate Affected Areas.				
	LOS after Mitigation	NI	SU	SU	SU	SU	SU
Impact Bot-3: Loss of USFS Sensitive, BLM Sensitive, or CRPR Species	LOS before Mitigation	NI	PS	PS	PS	PS	PS
	Mitigation Measure	None required.	Mitigation Measure Bot-3: Acquire and Preserve Mitigation Lands; Avoid Populations; Relocate USFS Sensitive, BLM Sensitive, and CRPR Plants and Revegetate Affected Areas.				
	LOS after Mitigation	NI	SU	SU	SU	SU	SU
Impact Bot-4: Loss of Jurisdictional Waters	LOS before Mitigation	NI	S	S	S	S	S
	Mitigation Measure	None required.	Mitigation Measure Bot-4: Mitigate Loss of Jurisdictional Waters.				
	LOS after Mitigation	NI	SU	SU	SU	SU	SU
Impact Bot-5: Loss of General Vegetation Habitats	LOS before Mitigation	NI	PS	PS	PS	PS	PS
	Mitigation Measure	None required.	Mitigation Measure Bot-5: Acquire and Preserve Mitigation Lands for Loss of General Vegetation Habitats.				
	LOS after Mitigation	NI	SU	SU	SU	SU	SU

Table 12-16. Summary of Mitigation Measures for Botanical Resources (contd.)

Impact		No-Action Alternative	CP1	CP2	CP3	CP4	CP5
Impact Bot-6: Spread of Noxious and Invasive Weeds	LOS before Mitigation	NI	PS	PS	PS	PS	PS
	Mitigation Measure	None required.	Mitigation Measure Bot-6: Develop a Weed Management Plan.				
	LOS after Mitigation	NI	LTS	LTS	LTS	LTS	LTS
Impact Bot-7: Altered Structure and Species Composition and Loss of Sensitive Plant Communities and Special-Status Plant Species Resulting from Altered Flow Regimes	LOS before Mitigation	LTS	S	S	S	S	S
	Mitigation Measure	None required.	Mitigation Measure Bot-7: Develop and Implement a Riverine Ecosystem Mitigation and Adaptive Management Plan to Avoid and Compensate for the Impact of Altered Flow Regimes on Riparian and Wetland Communities.				
	LOS after Mitigation	LTS	LTS	LTS	LTS	LTS	LTS
Impact Bot-8: Conflict with Approved Local or Regional Plans with Objectives of Riparian Habitat Protection or Watershed Management	LOS before Mitigation	LTS	PS	PS	PS	PS	PS
	Mitigation Measure	None required.	Mitigation Measure Bot-8: Implement Mitigation Measure Bot-7: Develop and Implement a Riverine Ecosystem Mitigation and Adaptive Management Plan to Avoid and Compensate for the Impact of Altered Flow Regimes on Riparian and Wetland Communities.				
	LOS after Mitigation	LTS	LTS	LTS	LTS	LTS	LTS
Impact Bot-9: Disturbance or Removal of Designated Critical Habitat for Special-Status Species	LOS before Mitigation	LTS	LTS	LTS	LTS	LTS	LTS
	Mitigation Measure	None required.	None needed; thus, none proposed.				
	LOS after Mitigation	LTS	LTS	LTS	LTS	LTS	LTS
Impact Bot-10: Loss of Sensitive Plant Communities and Special-Status Plant Species Resulting from Induced Growth	LOS before Mitigation	LTS	LTS	LTS	LTS	LTS	LTS
	Mitigation Measure	None required.	None needed; thus, none proposed.				
	LOS after Mitigation	LTS	LTS	LTS	LTS	LTS	LTS

Table 12-16. Summary of Mitigation Measures for Botanical Resources (contd.)

Impact		No-Action Alternative	CP1	CP2	CP3	CP4	CP5
Impact Bot-11: Loss of Sensitive Natural Communities or Habitats Resulting from Implementing the Gravel Augmentation Program or the Reading Island Restoration Plan, Rehabilitating the Reading Island Boat Ramp, or Constructing a Handicap Fishing Access Area	LOS before Mitigation	NI	NI	NI	NI	PS	PS
	Mitigation Measure	None required.	None needed; thus, none proposed.			Mitigation Measure Bot-11: Revegetate Disturbed Areas, Consult with DFG.	
	LOS after Mitigation	NI	NI	NI	NI	LTS	LTS
Impact Bot-12: Loss of Special-Status Plants Resulting from Implementing the Gravel Augmentation Program, Restoring Sacramento River Flow Through Anderson Slough, Rehabilitating the Reading Island Boat Ramp, or Constructing a Handicap Fishing Access Area	LOS before Mitigation	NI	NI	NI	NI	PS	PS
	Mitigation Measure	None required.	None needed; thus, none proposed.			Mitigation Measure Bot-12 : Conduct Preconstruction Surveys for Special-Status Plants and Avoid Special-Status Plant Populations During Construction.	
	LOS after Mitigation	NI	NI	NI	NI	LTS	LTS
Impact Bot-13: Spread of Noxious and Invasive Weeds Resulting from Implementing the Gravel Augmentation Program, Restoring Sacramento River Flow Through Anderson Slough, Rehabilitating the Reading Island Boat Ramp, or Constructing a Handicap Fishing Access Area	LOS before Mitigation	NI	NI	NI	NI	PS	PS
	Mitigation Measure	None required.	None needed; thus, none proposed.			Mitigation Measure Bot-13: Implement Weed Management Measures and Revegetation.	
	LOS after Mitigation	NI	NI	NI	NI	LTS	LTS

Table 12-16. Summary of Mitigation Measures for Botanical Resources (contd.)

Impact		No-Action Alternative	CP1	CP2	CP3	CP4	CP5
Impact Bot-14: Altered Structure and Species Composition and Loss of Sensitive Plant Communities and Special-Status Plant Species Resulting from Altered Flow Regimes on the Lower Sacramento River	LOS before Mitigation	LTS	S (lower Sacramento River); LTS (Delta)	S (lower Sacramento River); LTS (Delta)	S (lower Sacramento River); LTS (Delta)	S (lower Sacramento River); LTS (Delta)	S (lower Sacramento River); LTS (Delta)
	Mitigation Measure	None required.	Mitigation Measure Bot-14: Implement Mitigation Measure Bot-7: Develop and Implement a Riverine Ecosystem Mitigation and Adaptive Management Plan to Avoid and Compensate for the Impact of Altered Flow Regimes on Riparian and Wetland Communities.				
	LOS after Mitigation	LTS	LTS	LTS	LTS	LTS	LTS
Impact Bot-15: Conflict with Approved Local or Regional Plans with Objectives of Riparian Habitat Protection or Watershed Management Along the Lower Sacramento River	LOS before Mitigation	PS	PS	PS	PS	PS	PS
	Mitigation Measure	None required.	Mitigation Measure Bot-15: Implement Mitigation Measure Bot-7: Develop and Implement a Riverine Ecosystem Mitigation and Adaptive Management Plan to Avoid and Compensate for the Impact of Altered Flow Regimes on Riparian and Wetland Communities.				
	LOS after Mitigation	PS	LTS	LTS	LTS	LTS	LTS
Impact Bot-16: Loss of Sensitive Plant Communities and Special-Status Plant Species Resulting from Induced Growth Along the Lower Sacramento River and in the Delta	LOS before Mitigation	LTS	LTS	LTS	LTS	LTS	LTS
	Mitigation Measure	None required.	None needed; thus, none proposed				
	LOS after Mitigation	LTS	LTS	LTS	LTS	LTS	LTS
Impact Bot-17: Altered Structure and Species Composition and Loss of Sensitive Plant Communities and Special-Status Plant Species Resulting from Altered Flow Regimes in the CVP/SWP Service Areas	LOS before Mitigation	LTS	LTS	LTS	LTS	LTS	LTS
	Mitigation Measure	None required.	None needed; thus, none proposed.				
	LOS after Mitigation	LTS	LTS	LTS	LTS	LTS	LTS

Table 12-16. Summary of Mitigation Measures for Botanical Resources (contd.)

Impact		No-Action Alternative	CP1	CP2	CP3	CP4	CP5
Impact Bot-18: Conflict with Approved Local or Regional Plans with Objectives of Riparian Habitat Protection or Watershed Management in the CVP/SWP Service Areas	LOS before Mitigation	LTS	LTS	LTS	LTS	LTS	LTS
	Mitigation Measure	None required.	None needed; thus, none proposed.				
	LOS after Mitigation	LTS	LTS	LTS	LTS	LTS	LTS
Impact Bot-19: Loss of Sensitive Plant Communities and Special-Status Plant Species Resulting from Induced Growth in CVP/SWP Service Areas	LOS before Mitigation	LTS	LTS	LTS	LTS	LTS	LTS
	Mitigation Measure	None required.	None needed; thus, none proposed.				
	LOS after Mitigation	LTS	LTS	LTS	LTS	LTS	LTS

Notes:
LOS = level of significance
LTS = less than significant
NA = not applicable
NI = no impact
PS = potentially significant
S = significant
SU = significant and unavoidable

No-Action Alternative

Under the No-Action Alternative, no action would be taken, including implementation of mitigation measures; rather, existing conditions would continue to change into the future. No mitigation is needed.

CP1 – 6.5-Foot Dam Raise, Anadromous Fish Survival and Water Supply Reliability

No mitigation is needed for Impacts Bot-1 (CP1), Bot-9 (CP1), Bot-10 (CP1), Bot-11 (CP1) through Bot-13 (CP1), and Bot-16 (CP1) through Bot-19 (CP1). Mitigation is provided below for the remaining impacts of CP1 on botanical resources.

Mitigation Measure Bot-2 (CP1): Acquire and Preserve Mitigation Lands; Avoid Populations; Relocate MSCS Plants; and Revegetate Affected Areas

The following mitigation measures will reduce impacts on MSCS plants:

- When feasible in relocation areas, avoid or minimize actions that could result in harm or mortality to individuals or to the viability of populations.

- When feasible, Reclamation will relocate populations of MSCS plants that would be directly affected to suitable habitat within undisturbed portions of the Shasta Lake and vicinity portion of the primary study area.

- A mitigation and monitoring plan will be developed to monitor success of MSCS plant populations that have been relocated or revegetated. The plan will identify suitable sites for mitigation, species to be planted, and numbers and sizes of plantings. It will describe planting techniques, prescribe methods to remove existing noxious weeds, and establish reasonable performance standards and contingency measures. Further, it will establish conservation easements as appropriate. The vegetation restoration plan will be developed in consultation with the USACE, USFWS, USFS, and DFG.

- Where appropriate, MSCS covered plant species will be used for revegetation.

Implementation of this mitigation measure would reduce impacts on MSCS plant species; however, because successful relocation, transplanting, and artificial propagation of Shasta snow-wreath are unproven, impacts would remain significant and unavoidable.

Potential mitigation lands containing comparable habitat have been identified adjacent to the project. Additional discussion of how these lands may be applied as mitigation and at what ratios will be provided in the FEIS. A discussion of

mitigation for loss of habitat through preservation and enhancement in mitigation areas will be included in the FEIS.

Mitigation Measure Bot-3 (CP1): Acquire and Preserve Mitigation Lands; Avoid Populations; Relocate USFS Sensitive, BLM Sensitive and CRPR Plants and Revegetate Affected Areas The following mitigation measures will reduce impacts on USFS sensitive, BLM sensitive and CRPR plants:

When feasible in relocation areas, avoid or minimize actions that could result in harm or mortality to individuals or to the viability of populations.

- When feasible, Reclamation will relocate populations of USFS sensitive, BLM sensitive and CRPR plants that would be directly affected to suitable habitat within undisturbed portions of the Shasta Lake and vicinity portion of the primary study area.

- A mitigation and monitoring plan will be developed to monitor success of USFS sensitive, BLM sensitive, and CRPR plant populations that have been relocated or revegetated. The plan will identify suitable sites for mitigation, species to be planted, and numbers and sizes of plantings. It will describe planting techniques, prescribe methods to remove existing noxious weeds, and establish reasonable performance standards and contingency measures. Further, it will establish conservation easements as appropriate. The vegetation restoration plan will be developed in consultation with USACE, USFWS, USFS, and DFG.

- To the extent feasible, USFS sensitive, BLM sensitive, and CRPR plant species will be used for revegetation.

Implementation of this mitigation measure would reduce impacts on USFS sensitive, BLM sensitive, and CRPR plant species; however, because successful relocation and transplantation of these species are unproven, impacts would remain potentially significant and unavoidable.

Potential mitigation lands containing comparable habitat have been identified adjacent to the project. Additional discussion of how these lands may be applied as mitigation and at what ratios will be provided in the FEIS. A discussion of mitigation for loss of habitat through preservation and enhancement in mitigation areas will be included in the FEIS.

Mitigation Measure Bot-4 (CP1): Mitigate Loss of Jurisdictional Waters Specific mitigation measures have not been determined for this impact. Within relocation areas, jurisdictional waters of the United States will be avoided when feasible. Potential mitigation lands containing comparable habitat have been identified adjacent to the project. Additional discussion of how these lands may be applied as mitigation will be provided in the FEIS. A discussion of

mitigation for loss of habitat through preservation and enhancement in mitigation areas will be included in the FEIS.

Until the details of this mitigation measure are developed, Impact Bot-4 (CP1) is considered significant and unavoidable.

Mitigation Measure Bot-5 (CP1): Acquire and Preserve Mitigation Lands for Loss of General Vegetation Habitats It is anticipated that mitigation lands will be acquired and placed in conservation easements to mitigate for the loss of vegetation habitat. Additionally, opportunities for restoration and enhancement of habitat will be explored and defined. Potential mitigation lands containing comparable habitat in locations where these species are known to occur have been identified adjacent to the project. Additional discussion of how these lands could be applied as mitigation will be presented in the FEIS. However, the effectiveness of providing compensatory mitigation by acquiring and conserving habitat mitigation lands to mitigate inundation impacts cannot be accurately determined without additional details. This impact, therefore, is considered significant and unavoidable. Until the details of this mitigation measure are developed, Impact Bot-5 (CP1) is considered significant and unavoidable.

Mitigation Measure Bot-6 (CP1): Develop a Weed Management Plan Reclamation will develop a weed management plan to avoid or minimize the potential for project-related impacts from noxious and invasive plants. This plan would include the following:

- Conduct annual weed monitoring of relocation and construction areas for three seasons after project completion.
- Design and implement appropriate USFS approved eradication methods for weed species detected.
- Treat and monitor existing source weed populations within and adjacent to construction and relocation areas.
- In relocation areas, seed disturbed soils with native grass and forb seeds to discourage occupation by noxious weeds.
- Include C Provision 6.35, Equipment Cleaning (4/04), in all contracts.

Use only weed-free road fill, gravel, mulches, and seed sources. Implementation of these measures would reduce Impact Bot-6 (CP1) to a less than significant level.

Mitigation Measure Bot-7 (CP1): Develop and Implement a Riverine Ecosystem Mitigation and Adaptive Management Plan to Avoid and Compensate for the Impact of Altered Flow Regimes on Riparian and Wetland Communities Reclamation will develop and implement a riverine ecosystem mitigation and adaptive management plan to mitigate to the extent feasible any identified impacts of an altered Sacramento River flow regime on existing riparian and wetland communities, and associated instream, riparian, and wetland habitat values for aquatic and terrestrial special-status species along the Sacramento River from Shasta Dam to Colusa (River Mile 144). The plan will be consistent with and supporting implementation of the Senate Bill 1086 program, and will be developed in coordination with USFWS, the NMFS, DFG, and the Sacramento River Conservation Area Forum. The Plan will be developed before project construction. The plan is limited to the Sacramento River from Shasta Dam to Colusa (River Mile 144). The existing conditions as of 2010 are the baseline conditions.

The goals of the plan will be to result in no net reduction in the average amount of any of the following along the Sacramento River from Shasta Dam to Colusa:

- Channel migration in selected areas of natural vegetation dominated by native species
- Overbank inundation of natural vegetation dominated by native species in selected areas
- Regeneration of early-successional riparian vegetation (e.g., cottonwood regeneration) in selected areas

The riverine ecosystem mitigation plan will include all of the following elements:

- Modeling or monitoring at representative locations to quantify direct and indirect impacts resulting from adaptive management of project implementation. A method of quantifying impacts will be used that ensures repeatability.
- An evaluation of feasible modifications to the procedures for operating Shasta Dam (e.g., ramping rates) to do any of the following:
  - Reduce or eliminate adverse impacts on ecologically important bankfull and overbank flows (as feasible within existing flood reduction constraints)
  - Reduce or eliminate adverse impacts (e.g., reduction) on meander migration rates

  - Facilitate establishment of cottonwoods and early-successional vegetation at intervals sufficient to sustain cottonwoods and early-successional riparian vegetation along the Sacramento River riparian corridor and floodplain (e.g., at 5- to 15-year intervals)

  - Feasible modifications to operational procedures are those not in conflict with applicable laws, agreements, and regulations, or with the purpose of the project. Implementation of this mitigation measure cannot increase flood risk.

- A specific combination of mitigation actions will be developed and implemented to attain the plan's goals. Mitigation actions will consist of feasible modifications of dam operation procedures and/or funding of appropriate and feasible restoration actions that have been developed by Reclamation, other federal agencies, state or local governments, or private nonprofits and received applicable federal and state permits. Appropriate and feasible restoration actions do any of the following:

  - Enhance connectivity of river side channels (e.g., by modifying the elevation of secondary channels, remnant oxbows, or meander scars)

  - Expand the river meander zone at selected locations (e.g., by assisting in funding projects that meet this objective)

  - Increase floodplain connectivity (e.g., by assisting in funding projects that meet this objective)

  - Control and remove nonnative, invasive plant species from riparian areas to shift dominance to native species

  - Create riparian and wetland communities (e.g., through plantings)

  - Increase shaded riverine aquatic habitat (e.g., through plantings)

- The methods and results of an analysis demonstrating that a specified combination of mitigation actions should attain the plan's goals.

- The location of restoration actions specified in the combination of mitigation actions. Restoration actions will be performed on preserved sites and with funding for management in perpetuity. (Preserved sites include sites previously preserved by other entities.)

- Implementation mechanisms (i.e., mechanisms by which Reclamation will fund implementation) and criteria for implementing dam operation procedures that provide mitigation

- Parameters for preparation and content of restoration and management plans, or existing applicable plans.

At a minimum, mitigation in this plan will include the following:

- Feasible modifications to dam operation procedures identified as reducing adverse impacts on meander migration or ecologically important bankfull and overbank flows, or as facilitating cottonwood establishment

- Either of the following elements:

  – Provide actions or funding to increase meander migration, side-channel connectivity, or floodplain connectivity along the Sacramento River, and creation (or conversion of nonnative-dominated to native-dominated) of riparian or wetland communities

  – Provide mitigation that has been determined by USFWS, NMFS, and DFG to be of comparable or greater value and is included in the terms and conditions of permits for impacts on species listed as threatened or endangered by the State or Federal governments

Implementation of this mitigation measure would mitigate the impact of altered flow regimes on instream, riparian, and wetland communities, and thus would reduce Impact Bot-7 (CP1) to a less than significant level.

Mitigation Measure Bot-8 (CP1): Implement Mitigation Measure Bot-7 (CP1): Develop and Implement a Riverine Ecosystem Mitigation and Adaptive Management Plan to Reduce Conflicts with Approved Local or Regional Plans with Objectives of Riparian Habitat Protection or Watershed Management Reclamation will implement Mitigation Measure Bot-7 (CP1) as described above. As described under Mitigation Measure Bot-7 (CP1), developing and implementing a riverine ecosystem mitigation plan would reduce conflicts with approved local and regional plans that address and promote the conservation of riparian vegetation communities along the upper Sacramento River in the primary study area. Consequently, implementation of the previous mitigation measure would reduce Impact Bot-8 (CP1) to a less than significant level.

Mitigation Measure Bot-14 (CP1): Implement Mitigation Measure Bot-7 (CP1): Develop and Implement a Riverine Ecosystem Mitigation and Adaptive Management Plan to Avoid and Compensate for the Impact of Altered Flow Regimes on Riparian and Wetland Communities This measure is identical to Mitigation Measure Bot-7 (CP1) as described above. This mitigation measure involves developing and implementing of a riverine

ecosystem mitigation plan. Implementation of this mitigation measure would reduce Impact Bot-14 (CP1) to a less than significant level.

Mitigation Measure Bot-15 (CP1): Implement Mitigation Measure Bot-7 (CP1): Develop and Implement a Riverine Ecosystem Mitigation and Adaptive Management Plan to Reduce Conflicts with Approved Local or Regional Plans with Objectives of Riparian Habitat Protection or Watershed Management Reclamation will implement Mitigation Measure Bot-7 (CP1) as described above. As described under Mitigation Measure Bot-7 (CP1), developing and implementing a riverine ecosystem mitigation plan would reduce conflicts with approved local and regional plans that address and promote the conservation of riparian vegetation communities along the lower Sacramento River in the extended study area. Consequently, implementing the previous mitigation measure would reduce Impact Bot-15 (CP1) to a less than significant level.

CP2 – 12.5-Foot Dam Raise, Anadromous Fish Survival and Water Supply Reliability

No mitigation is needed for Impacts Bot-1 (CP2), Bot-9 (CP2), Bot-10 (CP2), Bot-11 (CP2) through Bot-13 (CP2), and Bot-16 (CP2) through Bot-19 (CP2). Mitigation is provided below for the remaining impacts of CP2 on botanical resources.

Mitigation Measure Bot-2 (CP2): Acquire and Preserve Mitigation Lands; Avoid Populations; Relocate MSCS Plants; and Revegetate Affected Areas This mitigation measure is identical to Mitigation Measure Bot-2 (CP1). Implementation of this mitigation measure would reduce impacts on MSCS species; however, because relocation of these species is unproven, impacts would remain significant and unavoidable.

Potential mitigation lands containing comparable habitat have been identified adjacent to the project. Additional discussion of how these lands may be applied as mitigation and at what ratios will be provided in the FEIS. A discussion of mitigation for loss of habitat through preservation and enhancement in mitigation areas will be included in the FEIS.

Mitigation Measure Bot-3 (CP2): Acquire and Preserve Mitigation Lands; Avoid Populations; Relocate USFS Sensitive, BLM Sensitive and CRPR Plants and Revegetate Affected Areas This mitigation measure is identical to Mitigation Measure Bot-3 (CP1). Implementation of this mitigation measure would reduce impacts on USFS sensitive, BLM sensitive and CRPR plant species; however, because relocation of these species is unproven, impacts would remain significant and unavoidable.

Potential mitigation lands containing comparable habitat have been identified adjacent to the project. Additional discussion of how these lands may be applied as mitigation and at what ratios will be provided in the FEIS. A discussion of

mitigation for loss of habitat through preservation and enhancement in mitigation areas will be included in the FEIS.

Mitigation Measure Bot-4 (CP2): Mitigate Loss of Jurisdictional Waters This mitigation measure is identical to Mitigation Measure Bot-4 (CP1). Specific mitigation measures have not been determined for this impact. Within relocation areas, jurisdictional waters of the United States will be avoided when feasible. Potential mitigation lands containing comparable habitat have been identified adjacent to the project. Additional discussion of how these lands may be applied as mitigation and at what ratios will be provided in the FEIS. A discussion of mitigation for loss of habitat through preservation and enhancement in mitigation areas will be included in the FEIS.

Until the details of this mitigation measure are developed, Impact Bot-4 (CP2) is considered significant and unavoidable.

Mitigation Measure Bot-5 (CP2): Acquire and Preserve Mitigation Lands for Loss of General Vegetation Habitats This mitigation measure is identical to Mitigation Measure Bot-3 (CP1). Specific mitigation measures have not been determined for this impact. Potential mitigation lands containing comparable habitat have been identified adjacent to the project. Additional discussion of how these lands may be applied as mitigation and at what ratios will be provided in the FEIS. A discussion of mitigation for loss of habitat through preservation and enhancement in mitigation areas will be included in the FEIS.

Until the details of this mitigation measure are developed, Impact Bot-5 (CP2) is considered significant and unavoidable.

Mitigation Measure Bot-6 (CP2): Develop a Weed Management Plan This mitigation measure is identical to Mitigation Measure Bot-6 (CP1). Implementation of this mitigation measure would reduce Impact Bot-6 (CP2) to a less than significant level.

Mitigation Measure Bot-7 (CP2): Develop and Implement a Riverine Ecosystem Mitigation and Adaptive Management Plan to Avoid and Compensate for the Impact of Altered Flow Regimes on Riparian and Wetland Communities This mitigation measure is identical to Mitigation Measure Bot-7 (CP1), except that mitigation in the riverine ecosystem mitigation plan will include either of the following elements:

- Increased meander migration, side-channel connectivity, or floodplain connectivity along the Sacramento River, and creation (or conversion from nonnative-dominated to native-dominated) of riparian or wetland communities

- Mitigation that has been determined by USFWS, NMFS, and DFG to be of comparable or greater value and is included in the terms and

conditions of permits for impacts on species listed as threatened or endangered by the State or Federal government

Implementation of this mitigation measure would reduce Impact Bot-7 (CP2) to a less than significant level.

Mitigation Measure Bot-8 (CP2): Implement Mitigation Measure Bot-7 (CP2): Develop and Implement a Riverine Ecosystem Mitigation and Adaptive Management Plan to Reduce Conflicts with Approved Local or Regional Plans with Objectives of Riparian Habitat Protection or Watershed Management Reclamation will implement Mitigation Measure Bot-7 (CP2) as described above. Developing and implementing this riverine ecosystem mitigation plan would reduce conflicts with approved local and regional plans that address and promote the conservation of riparian vegetation communities along the upper Sacramento River in the primary study area. Implementation of this mitigation measure would reduce Impact Bot-8 (CP2) to a less than significant level.

Mitigation Measure Bot-14 (CP2): Implement Mitigation Measure Bot-7 (CP2): Develop and Implement a Riverine Ecosystem Mitigation and Adaptive Management Plan to Avoid and Compensate for the Impact of Altered Flow Regimes on Riparian and Wetland Communities This mitigation measure is identical to Mitigation Measure Bot-7 (CP2). This mitigation measure involves the development and implementation of a riverine ecosystem mitigation plan. Implementation of this mitigation measure would reduce Impact Bot-14 (CP2) to a less than significant level.

Mitigation Measure Bot-15 (CP2): Implement Mitigation Measure Bot-7 (CP2): Develop and Implement a Riverine Ecosystem Mitigation and Adaptive Management Plan to Reduce Conflicts with Approved Local or Regional Plans with Objectives of Riparian Habitat Protection or Watershed Management Reclamation will implement Mitigation Measure Bot-7 (CP2) as described above. Developing and implementing this riverine ecosystem mitigation plan would reduce conflicts with approved local and regional plans that address and promote the conservation of riparian vegetation communities along the lower Sacramento River in the extended study area. This mitigation measure is identical to Mitigation Measure Bot-7 (CP2). Implementation of this mitigation measure would reduce Impact Bot-15 (CP2) to a less than significant level.

CP3 – 18.5-Foot Dam Raise, Anadromous Fish Survival and Water Supply

No mitigation is needed for Impacts Bot-1 (CP3), Bot-9 (CP3), Bot-10 (CP3), Bot-11 (CP3) through Bot-13 (CP3), and Bot-16 (CP3) through Bot-19 (CP3). Mitigation is provided below for the remaining impacts of CP3 on botanical resources.

Mitigation Measure Bot-2 (CP3): Acquire and Preserve Mitigation Lands; Avoid Populations; Relocate MSCS Plants; and Revegetate Affected Areas This mitigation measure is identical to Mitigation Measure Bot-2 (CP1). Implementation of this mitigation measure would reduce impacts on MSCS species; however, because relocation of these species is unproven, impacts would remain significant and unavoidable.

Potential mitigation lands containing comparable habitat have been identified adjacent to the project. Additional discussion of how these lands may be applied as mitigation and at what ratios will be provided in the FEIS. A discussion of mitigation for loss of habitat through preservation and enhancement in mitigation areas will be included in the FEIS.

Mitigation Measure Bot-3 (CP3): Acquire and Preserve Mitigation Lands; Avoid Populations; Relocate USFS Sensitive, BLM Sensitive and CRPR Plants and Revegetate Affected Areas This mitigation measure is identical to Mitigation Measure Bot-3 (CP1). Implementation of this mitigation measure would reduce impacts on USFS sensitive, BLM sensitive and CRPR plant species; however, because relocation of these species is unproven, impacts would remain significant and unavoidable.

Potential mitigation lands containing comparable habitat have been identified adjacent to the project. Additional discussion of how these lands may be applied as mitigation and at what ratios will be provided in the FEIS. A discussion of mitigation for loss of habitat through preservation and enhancement in mitigation areas will be included in the FEIS.

Mitigation Measure Bot-4 (CP3): Mitigate Loss of Jurisdictional Waters This mitigation measure is identical to Mitigation Measure Bot-4 (CP1). Specific mitigation measures have not been determined for this impact. Within relocation areas, jurisdictional waters of the United States will be avoided when feasible. Potential mitigation lands containing comparable habitat have been identified adjacent to the project. Additional discussion of how these lands may be applied as mitigation and at what ratios will be provided in the FEIS. A discussion of mitigation for loss of habitat through preservation and enhancement in mitigation areas will be included in the FEIS.

Until the details of this mitigation measure are developed, Impact Bot-4 (CP3) is considered significant and unavoidable.

Mitigation Measure Bot-5 (CP3): Acquire and Preserve Mitigation Lands for Loss of General Vegetation Habitats This mitigation measure is identical to Mitigation Measure Bot-3 (CP1). Specific mitigation measures have not been determined for this impact. Potential mitigation lands containing comparable habitat have been identified adjacent to the project. Additional discussion of how these lands may be applied as mitigation and at what ratios will be

provided in the FEIS. A discussion of mitigation for loss of habitat through preservation and enhancement in mitigation areas will be included in the FEIS.

Until the details of this mitigation measure are developed, Impact Bot-5 (CP3) is considered significant and unavoidable.

Mitigation Measure Bot-6 (CP3): Develop a Weed Management Plan This mitigation measure is identical to Mitigation Measure Bot-6 (CP1). Implementation of this mitigation measure would reduce Impact Bot-6 (CP3) to a less than significant level.

Mitigation Measure Bot-7 (CP3): Develop and Implement a Riverine Ecosystem Mitigation and Adaptive Management Plan to Avoid and Compensate for the Impact of Altered Flow Regimes on Riparian and Wetland Communities This mitigation measure is identical to Mitigation Measure Bot-7 (CP1), except that mitigation in the riverine ecosystem mitigation plan will include either of the following elements:

- Increased meander migration, side-channel connectivity, or floodplain connectivity along the Sacramento River, and creation (or conversion from nonnative-dominated to native-dominated) of riparian or wetland communities

- Mitigation that has been determined by USFWS, NMFS, and DFG to be of comparable or greater value and is included in the terms and conditions of permits for impacts on species listed as threatened or endangered by the State or Federal government.

Implementation of this mitigation measure would reduce Impact Bot-7 (CP3) to a less than significant level.

Mitigation Measure Bot-8 (CP3): Implement Mitigation Measure Bot-7 (CP3): Develop and Implement a Riverine Ecosystem Mitigation and Adaptive Management Plan to Reduce Conflicts with Approved Local or Regional Plans with Objectives of Riparian Habitat Protection or Watershed Management Reclamation will implement Mitigation Measure Bot-7 (CP3) as described above. The development and implementation of this riverine ecosystem mitigation plan would reduce conflicts with approved local and regional plans that address and promote the conservation of riparian vegetation communities along the upper Sacramento River in the primary study area. Implementation of this mitigation measure would reduce Impact Bot-8 (CP3) to a less than significant level.

Mitigation Measure Bot-14 (CP3): Implement Mitigation Measure Bot-7 (CP3): Develop and Implement a Riverine Ecosystem Mitigation and Adaptive Management Plan to Avoid and Compensate for the Impact of Altered Flow Regimes on Riparian and Wetland Communities This mitigation measure is identical to Mitigation Measure Bot-7 (CP3). This mitigation measure involves the development and implementation of a riverine ecosystem mitigation plan. Implementation of this mitigation measure would reduce Impact Bot-14 (CP3) to a less than significant level.

Mitigation Measure Bot-15 (CP3): Implement Mitigation Measure Bot-7 (CP3): Develop and Implement a Riverine Ecosystem Mitigation and Adaptive Management Plan to Reduce Conflicts with Approved Local or Regional Plans with Objectives of Riparian Habitat Protection or Watershed Management Reclamation will implement Mitigation Measure Bot-7 (CP3) as described above. The development and implementation of this riverine ecosystem mitigation plan would reduce conflicts with approved local and regional plans that address and promote the conservation of riparian vegetation communities along the lower Sacramento River in the extended study area. Implementation of this mitigation measure would reduce Impact Bot-15 (CP3) to a less than significant level.

CP4 – 18.5-Foot Dam Raise, Anadromous Fish Focus with Water Supply Reliability

No mitigation is needed for Impacts Bot-1 (CP4), Bot-9 (CP4), Bot-10 (CP4), and Bot-16 (CP4) through Bot-19 (CP4). Mitigation is provided below for the remaining impacts of CP4 on botanical resources.

Mitigation Measure Bot-2 (CP4): Acquire and Preserve Mitigation Lands; Avoid Populations; Relocate MSCS Plants; and Revegetate Affected Areas This mitigation measure is identical to Mitigation Measure Bot-2 (CP1). Implementation of this mitigation measure would reduce impacts on MSCS species; however, because relocation of these species is unproven, impacts would remain significant and unavoidable.

Potential mitigation lands containing comparable habitat have been identified adjacent to the project. Additional discussion of how these lands may be applied as mitigation and at what ratios will be provided in the FEIS. A discussion of mitigation for loss of habitat through preservation and enhancement in mitigation areas will be included in the FEIS.

Mitigation Measure Bot-3 (CP4): Acquire and Preserve Mitigation Lands; Avoid Populations; Relocate USFS Sensitive, BLM Sensitive and CRPR Plants and Revegetate Affected Areas This mitigation measure is identical to Mitigation Measure Bot-3 (CP1). Implementation of this mitigation measure would reduce impacts on USFS sensitive, BLM sensitive and CRPR plant species; however, because relocation of these species is unproven, impacts would remain significant and unavoidable.

Potential mitigation lands containing comparable habitat have been identified adjacent to the project. Additional discussion of how these lands may be applied as mitigation and at what ratios will be provided in the FEIS. A discussion of mitigation for loss of habitat through preservation and enhancement in mitigation areas will be included in the FEIS.

Mitigation Measure Bot-4 (CP4): Mitigate Loss of Jurisdictional Waters This mitigation measure is identical to Mitigation Measure Bot-4 (CP1). Specific mitigation measures have not been determined for this impact. Within relocation areas, jurisdictional waters of the United States will be avoided when feasible. Potential mitigation lands containing comparable habitat have been identified adjacent to the project. Additional discussion of how these lands may be applied as mitigation and at what ratios will be provided in the FEIS. A discussion of mitigation for loss of habitat through preservation and enhancement in mitigation areas will be included in the FEIS.

Until the details of this mitigation measure are developed, Impact Bot-4 (CP4) is considered significant and unavoidable.

Mitigation Measure Bot-5 (CP4): Acquire and Preserve Mitigation Lands for Loss of General Vegetation Habitats This mitigation measure is identical to Mitigation Measure Bot-3 (CP1). Specific mitigation measures have not been determined for this impact. Potential mitigation lands containing comparable habitat have been identified adjacent to the project. Additional discussion of how these lands may be applied as mitigation and at what ratios will be provided in the FEIS. A discussion of mitigation for loss of habitat through preservation and enhancement in mitigation areas will be included in the FEIS.

Until the details of this mitigation measure are developed, Impact Bot-5 (CP4) is considered significant and unavoidable.

Mitigation Measure Bot-6 (CP4): Develop a Weed Management Plan This mitigation measure is identical to Mitigation Measure Bot-6 (CP1). Implementation of this mitigation measure would reduce Impact Bot-6 (CP4) to a less than significant level.

Mitigation Measure Bot-7 (CP4): Develop and Implement a Riverine Ecosystem Mitigation and Adaptive Management Plan to Avoid and Compensate for the Impact of Altered Flow Regimes on Riparian and Wetland Communities This mitigation measure is identical to Mitigation Measure Bot-7 (CP1). Implementation of this mitigation measure would reduce Impact Bot-7 (CP4) to a less than significant level.

Mitigation Measure Bot-8 (CP4): Implement Mitigation Measure Bot-7 (CP1): Develop and Implement a Riverine Ecosystem Mitigation and Adaptive Management Plan to Reduce Conflicts with Approved Local or Regional Plans with Objectives of Riparian Habitat Protection or Watershed Management This mitigation measure is identical to Mitigation Measure Bot-7 (CP1). Implementation of this mitigation measure would reduce Impact Bot-8 (CP4) to a less than significant level.

Mitigation Measure Bot-11 (CP4): Revegetate Disturbed Areas, Consult with DFG Reclamation will implement the following measures to reduce and compensate for loss of sensitive natural communities:

- Before removing any vegetation at the augmentation sites and access areas, a survey will be conducted to map and classify the natural communities present in these areas, including wetland communities.

- Augmentation access will be designed to avoid disturbing wetland plant communities to the extent feasible. Removal of mature riparian vegetation and other sensitive vegetation will be minimized to the extent possible while still allowing access to gravel augmentation sites.

- DFG will be consulted with to determine if a Section 1602 streambed alteration agreement will be required for the gravel augmentation activities affecting the bed and bank of the Sacramento River and side channels.

- Staging and gravel and equipment storage will be confined to developed or disturbed areas to the extent feasible.

- A revegetation plan will be prepared to restore native vegetation in all areas cleared to implement the gravel augmentation program immediately following completion of the gravel augmentation activities at each augmentation site. The revegetation plan will include performance standards and success criteria to ensure that mitigation habitat would be successfully maintained and result in no net loss of sensitive natural communities, including riparian vegetation.

- Implement all conditions of the streambed alteration agreement to the satisfaction of DFG, subject to limitations on its authority set forth in Fish and Game Code Section 1600 et seq.

In addition, Reclamation will implement the following measures to reduce and compensate for potential loss of sensitive natural communities from the Reading Island Plan:

- A survey will be conducted before removing any vegetation at the augmentation sites and access areas, to map and classify the natural

communities present in restoration and potential construction areas at Reading Island.

- DFG will be consulted with to determine if a Section 1602 streambed alteration agreement will be required for the Reading Island restoration and construction activities affecting the bed and bank of the Sacramento River and side channel.

- Handicap fishing access will be designed to avoid disturbing sensitive plant communities to the extent feasible. A 100-foot no disturbance buffer shall be established around sensitive plant communities that are to be avoided during construction. Removal of mature riparian vegetation and other sensitive vegetation will be minimized to the extent possible.

- Staging, equipment storage, and construction access for Reading Island activities will be confined to existing roads and parking lots.

- Native riparian and other sensitive vegetation, if any, removed from the levee, boat ramp, and fishing access sites will be replaced on a no-net-loss basis. Riparian vegetation will be replaced through planting and establishment of comparable native riparian vegetation along the side channel floodplain. Other sensitive plant communities may be replaced through restoration of comparable native vegetation at other sites on Reading Island.

- Planting mix, composition, and density will be determined by a more detailed site analysis, but could include native cottonwood, willow, box elder, valley oak, western sycamore, elderberry, and a variety of understory brush species. Temporary irrigation will be provided on an as-needed basis.

Implement all conditions of the streambed alteration agreement to the satisfaction of DFG, subject to limitations on its authority set forth in Fish and Game Code Section 1600 et seq.

Implementation of this mitigation measure would reduce Impact Bot-11 (CP4) to a less than significant level.

Mitigation Measure Bot-12 (CP4): Conduct Preconstruction Surveys for Special-Status Plants and Avoid Special-Status Plant Populations During Construction Reclamation will implement the following measures to avoid impacts on special-status plants from resulting from the gravel augmentation program:

- Botanists will be hired to conduct protocol-level special-status plant surveys before commencing any construction activities that could disturb vegetation.

- All special-status plants identified within 250 feet of the proposed augmentation sites will be mapped and identified for avoidance. Access routes and gravel placement will be designed to avoid impacts on special-status plants.

- Fencing will be installed a minimum of 100 feet from special-status plants and no project activity will be permitted within the area occupied by special-status plants or the 100-foot buffer area around these plants.

- Insecticides, herbicides, fertilizers, or other chemicals that might harm special-status plants will not be used within 100 feet of the plants. Roadways and disturbed areas within 100 feet of special-status plants will be watered at least twice a day and as needed to minimize dust emissions.

In addition, Reclamation will implement the following measures to avoid impacts on special-status plants resulting from the Reading Island Plan:

- Qualified botanists will be hired to conduct protocol-level special-status plant surveys before commencing any construction activities that could disturb vegetation.

- All special-status plants identified within 250 feet of the proposed augmentation sites will be mapped and avoided to the extent feasible. It is unlikely that special-status plants are present on the levee, but if they are, it may not be possible to avoid them and still be able to breach the levee and restore connectivity to the Sacramento River. Handicap fishing access and boat ramp rehabilitation activities shall avoid special-status plants. Protective fencing will be installed around special-status plant locations and a 100-foot buffer zone during construction activities.

- Insecticides, herbicides, fertilizers, or other chemicals that might harm special-status plants will not be used within 100 feet of special-status plants. Roadways and disturbed areas within 100 feet of special-status plants will be watered at least twice a day and as needed to minimize dust emissions.

Implementation of this mitigation measure would reduce Impact Bot-12 (CP4) to a less than significant level.

Mitigation Measure Bot-13 (CP4): Implement Weed Management Measures and Revegetation Reclamation will implement the following measures to reduce the risk of introducing and spreading noxious weeds or invasive plant species during gravel augmentation or implementation of the Reading Island Plan:

- Before conducting gravel augmentation activities, invasive plant and noxious weed infestations will be identified and mapped within the augmentation sites, including vegetation clearing sites.

- Noxious weeds will be removed at the onset of construction and disposed of properly. If noxious weeds are not removed at the onset of construction, they will be fenced and avoided during construction.

- Any clothing, footwear, and equipment used during construction will be ensured free of soil, seeds, vegetative matter or other debris or potential seed-bearing material before entering the project sites or before moving from infested sites to uninfested sites.

- Mitigation Measure Bot-11 (CP4) will be implemented to restore native vegetation in all areas disturbed by gravel placement and construction of access routes immediately following completion of the gravel augmentation activities at each augmentation site.

- Only weed-free gravel, fill soil, mulch, seed mixes, and straw materials will be used during construction, implementation of BMPs, and post construction revegetation. Certified weed-free material will be used if available.

Implementation of this mitigation measure would reduce Impact Bot-13 (CP4) to a less than significant level.

Mitigation Measure Bot-14 (CP4): Implement Mitigation Measure Bot-7 (CP1): Develop and Implement a Riverine Ecosystem Mitigation and Adaptive Management Plan to Avoid and Compensate for the Impact of Altered Flow Regimes on Riparian and Wetland Communities This mitigation measure is identical to Mitigation Measure Bot-7 (CP1). Implementation of this mitigation measure would reduce Impact Bot-14 (CP4) to a less than significant level.

Mitigation Measure Bot-15 (CP4): Implement Mitigation Measure Bot-7 (CP1): Develop and Implement a Riverine Ecosystem Mitigation and Adaptive Management Plan to Reduce Conflicts with Approved Local or Regional Plans with Objectives of Riparian Habitat Protection or Watershed Management This mitigation measure is identical to Mitigation Measure Bot-7 (CP1). Implementation of this mitigation measure would reduce Impact Bot-15 (CP4) to a less than significant level.

CP5 – 18.5-Foot Dam Raise, Combination Plan

No mitigation is needed for Impacts Bot-1 (CP5), Bot-9 (CP5), Bot-10 (CP5), and Bot-16 (CP5) through Bot-19 (CP5). Mitigation is provided below for the remaining impacts of CP5 on botanical resources.

Mitigation Measure Bot-2 (CP5): Acquire and Preserve Mitigation Lands; Avoid Populations; Relocate MSCS Plants; and Revegetate Affected Areas This mitigation measure is identical to Mitigation Measure Bot-2 (CP1). Implementation of this mitigation measure would reduce impacts on MSCS species; however, because relocation of these species is unproven, impacts would remain significant and unavoidable.

Potential mitigation lands containing comparable habitat have been identified adjacent to the project. Additional discussion of how these lands may be applied as mitigation and at what ratios will be provided in the FEIS. A discussion of mitigation for loss of habitat through preservation and enhancement in mitigation areas will be included in the FEIS.

Mitigation Measure Bot-3 (CP5): Acquire and Preserve Mitigation Lands; Avoid Populations; Relocate USFS Sensitive, BLM Sensitive and CRPR Plants and Revegetate Affected Areas This mitigation measure is identical to Mitigation Measure Bot-3 (CP1). Implementation of this mitigation measure would reduce impacts on USFS sensitive, BLM sensitive and CRPR plant species; however, because relocation of these species is unproven, impacts would remain significant and unavoidable.

Potential mitigation lands containing comparable habitat have been identified adjacent to the project. Additional discussion of how these lands may be applied as mitigation and at what ratios will be provided in the FEIS. A discussion of mitigation for loss of habitat through preservation and enhancement in mitigation areas will be included in the FEIS.

Mitigation Measure Bot-4 (CP5): Mitigate Loss of Jurisdictional Waters This mitigation measure is identical to Mitigation Measure Bot-4 (CP1). Specific mitigation measures have not been determined for this impact. Within relocation areas, jurisdictional waters of the United States will be avoided when feasible. Potential mitigation lands containing comparable habitat have been identified adjacent to the project. Additional discussion of how these lands may be applied as mitigation and at what ratios will be provided in the FEIS. A discussion of mitigation for loss of habitat through preservation and enhancement in mitigation areas will be included in the FEIS.

Until the details of this mitigation measure are developed, Impact Bot-4 (CP5) is considered significant and unavoidable.

Mitigation Measure Bot-5 (CP5): Acquire and Preserve Mitigation Lands for Loss of General Vegetation Habitats This mitigation measure is identical

to Mitigation Measure Bot-3 (CP1). Specific mitigation measures have not been determined for this impact. Potential mitigation lands containing comparable habitat have been identified adjacent to the project. Additional discussion of how these lands may be applied as mitigation and at what ratios will be provided in the FEIS. A discussion of mitigation for loss of habitat through preservation and enhancement in mitigation areas will be included in the FEIS.

Mitigation Measure Bot-6 (CP5): Develop a Weed Management Plan This mitigation measure is identical to Mitigation Measure Bot-6 (CP1). Implementation of this mitigation measure would reduce Impact Bot-6 (CP5) to a less than significant level.

Mitigation Measure Bot-7 (CP5): Develop and Implement a Riverine Ecosystem Mitigation and Adaptive Management Plan to Avoid and Compensate for the Impact of Altered Flow Regimes on Riparian and Wetland Communities This mitigation measure is identical to Mitigation Measure Bot-7 (CP3). Implementation of this mitigation measure would reduce Impact Bot-7 (CP5) to a less than significant level.

Mitigation Measure Bot-8 (CP5): Implement Mitigation Measure Bot-7 (CP3): Develop and Implement a Riverine Ecosystem Mitigation and Adaptive Management Plan to Reduce Conflicts with Approved Local or Regional Plans with Objectives of Riparian Habitat Protection or Watershed Management This mitigation measure is identical to Mitigation Measure Bot-7 (CP3). Implementation of this mitigation measure would reduce Impact Bot-8 (CP5) to a less than significant level.

Mitigation Measure Bot-11 (CP5): Revegetate Disturbed Areas; Consult with DFG This mitigation measure is identical to Mitigation Measure Bot-11 (CP4). Implementation of this mitigation measure would reduce Impact Bot-11 (CP5) to a less than significant level.

Mitigation Measure Bot-12 (CP5): Conduct Preconstruction Surveys for Special-Status Plants and Avoid Special-Status Plant Populations During Construction This mitigation measure is identical to Mitigation Measure Bot-12 (CP4). Implementation of this mitigation measure would reduce Impact Bot-12 (CP5) to a less than significant level.

Mitigation Measure Bot-13 (CP5): Implement Weed Management Measures and Revegetation This mitigation measure is identical to Mitigation Measure Bot-13 (CP4). Implementation of this mitigation measure would reduce Impact Bot-13 (CP5) to a less than significant level.

Mitigation Measure Bot-14 (CP5): Implement Mitigation Measure Bot-7 (CP3): Develop and Implement a Riverine Ecosystem Mitigation and Adaptive Management Plan to Avoid and Compensate for the Impact of Altered Flow Regimes on Riparian and Wetland Communities This

mitigation measure is identical to Mitigation Measure Bot-7 (CP3). Implementation of this mitigation measure would reduce Impact Bot-14 (CP5) to a less than significant level.

Mitigation Measure Bot-15 (CP5): Implement Mitigation Measure Bot-7 (CP3): Develop and Implement a Riverine Ecosystem Mitigation and Adaptive Management Plan to Reduce Conflicts with Approved Local or Regional Plans with Objectives of Riparian Habitat Protection or Watershed Management This mitigation measure is identical to Mitigation Measure Bot-7 (CP3). Implementation of this mitigation measure would reduce Impact Bot-15 (CP5) to a less than significant level.

12.3.6 Cumulative Effects

A large number of past actions have occurred in the study area. These past actions have substantially degraded botanical resources within the primary and extended study areas. This degradation is indicated by the number of species that have been listed as threatened or endangered under the CESA and Federal ESA, and by the large portion of all native plant species that are now listed by CNPS as rare, threatened, or endangered, or that are now on CNPS watch or review lists.

Past actions have caused these effects by converting habitat to developed or agricultural land uses, altering biotic interactions or physical processes, and damaging or causing mortality from human activities (e.g., vegetation removal during road, levee, or utility maintenance).

Most botanical resources in the study area have been adversely affected by most of the mechanisms described above (i.e., conversion of habitat to developed or agricultural land uses, the spread of invasive species, alteration of physical processes, and human disturbance). Overall, these botanical resources have been substantially degraded by past actions, and past actions are continuing to affect them. In particular, the geographic range and abundance (and thus the effects) of many nonnative, invasive plant species that were introduced into the study area in the past are still rapidly increasing.

The construction of Shasta Dam and the subsequent flooding of the area now known as Shasta Lake affected botanical and wildlife resources endemic to the region. For example, based on existing population locations, Shasta snow-wreath populations may have connected at the confluence of the Pit, Squaw, McCloud, and Sacramento rivers before inundation. The creation of Shasta Lake fragmented this species habitat and populations. As a result, these populations are more vulnerable to extirpation.

The effects of climate change on operations at Shasta Lake could potentially affect botanical resources both at the lake and downstream. As described in the Climate Change Projection Appendix, climate change could result in higher reservoir releases in the future because of an increase in winter and early-spring

inflow into the lake from high-intensity storm events. The change in reservoir releases could be necessary to manage for flood events resulting from these potentially larger storms. The potential increase in releases from the reservoir could lead to long-term changes in flooding frequency and acreages and distribution of vegetation.

Shasta Lake and Vicinity

As described in Section 12.3, without mitigation, CP1 through CP5 could cause potentially significant effects on botanical and wetland resources in the primary and extended study areas. These effects could be caused by project construction activities; increased elevations of the water surface of Shasta Lake; and alteration of the flow regime of the Sacramento River and associated geomorphic processes, and thus of riparian vegetation. Although causing similar effects, CP1 – CP5 differ in the magnitude of their effects. At Shasta Lake and its vicinity, these potential adverse effects would be similar for all alternatives, but differ with the height of the dam raise: the effects of CP2 would be greater than CP1, but less than CP3 – CP5 (which would be identical). Along the upper Sacramento River and in the extended study area, potential adverse effects would be the result of altered flow regimes and would differ with both the height of the dam raise and operation of the dam: the effects of CP2 would be greater than CP1 and CP4 (which would be identical), but less than CP3 and CP5 (which also would have identical effects).

At Shasta Lake and vicinity, CP1 through CP5 would cause the loss of MSCS Covered Species, USFS sensitive, BLM sensitive, or CRPR Species, Jurisdictional Waters, and general habitats, and could cause the spread of noxious and invasive weeds. The mitigation measures described in Section 12.3.6 would reduce impacts on botanical and wetland resources. However, the adverse effects of CP1 through CP5 caused by construction activities and inundation would not be eliminated, with the exception of noxious and invasive weed impacts (Impact Bot-6). Because the overall effect of past actions on wetland and botanical resources has been cumulatively significant, and the likely additional effects of reasonably foreseeable future actions on these at Shasta Lake and in its vicinity, the adverse effects under CP1 through CP5 (except Impact Bot-6) would potentially be cumulatively considerable and these effects would be potentially cumulatively significant. Because mitigation measures to control the spread of weeds would effectively address the project's impact, however; CP1 through CP5 would not make a cumulatively considerable incremental contribution to an overall significant cumulative impact on plants and wetlands.

Upper Sacramento River and Extended Study Area

Along the Sacramento River and other rivers downstream from CVP and SWP reservoirs, substantial past alterations to geomorphic processes, vegetation, and associated habitats have resulted in an overall significant and substantial effect on these resources. Therefore, additional adverse effects would be cumulatively considerable. This adverse effect would be the result of the continued

consequences of past actions (e.g., construction of Shasta Dam and introduction of nonnative species), and of present and foreseeable water resource and levee actions whose adverse effects may not be fully mitigated.

Most adverse effects that are the continued consequences of past actions have been considered in the development of existing local and regional plans. Consequently, with respect to local and regional plans, there does not already exist an overall significant cumulative effect. However, the adverse effects of all present and reasonably foreseeable water resources and levee actions are not likely to be avoided or fully mitigated. The unmitigated effects of these actions could be sufficiently considerable to have a significant cumulative effect overall.

Habitat loss along the upper Sacramento River and in the extended study area has already resulted in an overall effect on sensitive communities and special-status plants that is significant and substantial. (It is the primary reason that a large number of plant species along the upper Sacramento River and in the extended study area have been listed as threatened or endangered by the State or Federal governments, or have been designated rare, threatened, or endangered by CNPS (i.e., placed on CNPS list 1B).)

CP1 – 6.5-Foot Dam Raise, Anadromous Fish Survival and Water Supply Reliability As described in Chapter 2, "Alternatives" without mitigation, by altering the flow regime and associated geomorphic processes on the Sacramento River, CP1 could affect sensitive plant communities and special-status species (Impact Bot-7 (CP1) and Bot-14 (CP1)) and could potentially affect regional or local plans with objectives of riparian habitat protection or watershed management (Impact Bot-8 (CP1) and Bot-15 (CP1)). These effects could occur on the upper Sacramento River and portions of the lower Sacramento River. Because substantial past alterations to geomorphic processes, vegetation, and associated habitats along the Sacramento River have resulted in an overall significant cumulative effect on these resources, additional adverse effects would be cumulatively considerable. However, with the implementation of Mitigation Measure Bot-7 (CP1), adverse effects from CP1 on botanical resources along the Sacramento River would be fully mitigated. Thus, CP1 would not result in a cumulatively considerable incremental effect on these resources, and the potential to affect regional or local plans would also be eliminated. Therefore, these effects of CP1 would not be cumulatively significant.

By altering the flow regimes below CVP and SWP reservoirs in the extended study area, CP1 could possibly cause similar effects on these rivers as along the Sacramento River. (These effects were identified as Impacts Bot-17 (CP1) and Bot-18 (CP1).) However, the alteration of these flow regimes would be less extensive than along the Sacramento River. Even without mitigation, the effects of CP1 on these rivers might not be sufficient to alter the extent or species composition of sensitive communities or to alter the habitats of special-status

plant species. In addition, Mitigation Measure Aqua-15 (CP1), "Maintain Flows in the Feather River, American River, and Trinity River Consistent with Existing Regulatory and Operational Requirements and Agreements," would reduce these effects to a level that is unlikely to alter the extent or species composition of sensitive communities or to alter the extent or quality of habitat for special-status plant species. Therefore, these effects of CP1 would not be a cumulatively considerable incremental contribution to a significant cumulative impact.

By altering flow regimes on the upper Sacramento River, CP1 also could affect designated critical habitat for special-status species of vernal pool habitats (Impact Bot-9 (CP1)). However, vernal pool plant communities and associated special-status species likely would not be affected by any of the alternatives. Therefore, the project would not have a cumulatively considerable effect, and would not be cumulatively significant.

Along the upper Sacramento River and in the extended study area, CP1 could induce growth that results in the loss of sensitive plant communities and special-status plant species (Impacts Bot-10 (CP1), Bot-16 (CP1), and Bot-19 (CP1)). Habitat loss has resulted in an overall significant cumulative effect on sensitive communities and special-status plants that is substantial. (It is the primary reason that a large number of plant species along the upper Sacramento River and in the extended study area have been listed as threatened or endangered by the State or Federal governments, or have been designated rare, threatened or endangered by CNPS (i.e., placed on CNPS list 1B).) CP1 could induce growth-related effects because it would increase water yield to water districts, and this could reduce a limitation on growth. For example, most CVP water supports agricultural purposes, and agricultural acreages are not expected to increase substantially over time. However, some increment of the CVP water could be used for municipal and industrial contractors, such as Contra Costa Water District or Santa Clara Valley Water District. In this case, some growth-related effects could occur from development and have an incremental effect on botanical resources. Present and foreseeable future projects are also likely to add to this habitat loss. Although the future effects of any growth-related effects induced by CP1 would be analyzed and mitigated during land use planning and environmental review for site-specific development projects, it is unlikely that all effects would be avoided or fully mitigated. Therefore, CP1 would make a small incremental, but cumulatively considerable, contribution to an existing overall significant cumulative impact. This would be a cumulatively significant and unavoidable effect.

As stated previously, effects of climate change on operations at Shasta Lake could include a higher frequency of high flow events, potentially resulting in changes to downstream vegetation. Potentially significant effects on vegetation and special-status species that would occur with implementation of CP1 could contribute to potentially significant affects of climate change on habitat acreages and distribution. Although mitigation measures listed above would be

implemented to reduce project-related impacts of CP1, CP1 would still make a considerable contribution to a potentially significant cumulative effect on botanical resources.

CP2 – 12.5-Foot Dam Raise, Anadromous Fish Survival and Water Supply Reliability The cumulative effects of CP2 would be similar to those of CP1, but greater in magnitude (because CP2 would entail more substantial alterations of flow regimes). Although greater in magnitude than the effects of CP1, the effects of CP2 on sensitive plant communities and special-status species along the upper Sacramento River and in the extended study area (Impacts Bot-7 (CP2), Bot-14 (CP2), and Bot-17 (CP2)), and potential effects on regional or local plans with objectives of riparian habitat protection or watershed management (Impacts Bot-8 (CP2), Bot-15 (CP2), and Bot-18 (CP2)) would not be considerable for the same reasons given for CP1. These would not be cumulatively significant effects.

Similarly, although greater in magnitude than the effects of CP1, the effects of CP2 on designated critical habitat for special-status species of vernal pool habitats (Impact Bot-9 (CP2)) would not be considerable for the same reasons given for CP1. This would not be a cumulatively significant effect.

Also similar to CP1, along the upper Sacramento River and in the extended study area, CP2 could cause growth-related effects that result in the loss of sensitive plant communities and special-status plant species (Impacts Bot-10 (CP2), Bot-16 (CP2), and Bot-19 (CP2)). However, the potential for CP2 to cause growth-related effects would be greater than for CP1. For the same reasons given for CP1, CP2 would make a small incremental, but cumulatively considerable, contribution to an existing overall significant cumulative impact. This would be a cumulatively significant and unavoidable effect.

As stated previously, effects of climate change on operations at Shasta Lake could include a higher frequency of high flow events, potentially resulting in changes to downstream vegetation. Potentially significant effects on vegetation and special-status species that would occur with implementation of CP2 could contribute to potentially significant affects of climate change on habitat acreages and distribution. Although mitigation measures listed above would be implemented to reduce project-related impacts of CP2, CP2 would still make a considerable contribution to a potentially significant cumulative effect on botanical resources.

CP3 – 18.5-Foot Dam Raise, Anadromous Fish Survival and Water Supply The cumulative effects of CP3 would be similar to those of CP1 and CP2, but greater in magnitude. Although greater in magnitude than the effects of CP1 or CP2 (because CP3 would entail more substantial alterations of flow regimes), the effects of CP3 on sensitive plant communities and special-status species along the upper Sacramento River and in the extended study area (Impacts Bot-7 (CP3), Bot-14 (CP3), and Bot-17 (CP3)), and potential effects on regional or

local plans with objectives of riparian habitat protection or watershed management (Impacts Bot-8 (CP3), Bot-15 (CP3), and Bot-18 (CP3)) would not be considerable for the same reasons given for CP1. These would not be cumulatively significant effects.

Similarly, although greater in magnitude than the effects of CP1 or CP2, the effects of CP3 on designated critical habitat for special-status species of vernal pool habitats (Impact Bot-9 (CP3)) would not be considerable for the same reasons given for CP1. This would not be a cumulatively significant effect.

Also similar to CP1 and CP2, along the upper Sacramento River and in the extended study area, CP3 could cause growth-related effects that result in the loss of sensitive plant communities and special-status plant species (Impacts Bot-10 (CP3), Bot-16 (CP3), and Bot-19 (CP3)). However, the potential for CP3 to cause growth-related effects would be greater than for CP1 or CP2. For the same reasons given for CP1, CP3 would make a small incremental, but cumulatively considerable, contribution to an existing overall significant cumulative impact. This would be a cumulatively significant and unavoidable effect.

As stated previously, effects of climate change on operations at Shasta Lake could include a higher frequency of high flow events, potentially resulting in changes to downstream vegetation. Potentially significant effects on vegetation and special-status species that would occur with implementation of CP3 could contribute to potentially significant affects of climate change on habitat acreages and distribution. Although mitigation measures listed above would be implemented to reduce project-related impacts of CP3, CP3 would still make a considerable contribution to a potentially significant cumulative effect on botanical resources.

CP4 – 18.5-Foot Dam Raise, Anadromous Fish Focus with Water Supply Reliability The cumulative effects of CP4 would be identical to those of CP3.

CP5 – 18.5-Foot Dam Raise, Combination Plan The cumulative effects of CP5 would be identical to those of CP3.

Chapter 13
Wildlife Resources

13.1 Affected Environment

This secetion deescribes the affected environment related to wildlife resources, including special-status species, for the dam and reservoir modifications proposed under the SLWRI. For a more in-depth description, see the *Wildlife Resources Technical Report.*

Shasta Dam and Shasta Lake are located on the upper Sacramento River in Northern California. Shasta Dam is located approximately 9 miles northwest of Redding, and the dam and entire reservoir are located in Shasta County. Elevations in the Shasta Lake vicinity portion of the primary study area range between approximately 1,070 and 1,200 feet, and the terrain is moderate to steep.

The wildlife resources setting for the Shasta Lake and vicinity portion of the primary study area consists of the impoundment area (five arms and the main body of Shasta Lake) and the relocation areas (Figure 13-1). The Shasta Lake and vicinity portion of the primary study area is composed of Shasta Dam and Shasta Lake and the lower reaches of the tributaries draining into Shasta Lake. In the initial phase of the SLWRI, 13 streams and rivers were selected to represent the diverse characteristics of the rivers and streams that flow into Shasta Lake.

Reclamation established project boundaries for focused surveys in the area that would be subject to inundation under various enlargement scenarios. The lower boundary corresponds to the current full-pool elevation defined by Reclamation (1,070-foot mean sea level (msl) contour line). The upper boundary was established using the 1,090-foot msl contour line around the entire lake. This area is hereafter referred to as the “impoundment area” (Figure 13-1).

To examine the physical and biological resources along riverine reaches that would be subject to inundation if Shasta Dam were enlarged, reaches of 11 streams and rivers that are tributary to Shasta Lake were also incorporated into the Shasta Lake and vicinity portion of the primary study area. These streams were selected by Reclamation in conjunction with USFS as an initial sampling of streams representative of riverine and riparian habitats.

Areas subject to physical disturbance as an indirect result of the proposed project (i.e., areas proposed as relocation sites for roadways, bridges, utilities,

and campgrounds that would be inundated subsequent to the enlargement of Shasta Dam as well as proposed dike locations) were incorporated into the Shasta Lake and vicinity portion of the primary study area. These locations are hereafter referred to as "relocation areas" (Figure 13-1).

For the purposes of this investigation, approximate acreages for habitat types are reported by arm of the lake. For a relocation area that falls between two arms, the area is included with the arm that has the most acreage of the vegetation type or water of the United States.

Descriptions of biological resources were derived primarily from the following sources:

- *Shasta Lake Water Resources Investigation Mission Statement Milestone Report* (Reclamation 2003)
- *Shasta Lake Water Resources Investigation Initial Alternatives Information Report* (Reclamation 2004)
- Chapter 3, "Biological Environment," in the *Draft Shasta Lake Water Resources Investigation Plan Formulation Report* (Reclamation 2007)
- USFWS Endangered Species Database (USFWS 2007a)
- The California Natural Diversity Database (CNDDB) (2011)

Several attachments to the *Wildlife Resources Technical Report* provide detailed lists and descriptions of special-status wildlife species present in the primary and extended study areas:

- Attachment 1, "Special-Status Wildlife Species Potentially Occurring in the Shasta Lake and Vicinity Portion of the Primary Study Area"
- Attachment 2, "Species Accounts for Special-Status Wildlife in the Shasta Lake and Vicinity Portion of the Primary Study Area"
- Attachment 3, "Breeding Bird Survey Results – 2007"
- Attachment 4, "Species Accounts for Special-Status Wildlife in the Primary Study Area Downstream from Shasta Dam"
- Attachment 5, "State and Federal Lists of Special-Status Wildlife Species in the Vicinity of the Primary Study Area"
- Attachment 6, "Special-Status Wildlife Species with Potential to Occur in the Primary and Extended Study Areas by Area"
- Attachment 7, "List of All Sensitive Wildlife Species in the Extended Study Area Reported to the CNDDB"

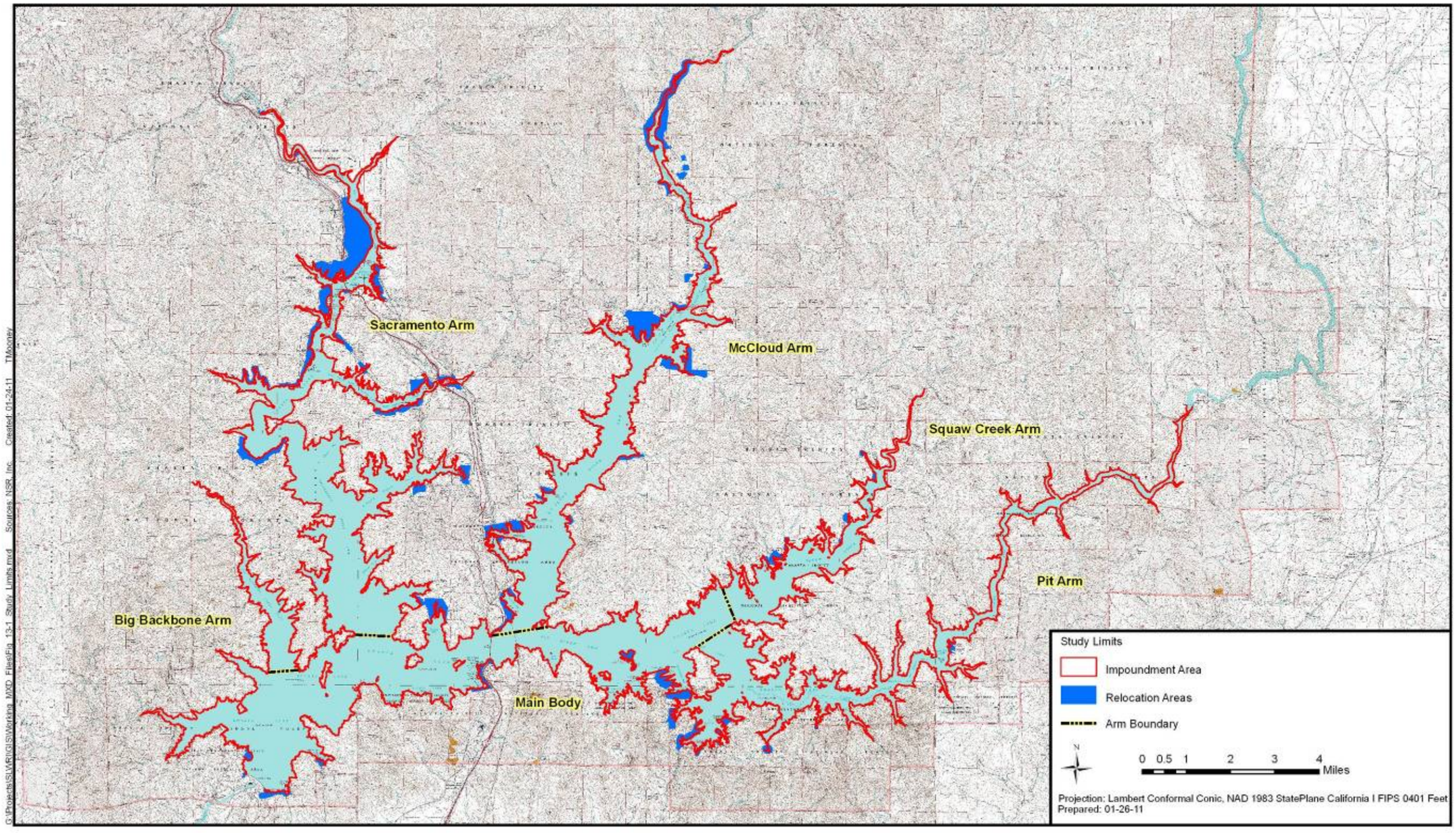


Figure 13-1. Study Limits

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13.1.1 Wildlife

Shasta Lake and Vicinity

Wildlife resources described in this chapter result from the wealth and diversity of climatic and vegetative associations in and adjacent to the Shasta Lake and vicinity portion of the primary study area. Influences from the Coast Ranges, the southern Cascade Range, the northern Sierra Nevada, the Great Basin, and the Central Valley provide for a unique mix of biota. Much of this region, especially in the Central Valley, has been modified by past and present land uses.

Prior to Euro-American settlement, the area was dominated by riparian vegetation in the annual floodplains, with stands of valley oak (*Quercus lobata*) and interior live oak (*Q. wislizenii*) on higher ground. Herbaceous wetland bottoms and upland native grassland communities were common in this vegetation mosaic. The extensive oak forests and riparian/wetland habitats hosted a diverse and abundant wildlife community. Cattle grazing, deforestation of the oak woodlands, water development, flood protection, and expansion of agriculture onto the floodplains in the early to mid-1800s substantially altered the historical floodplain and channel vegetation.

Rural development, fire suppression, recreation, and wildfires have affected the population and distribution of wildlife in this area. Fire suppression, which has generally increased understory vegetation, has had mixed effects on wildlife. Bear, deer, and birds that prefer near-ground vegetation for food and cover have generally benefited, whereas birds requiring aerial foraging habitat, such as the golden eagle (*Aquila chrysaetos*), American peregrine falcon (*Falco peregrinus anatum*), and great horned owl (*Bubo virginianus*), have declined. Species that have adapted or thrived in the altered human environment include coyotes (*Canis latrans*), raccoons (*Procyon lotor*), and various other late-successional species. The quality of potential bat habitat, found primarily in the limestone formations to the north and east of Shasta Lake, has suffered from increased use by recreational rock climbers and spelunkers. Wildlife may also be affected by fragmented travel corridors in certain portions of the area that prevent species from moving between remaining suitable habitats.

Wildlife Habitats The Shasta Lake and vicinity portion of the primary study area is characterized by a variety of habitats typical of transitional mixed woodland and low-elevation forest. These habitats were mapped and classified using the *Guide to Wildlife Habitats of California* (Mayer and Laudenslayer 1988). Habitats present in the Shasta Lake and vicinity portion of the primary study area are summarized in Table 13-1 and Table 13-2. The locations of each type are depicted in Figures 13-2a through 13-2f. The wildlife species typical of each of these communities are described below.

Table 13-1. Summary of Wildlife Habitats in the Impoundment Area

Habitat	Area (acres*)					
	Main Body	Big Backbone Arm	Sacramento Arm	McCloud Arm	Squaw Creek Arm	Pit Arm
Annual grassland	0.44	0.00	3.10	0.70	0.00	0.00
Barren	1.05	0.00	0.55	0.00	0.00	0.00
Blue oak – foothill pine	10.36	0.00	0.00	0.00	4.29	1.94
Blue oak woodland	0.00	0.00	0.00	0.00	0.00	6.81
Closed-cone pine – cypress	32.68	0.00	12.95	20.79	44.72	373.48
Douglas-fir	0.00	0.00	0.00	0.36	0.00	0.00
Lacustrine**	10,196.88	1,014.12	7,225.14	5,032.68	2,081.60	4,372.80
Mixed chaparral	29.19	13.64	161.04	15.06	10.35	59.50
Montane hardwood	73.49	38.76	171.01	66.06	19.43	2.49
Montane hardwood – conifer	70.68	0.99	150.42	140.93	111.63	10.55
Montane riparian	4.16	6.67	26.16	13.91	1.53	1.57
Ponderosa pine	215.11	30.72	188.19	161.74	49.56	57.50
Riverine	0.00	0.88	5.24	15.43	1.41	0.00
Urban	21.95	00.00	1.95	7.96	0.00	1.92
Total	10,655.99	1,105.79	7,945.75	5,475.62	2,324.52	4,888.56

Source: Data compiled by North State Resources, Inc., in 2011 based on habitat assessments and mapping.

Notes:

* Acreage values are approximate.

** Lacustrine values are included for the entire surface area of Shasta Lake. The extent of activity occurring within Shasta Lake has yet to be determined.

Table 13-2. Summary of Wildlife Habitats in the Relocation Areas

Habitat	Area (acres*)					
	Main Body	Big Backbone Arm	Sacramento Arm	McCloud Arm	Squaw Creek Arm	Pit Arm
Annual grassland	5.05	0.00	29.02	10.65	1.29	1.25
Barren	0.00	0.00	0.00	0.82	0.00	0.00
Blue oak–foothill pine	3.61	0.00	0.00	0.00	0.00	13.74
Blue oak woodland	0.00	0.00	0.00	3.89	0.00	2.28
Closed-cone pine–cypress	0.11	0.00	56.90	8.95	1.94	33.72
Douglas-fir	0.00	0.00	0.00	3.18	0.00	0.00
Mixed chaparral	25.68	0.00	120.00	46.36	4.44	134.82
Montane hardwood	48.21	0.00	198.56	214.87	6.34	3.44
Montane hardwood–conifer	121.63	0.00	205.41	316.45	42.22	42.28
Montane riparian	0.34	0.00	4.72	8.02	0.23	1.45
Ponderosa pine	185.06	0.00	466.94	406.43	43.08	45.30
Riverine	0.00	0.00	0.39	3.75	0.00	0.00
Urban	21.05	0.00	230.58	0.48	0.00	2.49
Total	408.74	0.00	1,312.51	1,023.04	99.53	280.48

Source: Data compiled by North State Resources, Inc., in 2011 based on habitat assessments and mapping.

Note:*

Acreage values are approximate.

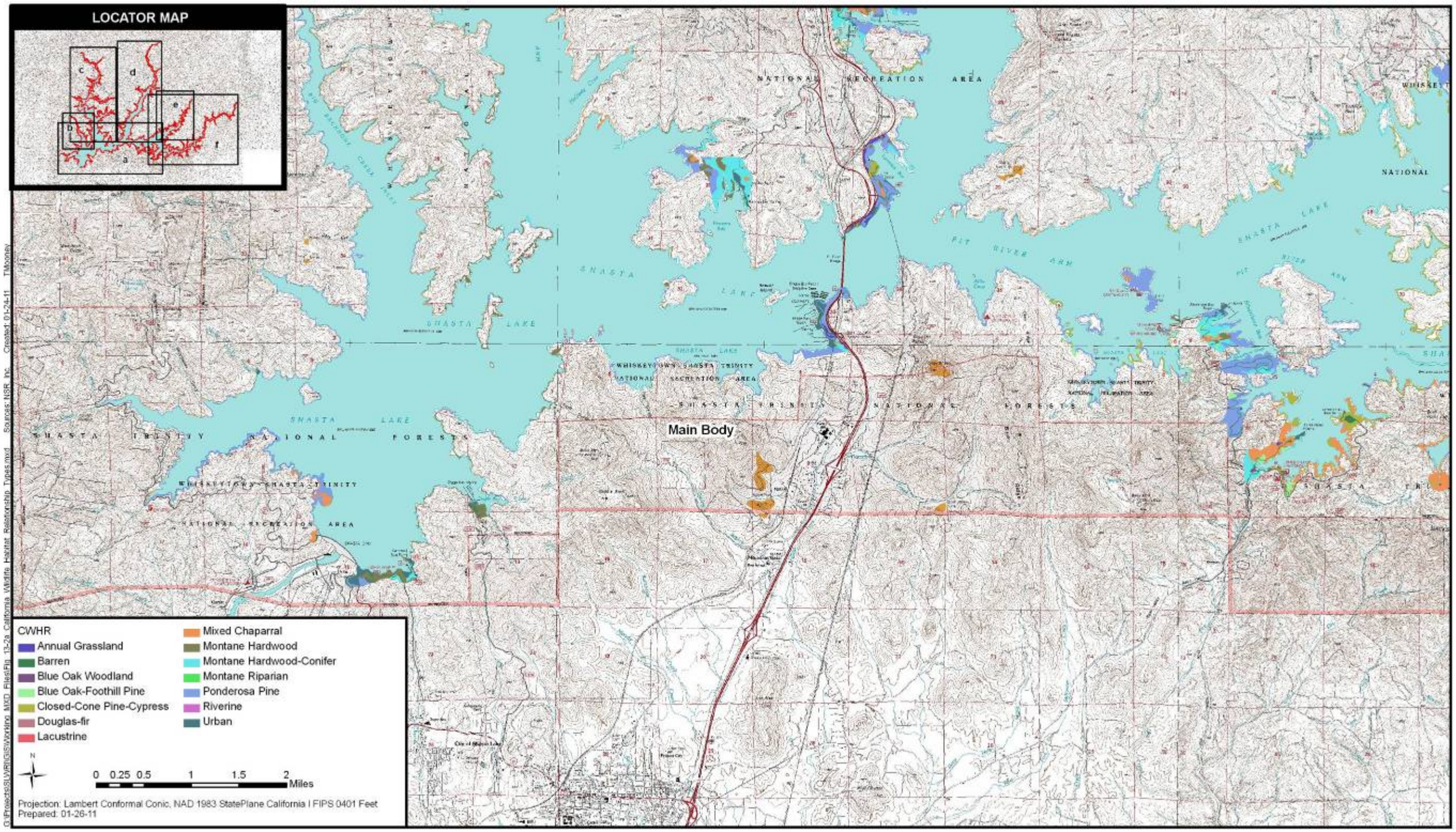


Figure 13-2a. California Wildlife Habitat Relationship Types

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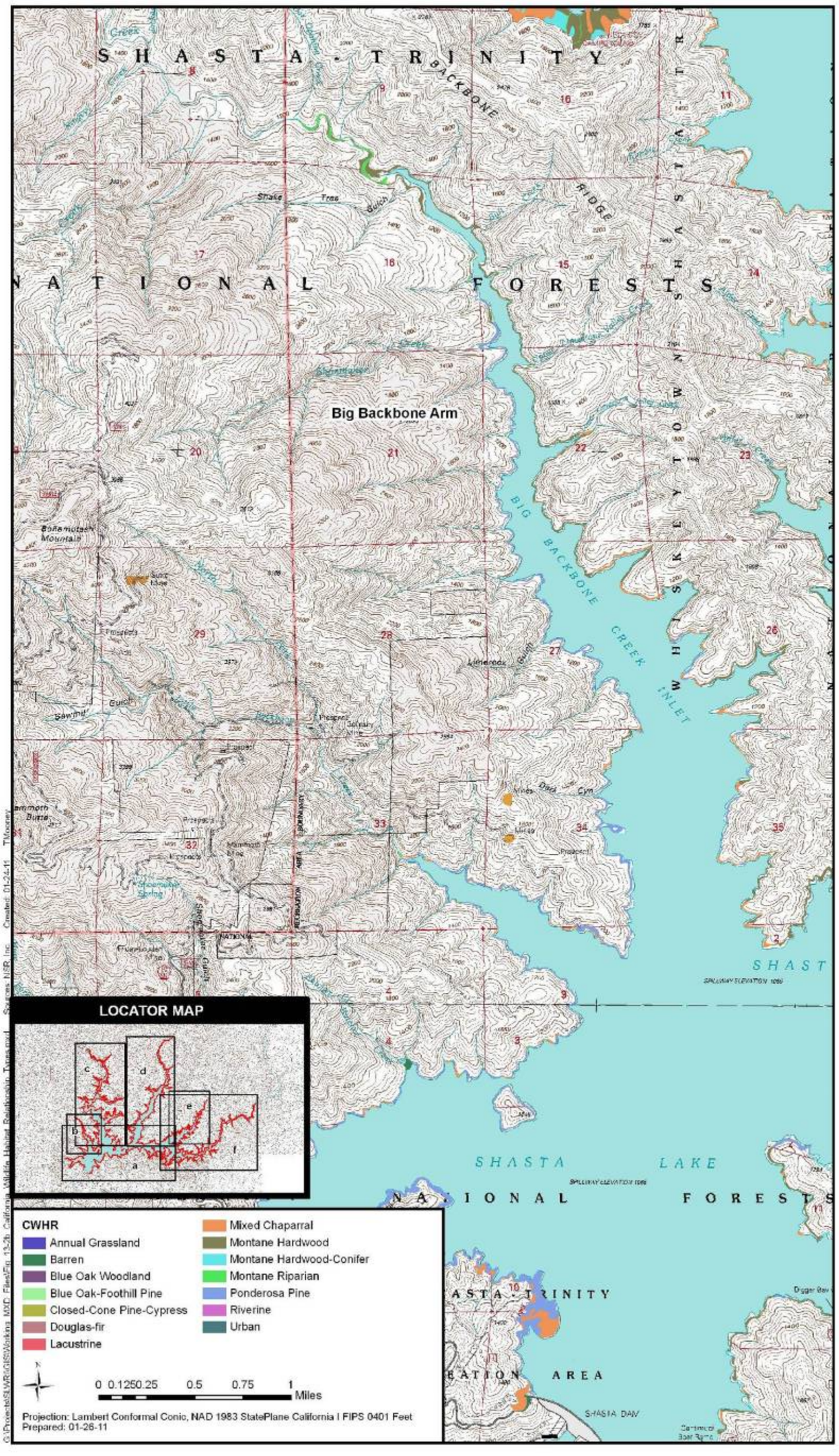


Figure 13-2b. California Wildlife Habitat Relationship Types

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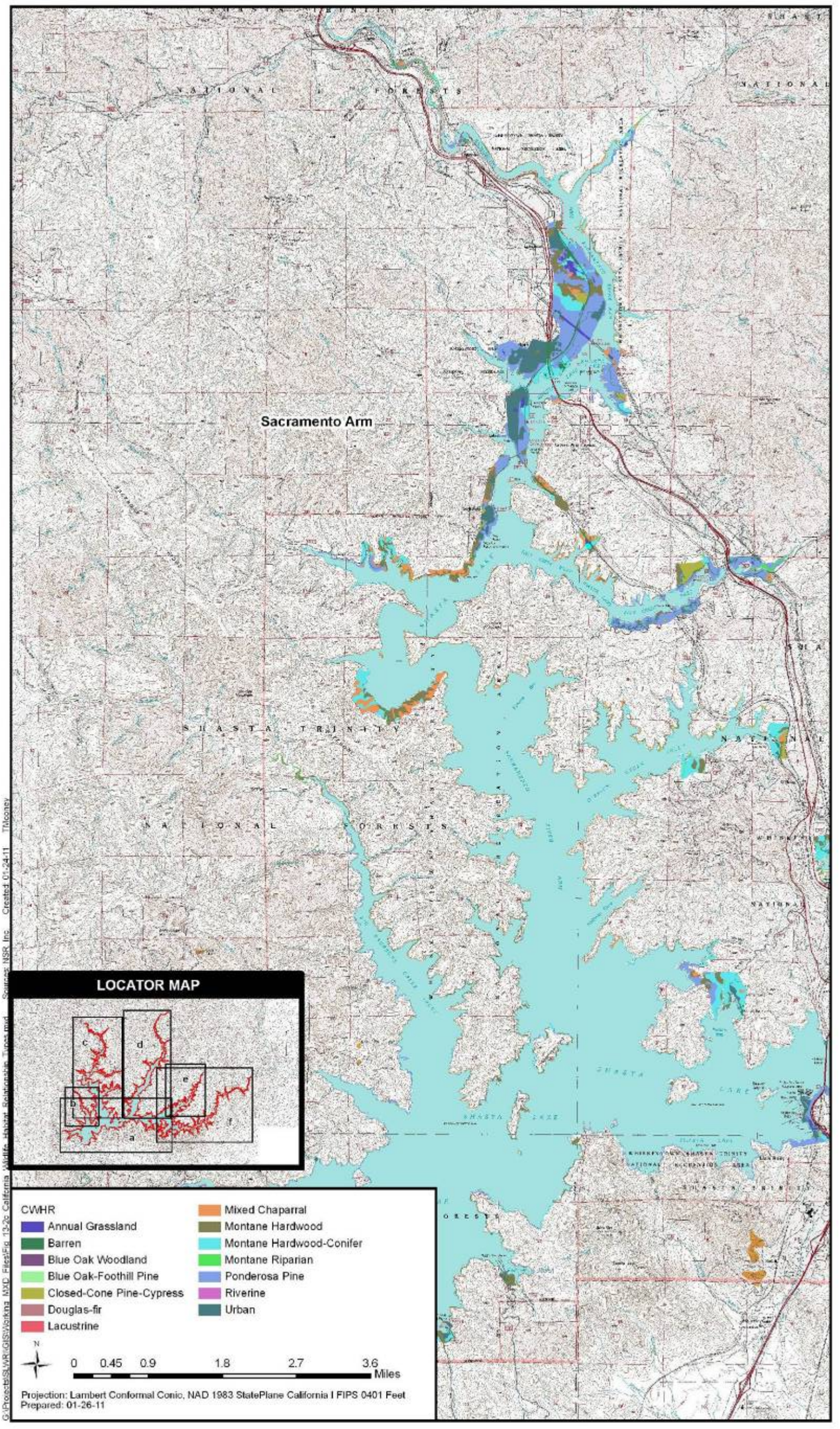


Figure 13-2c. California Wildlife Habitat Relationship Types

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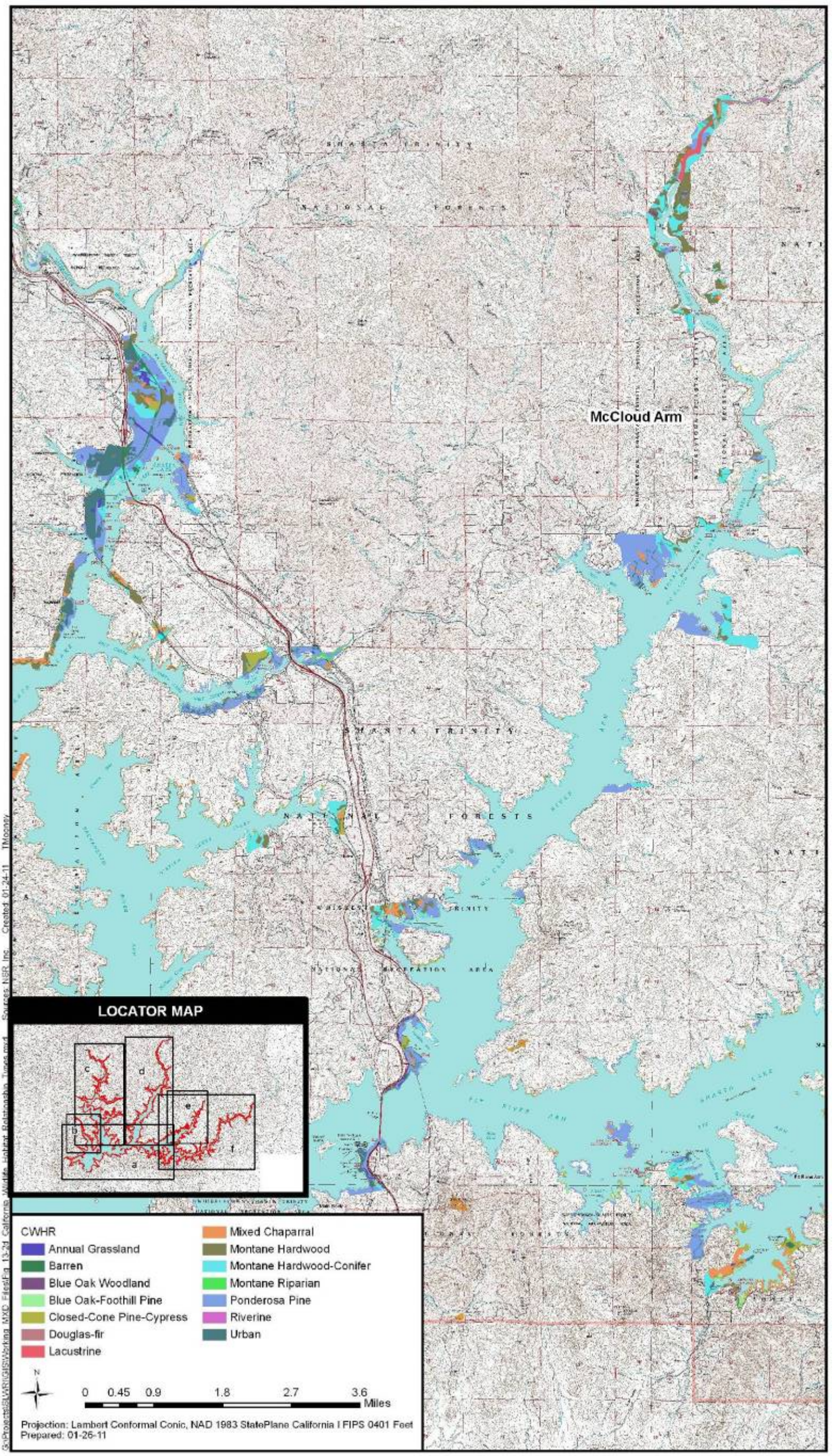


Figure 13-2d. California Wildlife Habitat Relationship Types

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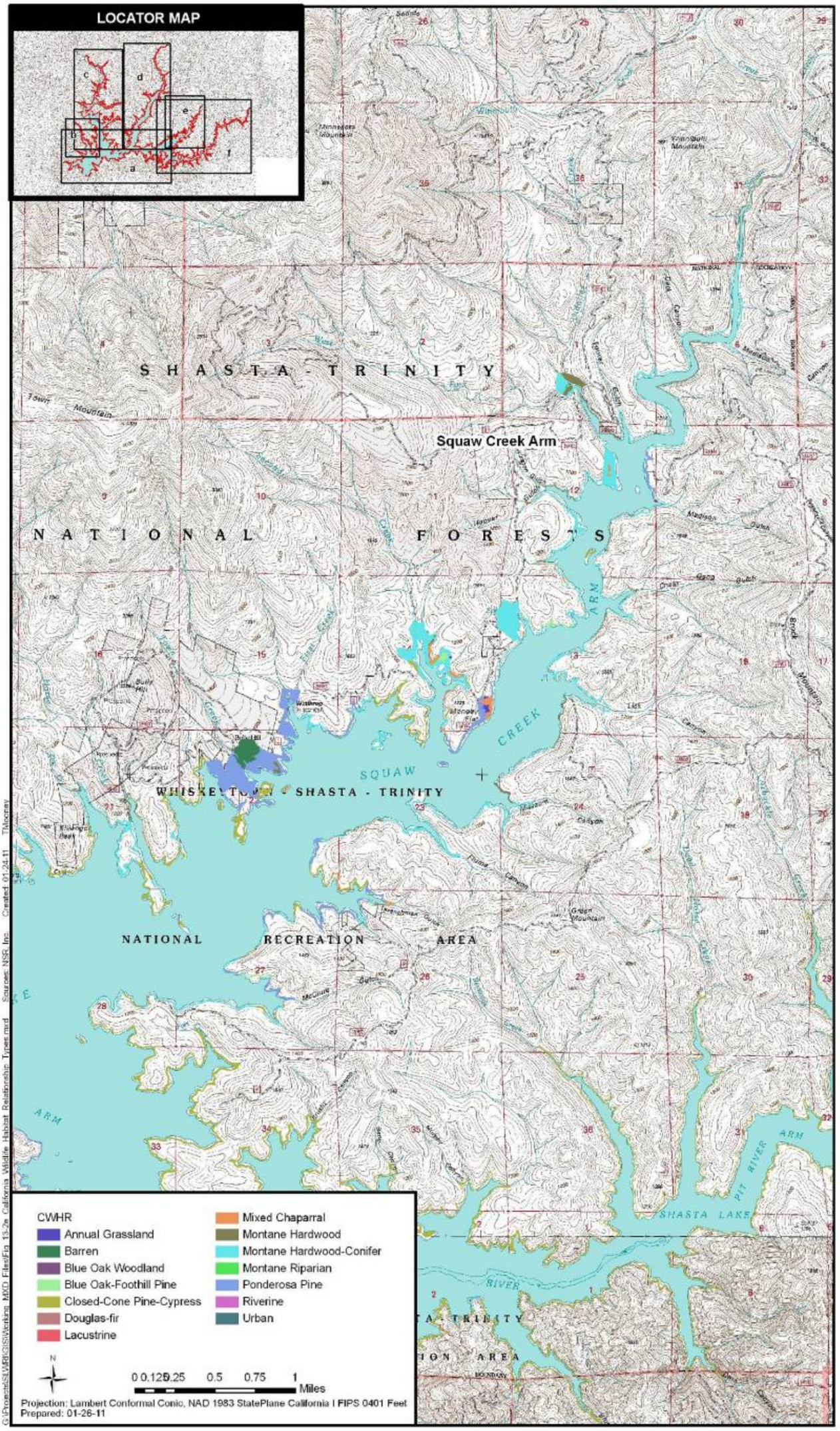


Figure 13-2e. California Wildlife Habitat Relationship Types

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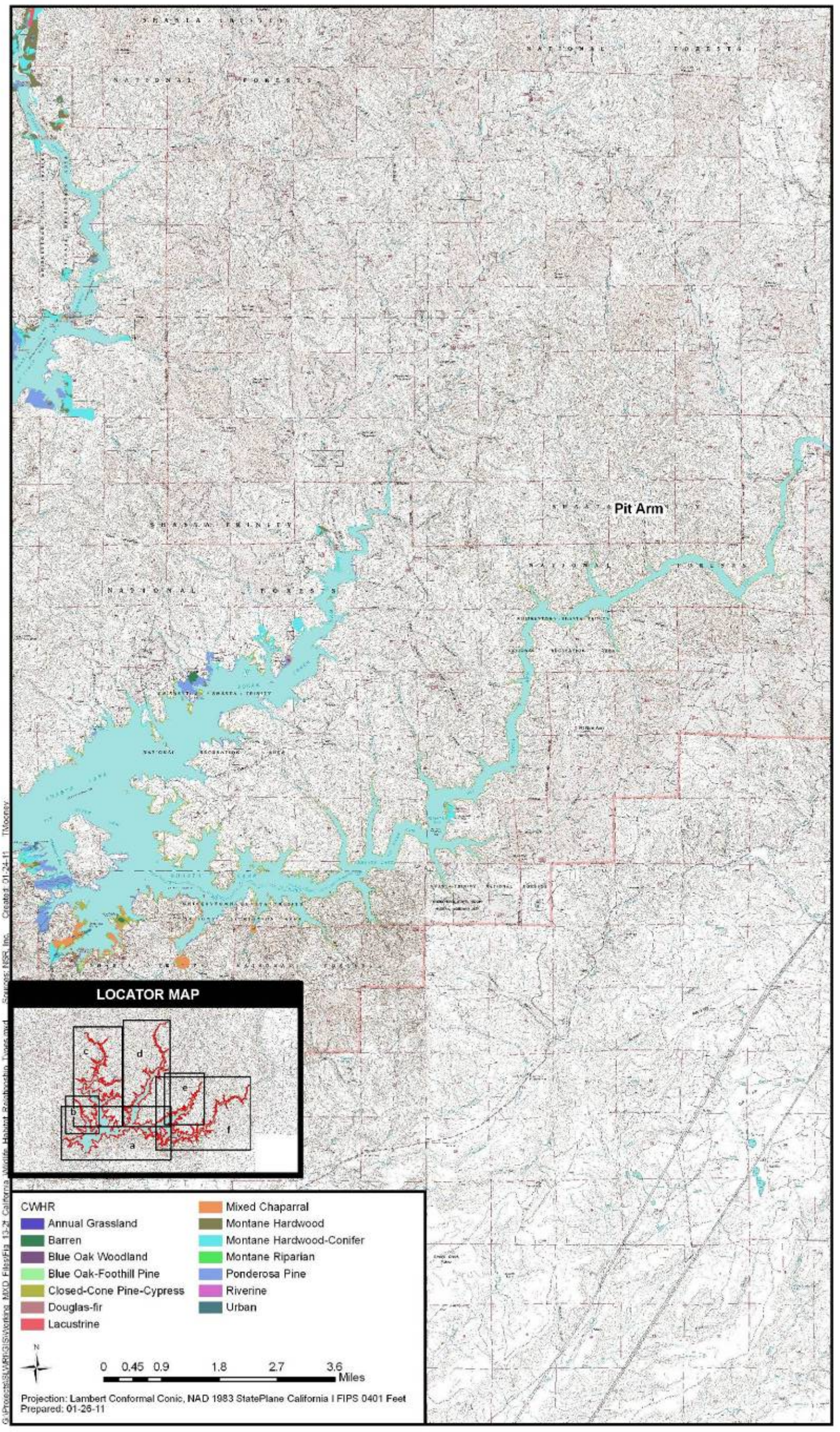


Figure 13-2f. California Wildlife Habitat Relationship Types

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Annual Grassland Annual grassland is uncommon in the Shasta Lake and vicinity portion of the primary study area and occurs as small inclusions in other more prevalent plant series types or in areas subjected to previous disturbance. Dominant species include wild oat (*Avena fatua*), cheatgrass (*Bromus tectorum*), ripgut (*B. diandrus*), yellow star-thistle (*Centaurea solstitialis*), squirreltail (*Elymus elymoides*), and European hairgrass (*Aira caryophyllea*). Grassland bird species such as the mourning dove (*Zenaida macroura*), savannah sparrow (*Passerculus sandwichensis*), and white-crowned sparrow (*Zonotrichia leucophrys*), as well as rodents such as the California ground squirrel (*Spermophilus beecheyi*), Botta's pocket gopher (*Thomomys bottae*), and deer mouse (*Peromyscus maniculatus*), may forage on the seed crop this community provides. These species, in turn, attract predators such as the gopher snake (*Pituophis melanoleucus*), American kestrel (*Falco sparverius*), red-tailed hawk (*Buteo jamaicensis*), and coyote. Reptile species expected to inhabit this area include the western fence lizard (*Sceloporus occidentalis*), western skink (*Eumeces skiltonianus*), western rattlesnake (*Crotalus viridis*), and yellow-bellied racer (*Coluber constrictor*).

Barren Barren habitat consists mainly of nonvegetated human-made features scattered throughout the Shasta Lake and vicinity portion of the primary study area, including boat ramps, parking lots, and roads. Other barren habitats include a large gravel plain feature at the confluence of Butcher Creek and Shasta Lake (Main Body) and a sealed riprap feature adjacent to Interstate 5 near the upper Sacramento Arm and Shasta Lake confluence. Vegetation is usually not present, although sparse opportunistic grasses/forbs or weedy species may be present. Barren habitat has limited value for wildlife; however, many species in adjacent habitats may use these areas occasionally as opportunities arise, such as for feeding. Also, open nesting species such as killdeer (*Charadrius vociferus*) may use some barren surfaces for nesting.

Blue Oak Woodland Blue oak woodlands occur mainly as small inclusions within other more prevalent habitats; however, moderate-sized stands also occur. This habitat occurs at scattered locations along the Main Body, McCloud Arm, and Pit Arm. Blue oak woodland is characterized by a moderate overstory of blue oak *(Quercus douglasii)* with a dense herbaceous understory. Oak woodlands produce acorns used as forage by a variety of species, including acorn woodpeckers (*Melanerpes formicivorus*), western scrub-jays (*Aphelocoma californica*), turkey (*Meleagris gallopavo*), western gray squirrels (*Sciurus griseus*), and black-tailed deer (*Odocoileus hemonius columbianus*). Snags and live trees containing cavities provide nesting habitat for species such as the western bluebird (*Salia mexicana*), tree swallow (*Tachycineta bicolor*), American kestrel, and northern flicker (*Colaptes auratus*), as well as roost sites for bats and denning sites for mammals such as the raccoon, Virginia opossum (*Didelphis virginiana*), and gray fox (*Urocyon cinereoargenteus*). Raptors, including the red-tailed hawk and great horned owl, also nest in these woodlands. Amphibian and reptile species found here include the Pacific chorus frog (*Pseudacris regilla*), bullfrog (*Rana catesbeiana*), western fence lizard,

southern alligator lizard (*Elgaria multicarinata*), western terrestrial garter snake (*Thamnophis elegans*), common garter snake (*Thamnophis sirtalis*), and western rattlesnake.

Blue Oak – Foothill Pine Blue oak–foothill pine habitat also occurs mainly as small inclusions within other more prevalent habitats in the Shasta Lake and vicinity portion of the primary study area; however, moderate-sized stands also occur. This habitat is found in the Main Body, Squaw Creek Arm, and Pit Arm. Species composition is similar to the blue oak woodland habitat; however, gray pine and a shrub component are more common. Dominant overstory species include blue oak, California black oak *(Quercus kelloggii),* valley oak *(Quercus lobata),* interior live oak *(Quercus wislizenii),* and gray pine *(Pinus sabiniana).* Common shrubs observed in this habitat include white leaf manzanita *(Arctostaphylos viscida),* buck brush *(Ceanothus cuneatus),* poison oak *(Toxicodendron diversilobum),* coffee berry *(Rhamnus californica),* snowdrop bush *(Styrax officinalis),* wild mock orange *(Philadelphus lewisii),* deer brush *(Ceanothus integerrimus),* and California buckeye *(Aesculus californica).* Common grasses and forbs observed in this vegetation habitat include pussy ears *(Calochortus tolmiei),* Pacific hounds tongue *(Cynoglossum grande),* slender wild oat, and soaproot *(Chlorogalum pomeridianum).* Lianas of Dutchman's pipe *(Aristolochia californica)* and chaparral clematis *(Clematis lasiantha)* shroud shrubs and often grow into the tree canopy.

The blue oak–foothill pine community provides breeding habitat for a large variety of wildlife species, although no species is completely dependent on it for breeding, feeding, or cover. Many of the species found in blue oak habitat are also found here. Acorns and gray pine seeds are an important resource for many of the species using this habitat, such as the acorn woodpecker, western scrub-jay, and western gray squirrel. The newly emerged leaves of oaks in the spring support an abundance of insects that attract migrating and nesting warblers, vireos, flycatchers, and other insectivorous birds. In addition, the shrubs provide habitat for birds such as the spotted towhee (*Pipilo maculatus*), California towhee (*Pipilo crissalis*), wrentit (*Chamaea fasciata*), and blue-gray gnatcatcher (*Polioptila caerulea*). Characteristic reptiles and amphibians include western toads (*Bufo boreas*), a wide variety of snakes (common garter snakes, California whipsnakes (*Masticophis lateralis*), gopher snakes, and western rattlesnakes), western skinks, southern alligator lizards, and western fence lizards.

Closed-Cone Pine – Cypress Closed-cone pine–cypress consists of open to dense knobcone pine (*Pinus contorta*) stands. This habitat is scattered throughout all portions of the Shasta Lake and vicinity portion of the primary study area and often occurs in disturbed areas, including areas of historic mining activities and past or recent wildfires. Dominant species include knobcone pine, with occasional canyon live oak (*Quercus chrysolepis*), California black oak, ponderosa pine, and gray pine. The shrub layer is moderate to dense and is dominated by white leaf manzanita and poison oak. The ground layer varies and is dominated by various grasses and forbs.

Numerous game and nongame species make use of this habitat for feeding and cover. Steller's jays (*Cyanocitta stelleri*) and western scrub-jays, downy woodpeckers (*Picoides pubescens*), and western gray squirrels extract seeds from partially opened cones. The great horned owl and red-tailed hawk are among the few species known to use this habitat for breeding.

Douglas-Fir As a habitat type, Douglas-fir is uncommon in the Shasta Lake and vicinity portion of the primary study area. This habitat type occurs in the upper portion of the McCloud Arm. Douglas-fir is characterized by moderate to dense conifer stands dominated by Douglas-fir (*Pseudotsuga menziesii*), with occasional ponderosa pine (*Pinus ponderosa*), sugar pine (*Pinus lambertiana*), incense cedar (*Calocedrus decurrens*), canyon live oak, and California black oak. Associated understory species vary and include Pacific dogwood (*Cornus nuttallii*), mock orange (*Philadelphus lewisii*), poison oak, snowdrop bush, and white leaf manzanita. The ground layer ranges from open to moderate and is dominated by various grasses and forbs. The multilayered vegetation in the Douglas-fir community supports a variety of wildlife species. A significant feature of the community is the presence of cavity-bearing trees. Mature, fire-damaged, and wind-damaged forests typically contain snags (dead trees that are still standing), which are a valuable resource for birds and mammals that prefer nest and den sites in cavities, such as the flammulated owl (*Otus flammeolus*) and northern pygmy owl (*Glaucidium gnoma*). Snags also support wood-boring insects that provide food for bark-gleaning insectivorous birds such as the brown creeper (*Certhia americana*). Other birds foraging and/or breeding in this habitat include the sharp-shinned hawk (*Accipiter striatus*), American peregrine falcon, mountain quail, western wood-pewee (*Contopus sordidulus*), and western tanager (*Piranga ludoviciana*). Mammals found in this habitat include the long-eared myotis (*Myotis evotis*), western red bat (*Lasiurus blossevillii*), northern flying squirrel (*Glaucomys sabrinus*), and bobcat (*Lynx rufus*).

Lacustrine Lacustrine habitat consists of the area regularly inundated by Shasta Lake (i.e., areas up to and below the 1,070-foot elevation). Most of this area is barren of vegetation and is characterized as exposed soil and/or rock. Portions of the lacustrine habitat do support vegetation during draw-down periods, including woody riparian species such as black willow, button willow, Fremont cottonwood, and various grasses and forbs.

Mixed Chaparral Mixed chaparral is a common habitat type and is scattered throughout all portions of the Shasta Lake and vicinity portion of the primary study area. This habitat often occurs on exposed slopes and/or in disturbed areas, including historic mining activities and past or recent wildfires. Mixed chaparral is typically characterized by dense shrub stands dominated by white leaf manzanita, buck brush, toyon *(Hetermeles arbutifolia),* California buckeye, Brewer's oak *(Quercus garryana* var. *breweri),* California bay *(Umbellularia californica),* interior live oak, Lemmon's ceanothus *(Ceanothus lemmonii),* birch-leaf mountain mahogany *(Cercocarpus betuloides),* holly-leaf redberry

(Rhamnus ilicifolia), yerba santa *(Eriodictyon californicum),* and poison oak. Few herbaceous plants occur in this habitat. Mixed chaparral provides habitat for a wide variety of wildlife species. It provides seeds, fruit, and protection from predators and harsh weather. In addition, it provides singing, roosting, and nesting sites for many species of birds, including the California quail (*Callipepla californica*), wrentit, and Bewick's wren (*Thryomanes bewickii*). Mammals common in this habitat include the black-tailed hare (*Lepus californicus*), gray fox, coyote, and deer mouse. Reptiles that make use of this habitat include the western fence lizard and southern alligator lizard.

Montane Hardwood Montane hardwood is a common tree habitat type and is scattered throughout all portions of the Shasta Lake and vicinity portion of the primary study area. The montane hardwood stands are typically characterized by moderate to dense stands of California black oak, canyon live oak, and occasional interior live oak. The understory is variable, although often sparse in the evergreen (live oak) stands because of a typically dense overstory canopy. Mast crops provided by montane hardwood forests are an important food resource for many species, including the acorn woodpecker, Steller's jay, mountain quail (*Oreortyx pictus*), western gray squirrel, and black-tailed deer. In addition, cavities in mature trees provide nesting and denning habitat for species such as the northern flicker, western screech owl (*Otus kennicottii*), American kestrel, and Virginia opossum. In moist areas, many amphibians and reptiles are found in the detrital layer, including ensatina (*Ensatina eschscholtzii*) and western skink.

Montane Hardwood – Conifer Montane hardwood–conifer is a common tree habitat type and is scattered throughout all portions of the Shasta Lake and vicinity portion of the primary study area. Montane hardwood–conifer is a complex forest type generally characterized by a complex of hardwood and conifer tree species. Stand composition varies, depending on numerous physical and geographic factors, and can include California black oak, canyon live oak, interior live oak, Oregon white oak (*Quercus garryana*), gray pine, ponderosa pine, Douglas-fir, sugar pine, and knobcone pine. Understory species are generally moderate to dense and include white leaf manzanita, buck brush, California buckeye, western redbud *(Cercis occidentalis),* California bay, poison oak, birch-leaf mountain mahogany, Brewer's oak, and snowdrop bush. The ground layer varies and is dominated by various grasses and forbs, including pussy ears, soaproot, Pacific hound's tongue, and slender wild oat.

The variability of the canopy cover and understory vegetation makes montane hardwood–conifer habitat suitable for numerous species of wildlife. Hollow trees and logs provide denning sites for mammals such as the coyote and gray fox, and cavities in mature trees are used by cavity-dwelling species such as the acorn woodpecker, violet-green swallow (*Tachycineta thalassina*), northern flicker, great horned owl, raccoon, and California myotis (*Myotis californicus*). In addition, raptors, such as the red-tailed hawk, construct nests in the upper canopy of mature trees. Moreover, mast crops and conifer seeds are an

important food source for many birds and mammals, including the Steller's jay, acorn woodpecker, California quail, black-tailed deer, and western gray squirrel. In moist areas, many amphibians and reptiles, including ensatina and western fence lizards, inhabit the detrital layer. Snakes, including the western rattlesnake and sharp-tailed snake (*Contia tenuis*), also are found in this habitat.

Montane Riparian Montane riparian is the dominant riparian habitat type and is scattered throughout all portions of the Shasta Lake and vicinity portion of the primary study area. Montane riparian habitat occurs as thin stringers and large patches along most stream corridors and is characterized as a sparse overstory of white alder (*Alnus rhombifolia*), Fremont cottonwood (*Populus fremontii*), or big leaf maple (*Acer macrophyllum*), along with a fairly dense mid-story and herbaceous layer. The mid-story is dominated by red osier dogwood (*Cornus sericea*), arroyo willow (*Salix lasiolepis*), narrow-leafed willow (*S. exigua*), red willow *(S. laevigata*), spicebush (*Calycanthus occidentalis*), mock orange, button willow (*Cephalanthus occidentalis*), American dogwood (*Cornus cericea*), California ash (*Fraxinus dipetala*), and mugwort (*Artemesia douglasiana*). Brambles of Himalayan blackberry (*Rubus discolor*) and California blackberry (*R. ursinus*) often engulf broader, low-gradient riparian areas. Lianas including California grape and greenbriar (*Smilax californica*) grow into the canopy.

Riparian habitats are among the most important wildlife habitats because of their high floristic and structural diversity, high biomass (and therefore high food abundance), and high water availability. In addition to providing breeding, foraging, and roosting habitat for a diverse array of animals, riparian habitats also provide movement corridors for some species, connecting a variety of habitats throughout the region.

The leaf litter, fallen tree branches, and logs associated with the riparian community in the study area provide cover for the western toad and Pacific chorus frog. The western fence lizard, western skink, and southern alligator lizard are also expected to occur here. Common species nesting and foraging primarily in the riparian tree canopy include the bushtit (*Psaltriparus minimus*), white-breasted nuthatch (*Sitta carolinensis*), and Nuttall's woodpecker (*Picoides nuttallii*). Other resident species, such as the spotted towhee and song sparrow (*Melospiza melodia*), nest and forage on or very close to the ground, usually in dense vegetation. A variety of mammals also inhabit riparian communities, including the deer mouse, raccoon, and Virginia opossum.

Ponderosa Pine Ponderosa pine is the most common conifer habitat type in the Shasta Lake and vicinity portion of the primary study area and is scattered throughout all portions of the area. This habitat is characterized by open to dense conifer stands dominated by ponderosa pine. Associated species include occasional Douglas-fir, sugar pine, incense cedar, canyon live oak, and California black oak. Associated understory species vary and include redbud, buck brush, mock orange, poison oak, snowdrop bush, and white leaf

manzanita. The ground layer ranges from open to moderate and is dominated by various grasses and forbs.

Ponderosa pine needles, cones, buds, pollen, twigs, seeds, and associated fungi and insects provide food for many species of birds and mammals, including the mountain quail, western gray squirrel, black-tailed deer, Allen's chipmunk (*Tamias senex*), and black bear (*Ursus americanus*). Mature trees provide nesting habitat for raptors such as the bald eagle (*Haliaeetus leucocephalus*), osprey (*Pandion haliaetus*), sharp-shinned hawk, and red-tailed hawk, and snags and hollow logs provide shelter for species such as the Virginia opossum and western spotted skunk (*Spilogale gracilis*).

Riverine Riverine habitat includes the free-flowing portions of the larger Shasta Lake tributaries in the Shasta Lake and vicinity portion of the primary study area. The riverine habitat is highly variable and ranges from moderate, low-gradient to steep, well-confined stream reaches. Most riverine habitat is dominated by run-and-riffle habitats, with bedrock, boulder, cobble, gravel, and sand substrates. The vegetation in the active stream channel is sparse, with occasional clumps of torrent sedge (*Carex nudata*) and Indian rhubarb (*Darmera peltata*).

Riverine areas provide habitat for numerous fish, including rainbow trout (*Oncorhynchus mykiss*), brown trout (*Salmo trutta*), smallmouth bass (*Micropterus dolomieu*), and riffle sculpin (*Cottus gulosus*). Aquatic wildlife species include the foothill yellow-legged frog (*Rana boylii*), aquatic garter snake (*Thamnophis atratus*), and the aquatic phase of the rough-skinned newt (*Taricha granulosa granulosa*). Birds present include the American dipper (*Cinclus mexicanus*), common merganser (*Mergus merganser*), and belted kingfisher (*Ceryle alcyon*). Many mammals in the surrounding upland habitats use the riverine areas, including raccoon, gray fox, and black-tailed deer.

Urban Urban habitat consists of various human-made features scattered throughout the Shasta Lake and vicinity portion of the primary study area, including resorts and a portion of the visitor center complex at Shasta Dam. These features are typically a combination of buildings, pavement areas with manicured landscaping, and lawns. The wildlife species most often associated with urban areas are those that are most tolerant of periodic human disturbances, including several introduced species, such as European starling (*Sturnus vulgaris*), rock dove (*Columba livia*), and house mouse (*Mus musculus*). Native species that are able to use these habitats include the western fence lizard, American robin (*Turdus migratorius*), Brewer's blackbird (*Euphagus cyanocephalus*), northern mockingbird (*Mimus polyglottos*), mourning dove, house finch (*Carpodacus mexicanus*), California ground squirrel, black-tailed hare, and striped skunk (*Mephitis mephitis*). In addition, bats that forage in nearby habitats may make use of small cavities around the eaves of structures.

Upper Sacramento River (Shasta Dam to Red Bluff)

Important wildlife habitat is found throughout the upper Sacramento River portion of the primary study area, and large contiguous blocks that contain multiple habitat types have the potential to support the highest wildlife diversity and abundance. Overall, the quantity and variety of wildlife species now inhabiting the area have been reduced since agricultural and residential development permanently removed much of the native and natural habitat. Most affected have been wildlife species associated with riparian habitats, which have declined substantially and been highly altered by land use, water resources development, and land management practices. Wildlife species associated with grassland and oak woodland habitats have also been affected by habitat loss resulting from habitat conversions to residential, commercial, and agricultural uses; cattle grazing; and other compounding factors such as lack of oak regeneration, spread of Sudden Oak Death Syndrome, and competition from invasive species. The region also supports a variety of nonnative plant and animal species, some of which are detrimental to survival of native species.

Habitats present in this portion of the primary study area are riparian woodland, riparian scrub, oak woodland, chaparral, annual grassland, agriculture, and urban. (See the Wildlife Resources Technical Report for a description of the plant and wildlife species typical of these habitats.)
Riparian habitat has been designated by DFG as a sensitive habitat in California because of its limited abundance and high value to wildlife.

Lower Sacramento River and Delta

The roughly 300 miles of the Sacramento River can be subdivided into distinct reaches. The reaches in the lower Sacramento River and Delta portion of the extended study area are discussed separately below because of differences in morphology, riparian vegetation, and habitat functions.

Sacramento River from Red Bluff Diversion Dam to the Delta Most habitat types and many of the wildlife species found in the upper Sacramento River portion of the primary study area have the potential to occur in the Central Valley portion of the extended study area, with additional species occurring in upland and foothill areas. The segment of the extended study area between Red Bluff Diversion Dam (RBDD) and the Delta includes a diverse array of wildlife habitats – floodplains, basins, terraces, active and remnant channels, and oxbow sloughs. The variety and availability of habitats along the middle Sacramento River support a wide range of wildlife species: a variety of waterfowl, raptors, and migratory and resident avian species, plus a variety of mammals, amphibians, and reptiles that inhabit both aquatic and upland habitats.

Sacramento-San Joaquin River Delta Delta wetlands are considered to be among the most productive wildlife habitats in California. These wetlands consist of permanent saline, brackish, and freshwater marshes; seasonal freshwater wetlands; open water; tidal and nontidal marshes, and emergent wetlands; and agricultural cropland (CALFED 2000a). (See the *Wildlife*

Resources Technical Report for a discussion of the plant and wildlife species typical of Delta wetlands.)

San Joaquin River Basin to the Delta Most habitat types and many of the wildlife species described above for the Sacramento River corridor have the potential to occur in the Central Valley portion of the extended study area, with additional species occurring in upland and foothill areas. The current wildlife habitat value of this area is somewhat limited by the predominance of agricultural lands, which support a relatively low diversity of wildlife species. However, the orchards, row and field crops, and fallow fields can be used by a number of common species, and fallow fields and some crops (e.g., wheat and barley) can support a variety of small mammals and provide high-quality foraging habitat for many species of raptors. More importantly, remnant native vegetation patches are likely to support a high diversity of wildlife species.

CVP/SWP Service Areas

The CVP and SWP service areas contain a large diversity of both lowland and upland habitats and species, although agricultural and urban growth has reduced the area and connectivity of important habitats that are critical to sustaining a wide variety of unique plants and animals (CALFED 2000a). The agricultural land and urban development that dominate the CVP and SWP service areas, respectively, can support many wildlife species, most of which are highly adapted to these disturbed environments.

13.1.2 Special-Status Species

Special-status species addressed in this section include animals that are legally protected or are otherwise considered sensitive by Federal, State, or local resource conservation agencies and organizations. Specifically, these include species that are Federally listed and/or State-listed as rare, threatened, or endangered; those considered as candidates or proposed for listing as threatened or endangered; species identified by DFG as fully protected or species of special concern, species identified by USFS as sensitive, or endemic; species identified by the U.S. Bureau of Land Management (BLM) as sensitive; species designated by the Northwest Forest Plan as survey and manage; other animals protected by the California Fish and Game Code; and those designated as Multi-Species Conservation Strategy (MSCS) covered species by the CALFED Bay-Delta Program (CALFED).

Shasta Lake and Vicinity

For the purposes of this evaluation, wildlife species of concern include species that are any of the following:

- Designated as threatened or endangered by the State or Federal government
- Proposed or petitioned for Federal listing as threatened or endangered

- State or Federal candidates for listing as threatened or endangered
- Identified by DFG as a species of special concern
- Considered sensitive or endemic by USFS
- Considered sensitive by BLM
- Considered survey and manage species by Northwest Forest Plan
- Designated as MSCS-covered species by CALFED

Special-status wildlife species with the potential to occur in the Shasta Lake and vicinity portion of the primary study area were determined using several database searches, review of USFWS and DFG special-status species lists for Shasta County, review of other appropriate literature, discussions with resource agency personnel, and professional experience in the area. All special-status wildlife species potentially occurring in the Shasta Lake and vicinity portion of the primary study area are discussed in Attachment 1 of the *Wildlife Resources Technical Report*, which provides a general comparison of habitat requirements for each species and the general habitats in the primary study area above Shasta Dam. For those special-status species for which generally suitable habitat was determined to be present, results from the various vegetation habitat mapping and wildlife surveys conducted in the area by North State Resources, Inc. (NSR) since 2002 were used to determine the likelihood of their presence in the primary study area above Shasta Dam (Table 13-3).

The survey and manage species include species listed in the most current survey and manage species list considered by the Northwest Forest Plan Survey and Manage Program. This list includes species from the current annual review for survey and manage species that was completed in compliance with the 2001 record of decision (ROD) for amendments to the survey and manage, protection buffer, and other mitigation measures standards and guidelines. Compliance with this ROD is conducted by completion of an annual species review and category assignment. The current survey and manage species list is from the December 2003 annual status review and includes species included in *Survey and Manage Standards and Guidelines and Category Assignment* of the 1994 ROD for the Northwest Forest Plan. For the purposes of this evaluation, survey and manage species of concern include taxa that are designated as Category A and C by the current category assignment. These categories include taxa that require what are known as predisturbance (i.e., preproject) surveys.

The CNDDB was reviewed for records of special-status plant species in or near the Shasta Lake and vicinity portion of the primary study area. The CNDDB is a database consisting of historical observations of special-status plant species, wildlife species, and natural communities. The CNDDB is limited to reported

sightings and is not a comprehensive list of special-status species that could occur in a particular area.

Table 13-3. Wildlife Species of Concern in the Shasta Lake and Vicinity Portion of the Primary Study Area

Common Name	Scientific Name	Status	Potential for Occurrence
Shasta sideband	*Monadenia troglodytes troglodytes*	FP, USFS S, S&M, MSCS m	Endemic to Shasta County. Potentially occurring in mixed conifer and woodland habitats, especially near limestone. Species occurs in limestone on the McCloud Arm from Potter Creek north.
Wintu sideband	*Monadenia troglodytes wintu*	FP, USFS S, S&M	Endemic to Shasta County. Potentially occurring in mixed conifer and woodland habitats, especially near limestone. Known to occur between the Pit and Squaw Creek arms and at Moutain Gate.
Shasta chaparral	*Trilobopsis roperi*	FP, USFS S, S&M	Endemic to Shasta County. Potentially occurring in mixed conifer and conifer/woodland habitats. Known occurrences in the Shasta Lake and vicinity portion of the study area.
Shasta hesperian	*Vespericola shasta*	FP, USFS S, S&M	Endemic to Klamath Province. Potentially occurring in mixed conifer and conifer/woodland habitats (riparian and/or riverine habitats). Only known from the southeastern Klamath Mountains region. Known occurrences in the Shasta Lake and vicinity portion of the study area.
Shasta salamander	*Hydromantes shastae*	CT, USFS S, S&M, MSCS m, BLMS	Only known from the southeastern Klamath Mountains region. Potentially occurring in mixed conifer, woodland, and chaparral habitats, especially near limestone. Known occurrences in the Shasta Lake and vicinity portion of the study area.
Tailed frog	*Ascaphus truei*	CSC	Potentially occurring in stream habitats in the Shasta Lake and vicinity portion of the study area. Known occurrences in the McCloud Arm and the upper Sacramento Arm tributaries outside the study area boundaries (DFG 2003).
California red-legged frog	*Rana draytonii*	FT, CSC, MSCS m	Requires aquatic habitat for breeding; also uses a variety of other habitat types including riparian and upland areas. A habitat assessment has been prepared to determine habitat suitability in the vicinity of Shasta Lake. Species has not been recorded in Shasta County since 1926 (University of Michigan Museum of Zoology 2009).
Foothill yellow-legged frog	*Rana boylii*	CSC, USFS S, MSCS m, BLMS	Potentially occurring in stream habitats. Known occurrences scattered throughout the Shasta Lake and vicinity portion of the primary study area.
Northwestern pond turtle	*Actinemys marmorata marmorata*	CSC, USFS S, MSCS m	Potentially occurring in stream or other wetland habitats. Adjacent upland habitats are potential nesting areas. Known occurrences scattered throughout the Shasta Lake and vicinity portion of the primary study area.
Long-eared owl	*Asio otus*	CSC, MSCS m	Potentially occurring in coniferous forest habitats.
Northern goshawk	*Accipiter gentilis*	CSC, USFS S, BLMS	Potentially occurring in mixed conifer habitats. Known to occur in the upper McCloud Arm.
Cooper's hawk	*Accipiter cooperi*	MSCS m	Potentially occurring in mixed conifer and conifer/woodland habitats.
Great blue heron	*Ardea herodias*	MSCS m	Known to breed in nearshore wooded habitat in the Turntable Bay area of Shasta Lake.

Table 13-3. Wildlife Species of Concern in the Shasta Lake and Vicinity Portion of the Primary Study Area (contd.)

Common Name	Scientific Name	Status	Potential for Occurrence
Willow flycatcher	*Empidonax traillii*	CE, USFS S, MSCS r	Uncommon migrant in riparian habitat; unlikely to nest in the Shasta Lake and vicinity portion of the primary study area.
American peregrine falcon	*Falco peregrinus anatum*	FD, CD, CP, MSCS m	Potentially occurring in mixed conifer and conifer/woodland habitats. Nesting sites in the study area unlikely due to lack of suitable eyrie sites; however, potential eyrie sites occur adjacent to the Shasta Lake and vicinity portion of the primary study area. Known historical eyrie along the McCloud Arm, and "new" eyrie found at the Gooseneck (Sacramento Arm).
Bald eagle	*Haliaeetus leucocephalus*	FD, FB, CE, CP, USFS S, MSCS m, BLMS	Potentially occurring in riverine and lacustrine habitats. Common at Shasta Lake, and a substantial number of nests occur in the Shasta Lake and vicinity portion of the primary study area and vicinity. Shasta Lake has the highest density of breeding bald eagles in the continental United States.
Osprey	*Pandion haliaetus*	MSCS m	Potentially occurring in riverine and lacustrine habitats. Common at Shasta Lake, and many known nests occur in the Shasta Lake and vicinity portion of the primary study area and vicinity.
Northern spotted owl Critical Habitat	*Strix occidentalis caurina*	FT, MSCS m	Potentially occurring in coniferous forest habitats. The species has been recorded within 0.5 mile of the study area along the Squaw Creek Arm (DFG 2003). Critical habitat occurs in the upper portion of the Squaw Creek and Pit arms.
Vaux's swift	*Chaetura vauxi*	CSC	Potentially occurring in coniferous forest and conifer/woodland habitats. Known to occur in the Shasta Lake and vicinity portion of the study area.
Yellow warbler	*Dendroica petechia brewsteri*	CSC, MSCS r	Potentially occurring in riparian habitats. Known occurrences in and near the Shasta Lake and vicinity portion of the primary study area.
Yellow-breasted chat	*Icteria virens*	CSC, MSCS m	Potentially occurring in riparian habitats. Known occurrences in and near the Shasta Lake and vicinity portion of the primary study area.
Purple martin	*Progne subis*	CSC	Potentially occurring in conifer, woodland, and riparian habitats. Foraging habitat occurs throughout Shasta Lake and vicinity portion of the primary study area. Shasta Lake is one of the few known breeding sites in interior California.
Pallid bat	*Antrozous pallidus*	CSC, USFS S, BLMS	Potentially occurring in mixed conifer and conifer/woodland habitat throughout the study area.
Ringtail	*Bassariscus astutus*	CP, MSCS m	Potentially occurring in mixed conifer and conifer/woodland habitats. Known occurrences in and near the Shasta Lake and vicinity portion of the primary study area.
Spotted bat	*Euderma maculatum*	CSC, BLMS	Potentially occurring in mixed conifer and conifer/woodland habitat throughout the study area. Species has been recorded on Squaw Creek within approximately 6 miles of the Shasta Lake and vicinity portion of the primary study area (DFG 2003).

Table 13-3. Wildlife Species of Concern in the Shasta Lake and Vicinity Portion of the Primary Study Area (contd.)

Common Name	Scientific Name	Status	Potential for Occurrence
Western mastiff bat	*Eumops perotis*	CSC, MSCS m*, BLMS *californicus subspecies only	Potentially occurring in mixed conifer and conifer/woodland habitat throughout the Shasta Lake and vicinity portion of the primary study area.
Western red bat	*Lasiurus blossevillii*	USFS S	Potentially occurring in mixed conifer and conifer/woodland habitat throughout the Shasta Lake and vicinity portion of the primary study area.
American marten	*Martes americana*	USFS S	Mixed evergreen forests with abundant cavities for denning and nesting and open areas for foraging.
Pacific fisher	*Martes pennanti*	FC, CSC, USFS S, BLMS	Potentially occurring in mixed conifer and conifer/woodland habitats. Known occurrences in and near the Shasta Lake and vicinity portion of the primary study area.
Long-eared myotis	*Myotis evotis*	BLMS	Potentially occurring in a wide variety of forest habitats throughout the study area.
Yuma myotis	*Myotis yumanensis*	BLMS	Potentially occurring in a wide variety of forest habitats throughout the study area.
Townsend's big-eared bat	*Plecotus townsendii*	CSC, USFS S	Potentially occurring in mixed conifer and conifer/woodland habitat throughout the study area. The species was observed in the Shasta Lake and vicinity portion of the primary study area by NSR biologists in June 2008.

Source: DFG 2003

Key:

Status Definitions

BLMS = U.S. Bureau of Land Management sensitive
CD = State delisted
CE = State-listed as endangered
CP = California fully protected
CSC = California species of special concern
CT = California (State) listed as threatened
FB = Federal Bald and Golden Eagle Protection Act
FC = Federal candidate for listing
FD = Federally delisted
FP = Federally petitioned for listing
FT = Federally listed as threatened
MSCS = Multi-Species Conservation Strategy covered species
  m = Maintain. Ensure that any adverse effects on the species that could be associated with implementation of CALFED Bay-Delta Program actions will be fully offset through implementation of actions beneficial to the species.
  r = Contribute to recovery. Implement some of the actions deemed necessary to recover species' populations in the Multi-Species Conservation Strategy focus area.
S&M = Survey and manage species
USFS S = U.S. Forest Service sensitive

The life history of species known or potentially occurring in the Shasta Lake and vicinity portion of the primary study area are described in detail in Attachment 2 of the *Wildlife Resources Technical Report*. Figures 13-3a through 13-3f depict the known locations of special-status wildlife species in the primary study area above Shasta Dam located during various surveys conducted by NSR and recent USFS records. Figures 13-4a through 13-4f depict the known locations of special-status terrestrial mollusks.

Summary of Wildlife Investigations Because wildlife studies are ongoing, technical memoranda describing methods, results, and conclusions in detail will be provided in the Final Environmental Impact Statement (FEIS).

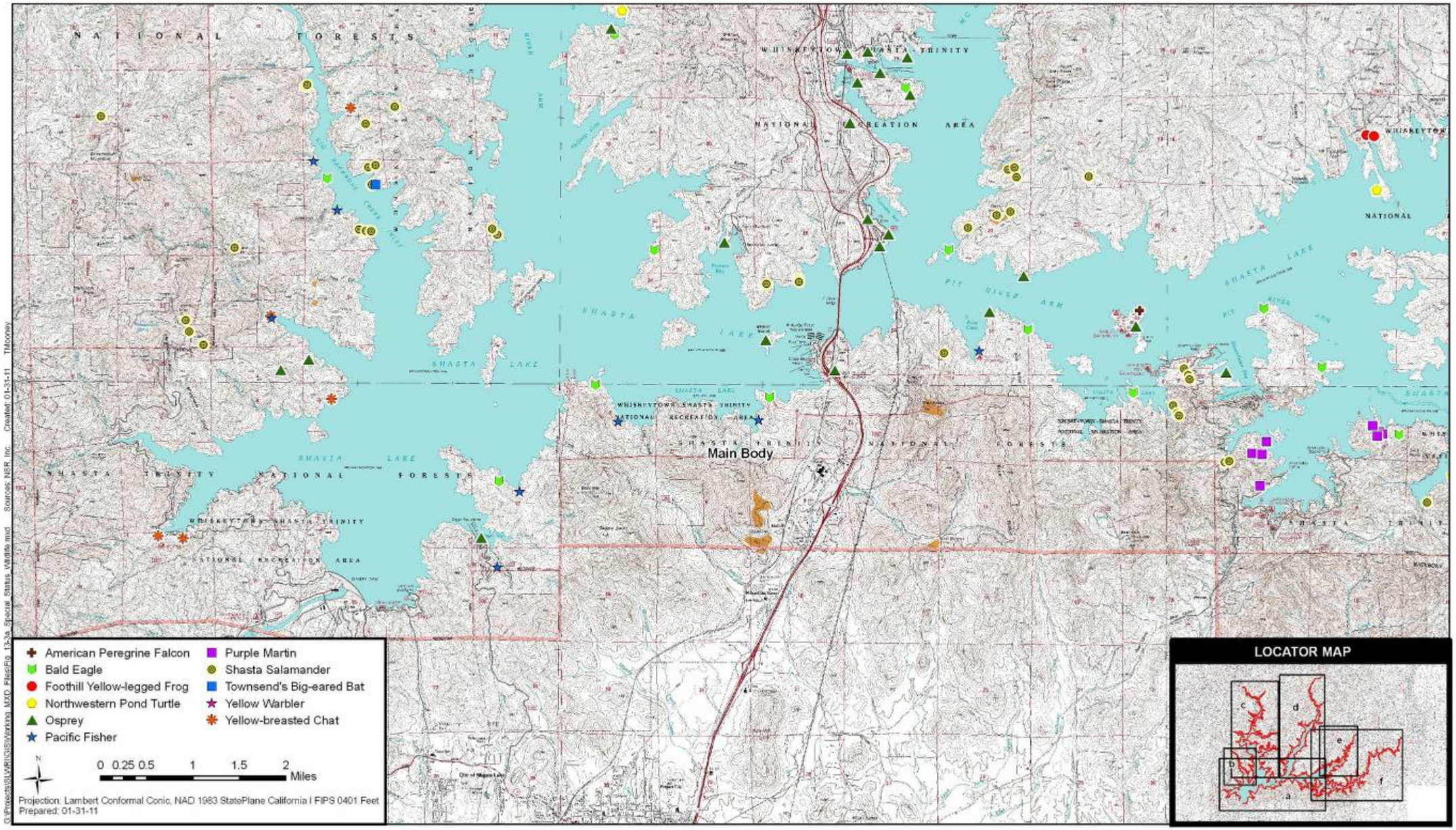


Figure 13-3a. Special-Status Wildlife Occurring in Shasta Lake and Vicinity

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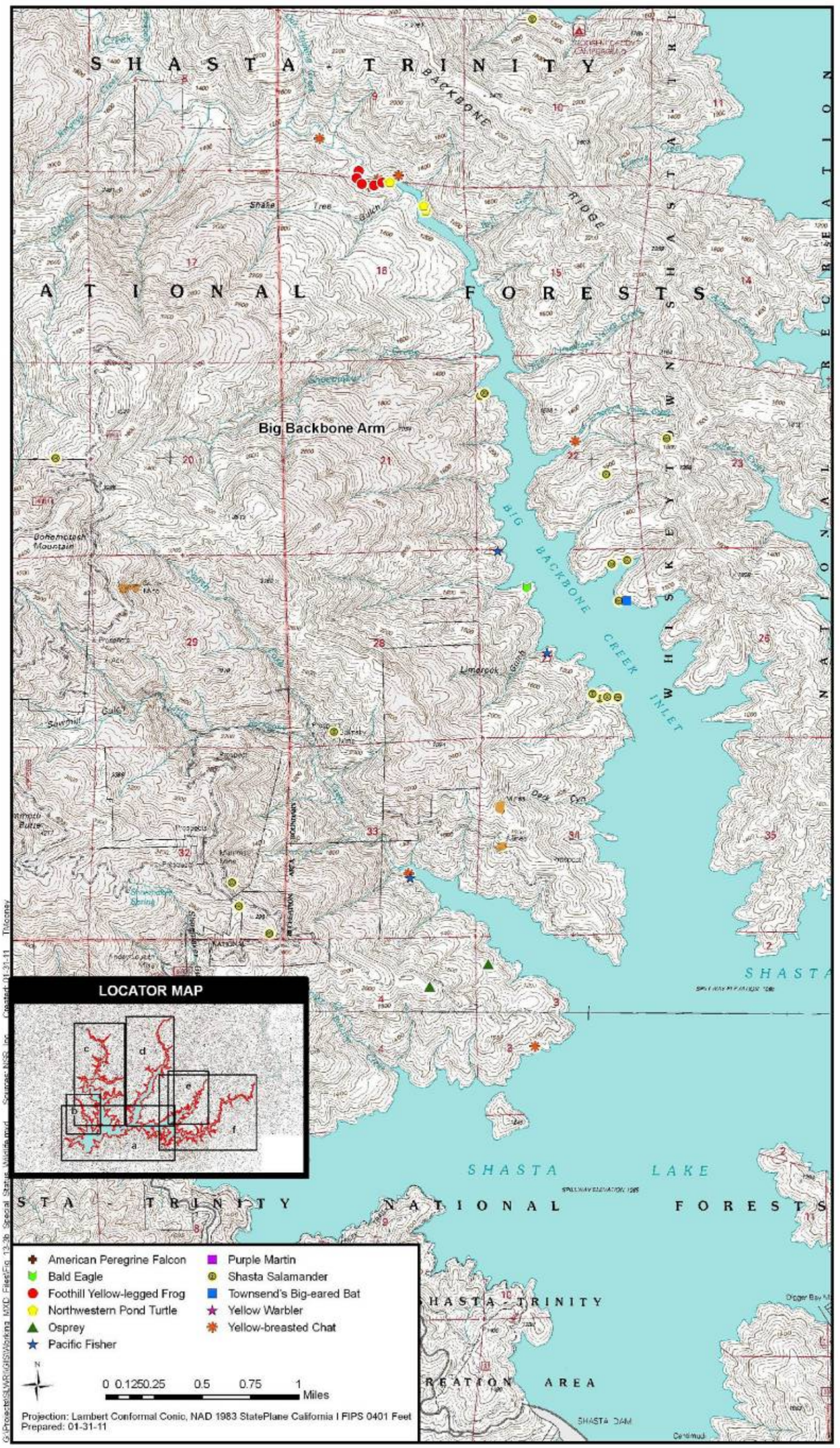


Figure 13-3b. Special-Status Wildlife Occurring in Shasta Lake and Vicinity

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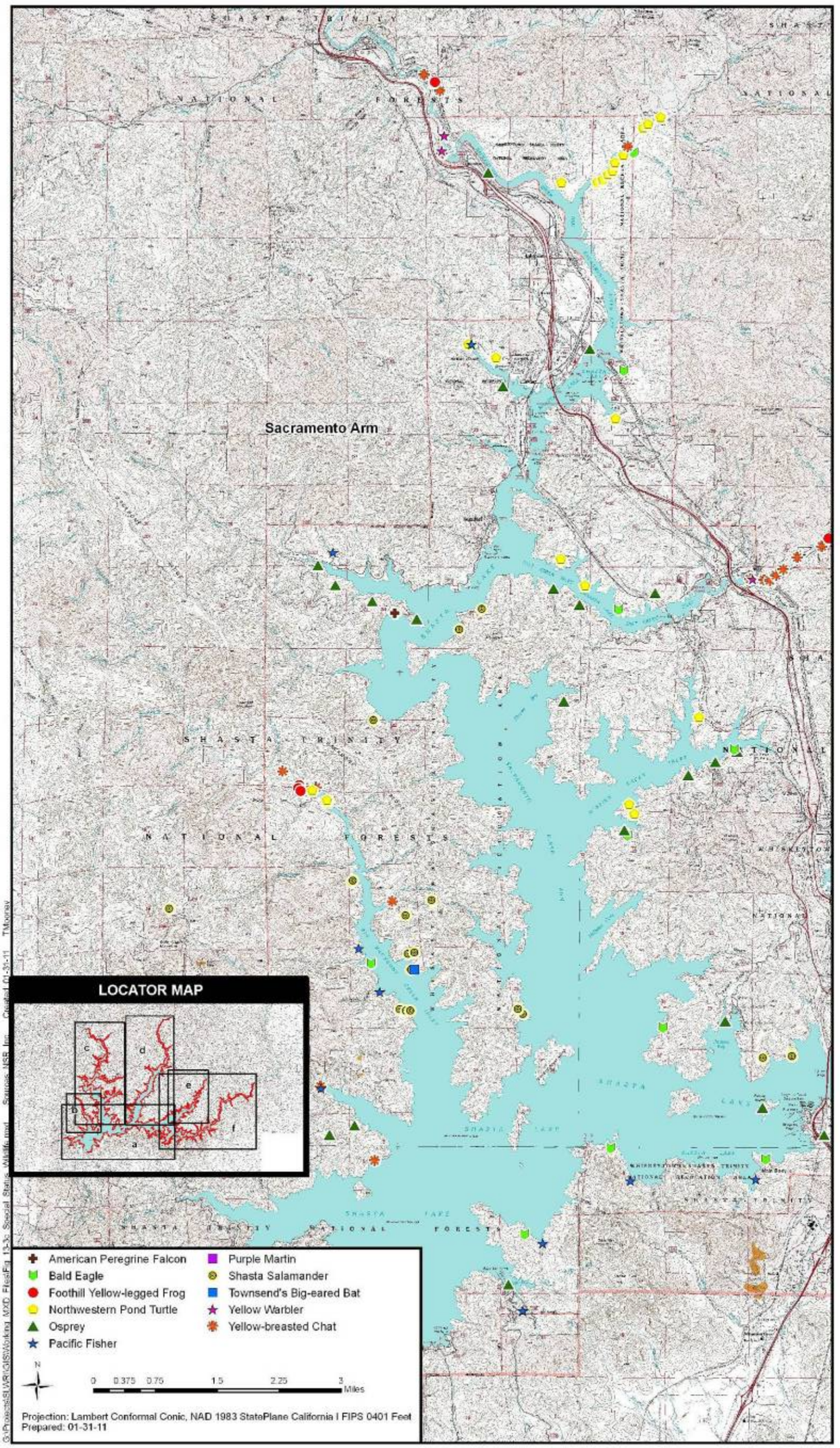


Figure 13-3c. Special-Status Wildlife Occurring in Shasta Lake and Vicinity

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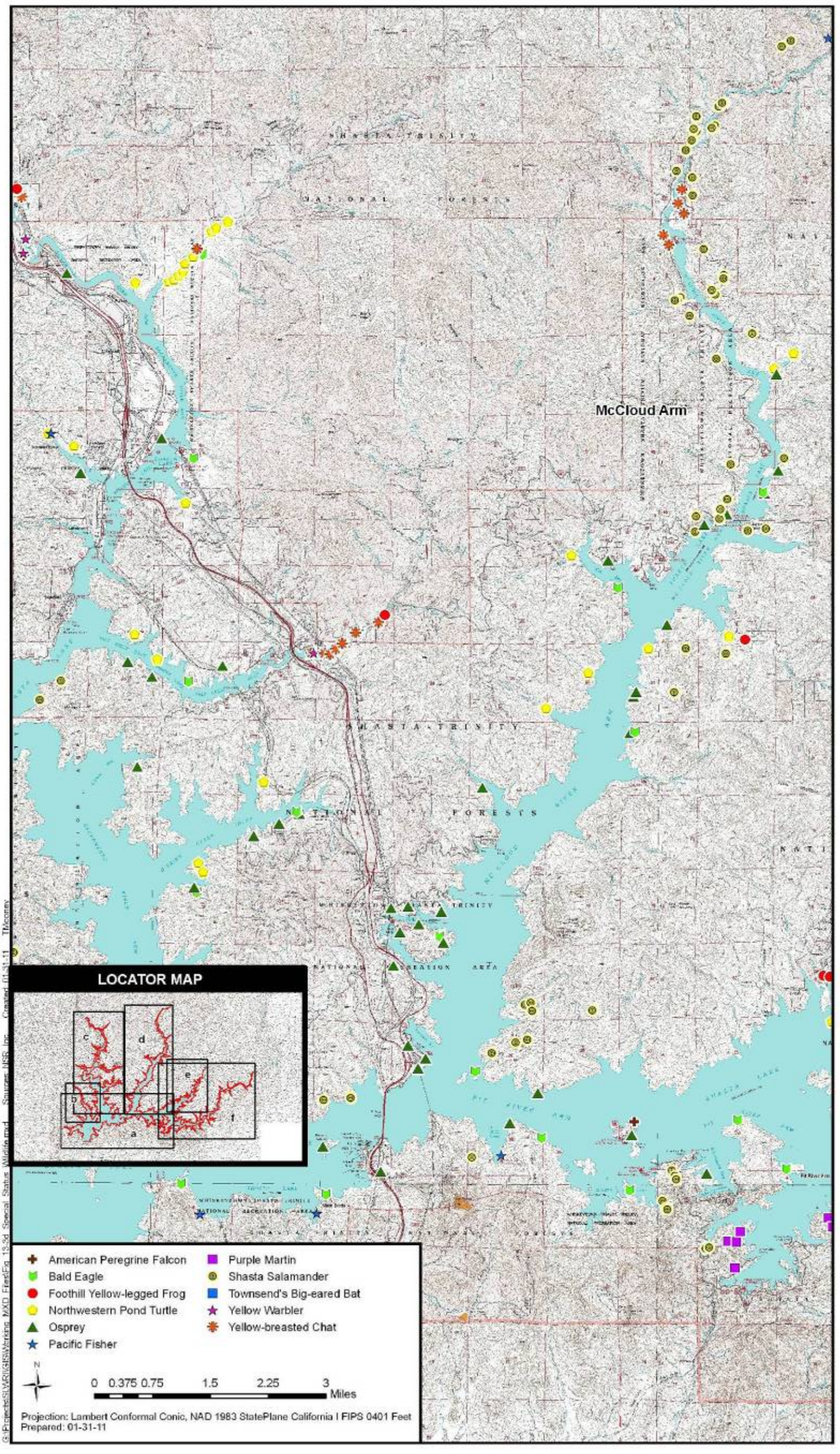


Figure 13-3d. Special-Status Wildlife Occurring in Shasta Lake and Vicinity

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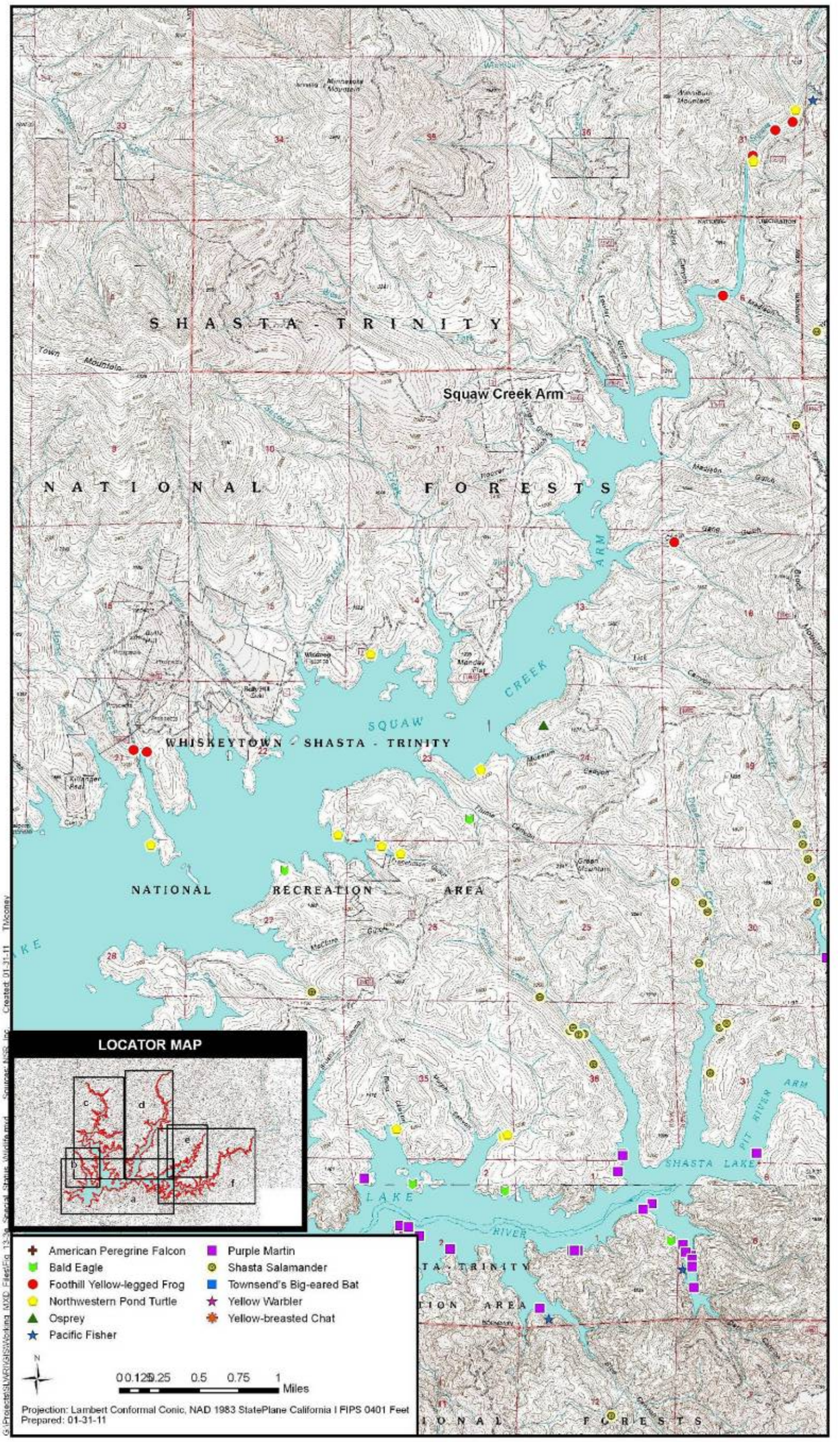


Figure 13-3e. Special-Status Wildlife Occurring in Shasta Lake and Vicinity

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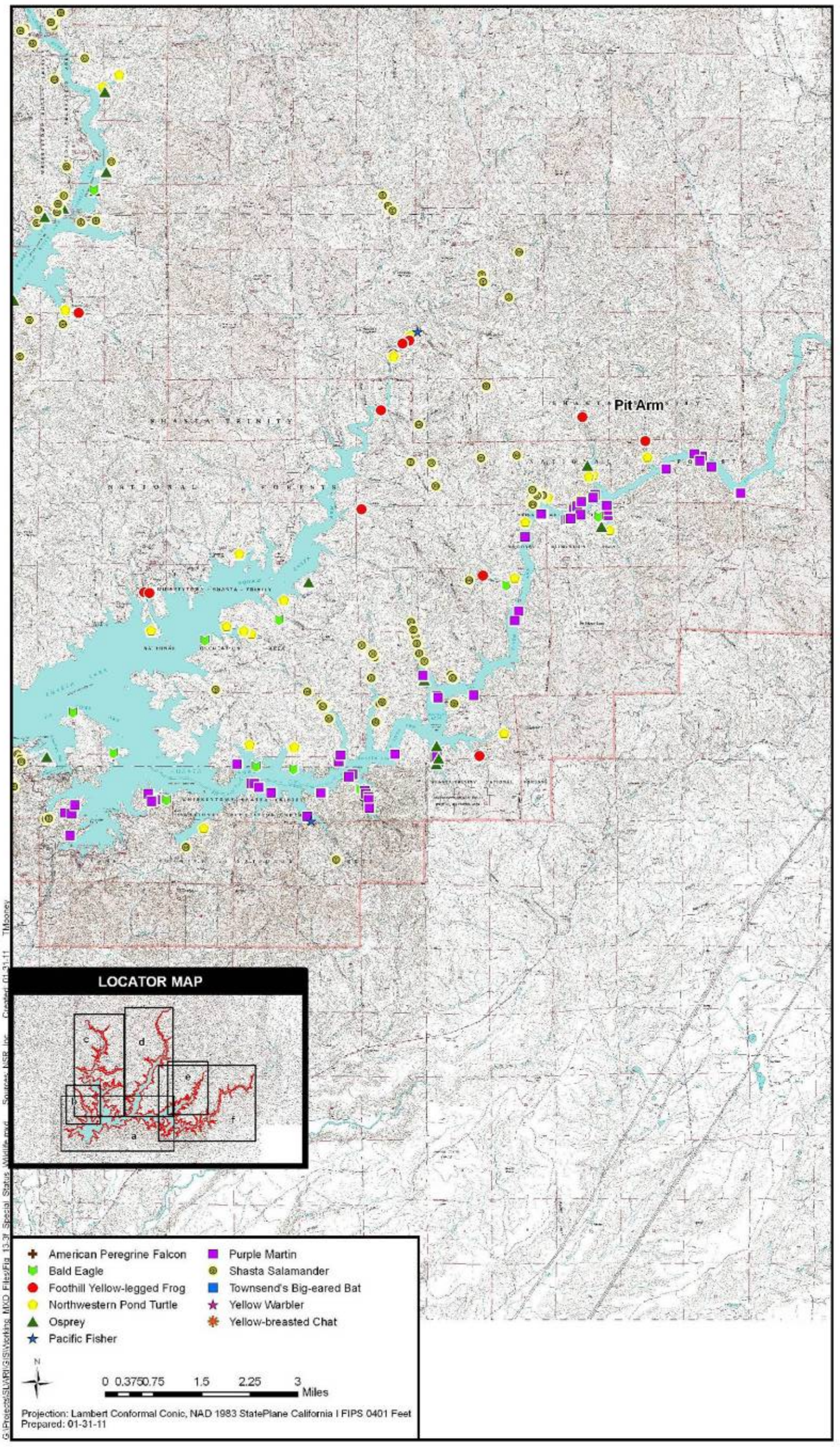


Figure 13-3f. Special-Status Wildlife Occurring in Shasta Lake and Vicinity

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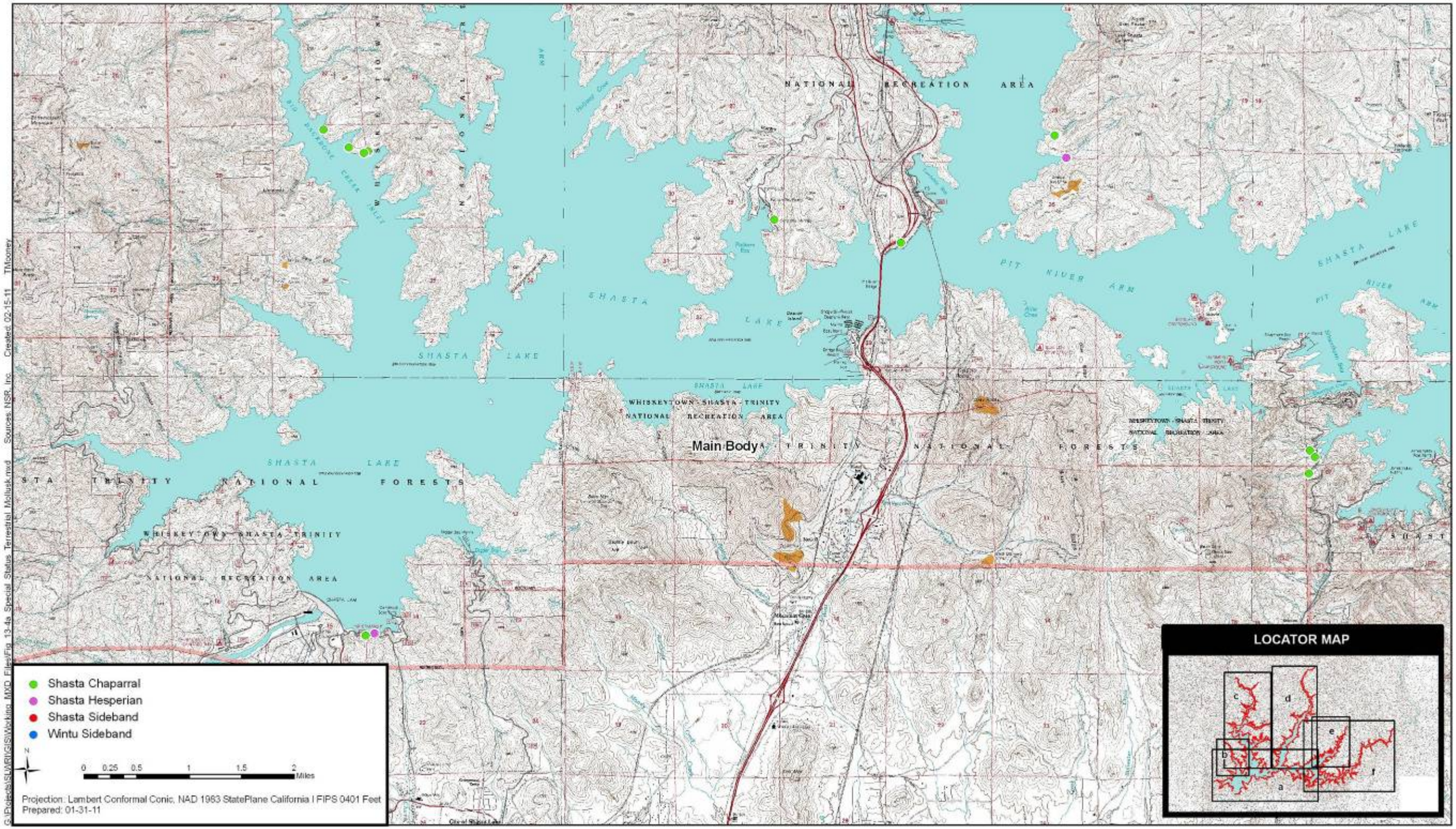


Figure 13-4a. Special-Status Terrestrial Mollusks Occurring in Shasta Lake and Vicinity

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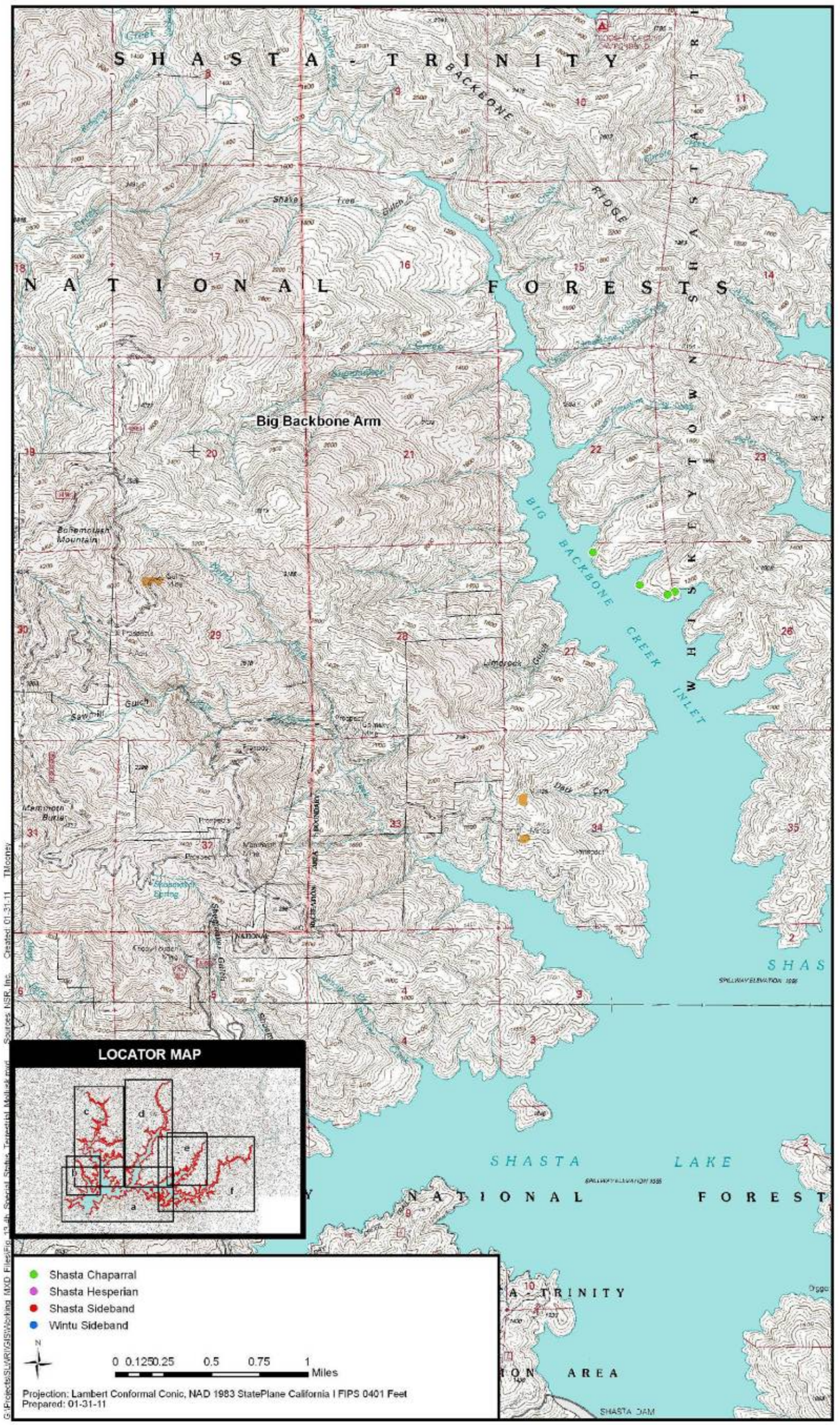


Figure 13-4b. Special-Status Terrestrial Mollusks Occurring in Shasta Lake and Vicinity

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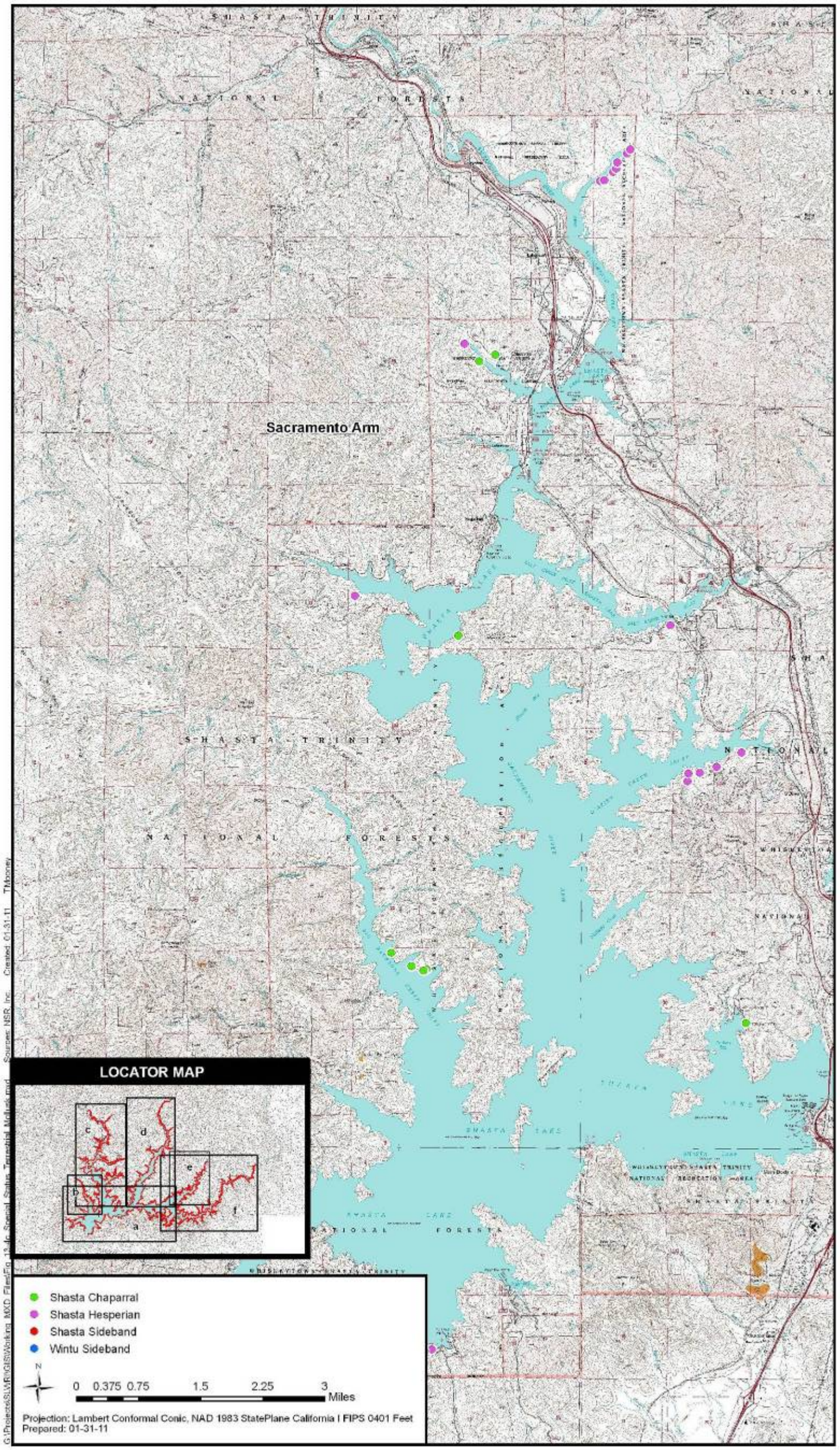


Figure 13-4c. Special-Status Terrestrial Mollusks Occurring in Shasta Lake and Vicinity

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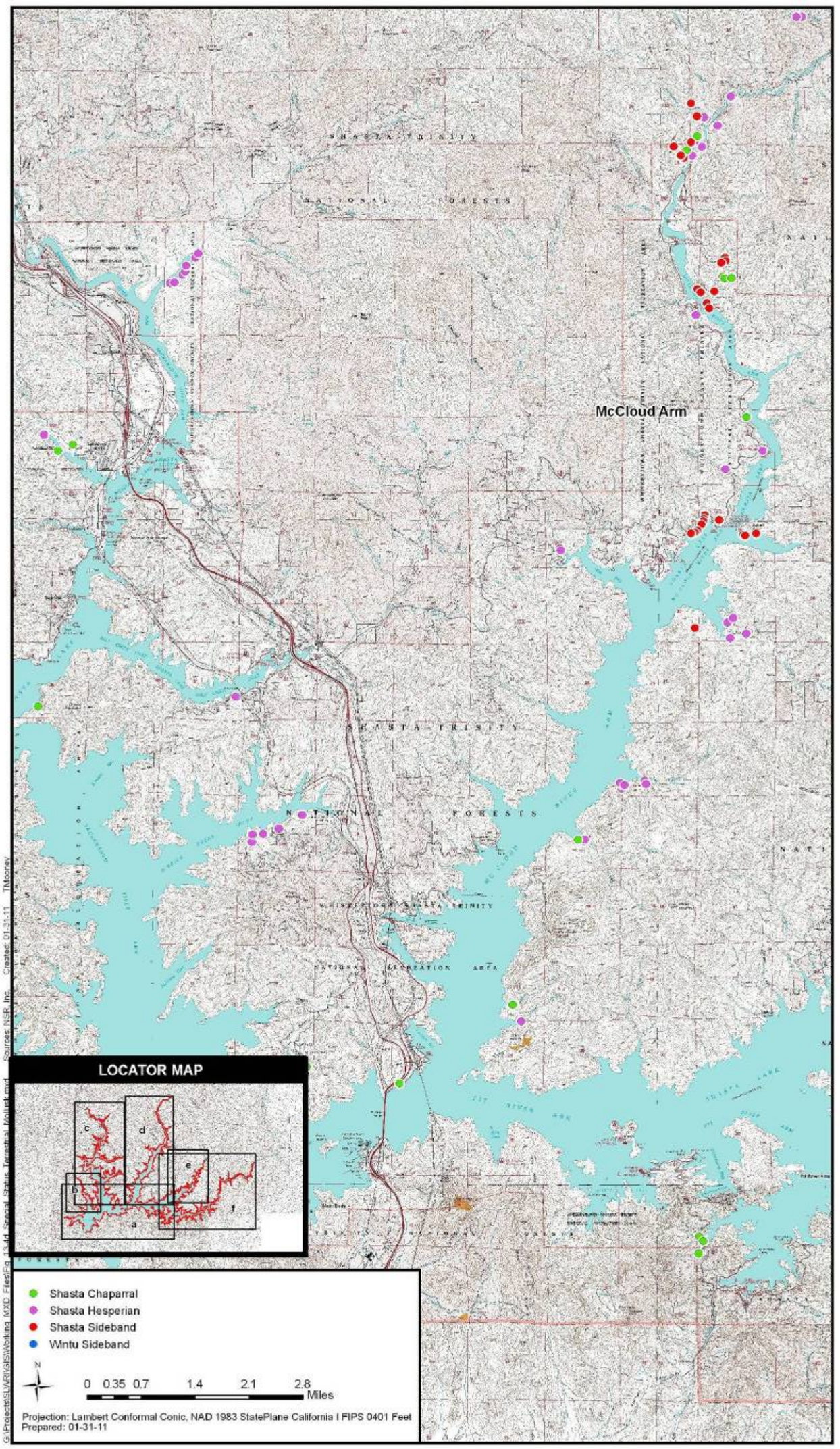


Figure 13-4d. Special-Status Terrestrial Mollusks Occurring in Shasta Lake and Vicinity

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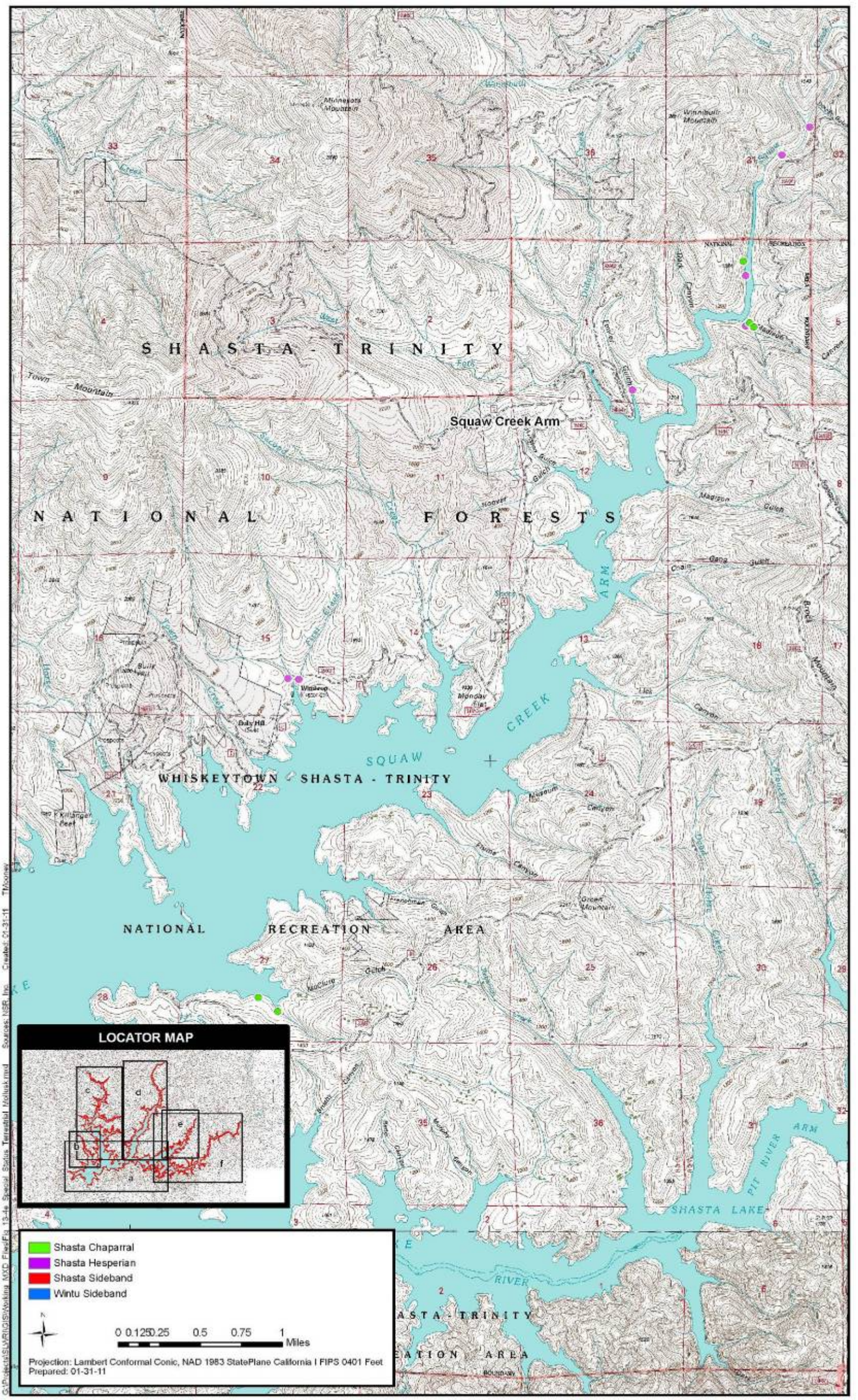


Figure 13-4e. Special-Status Terrestrial Mollusks Occurring in Shasta Lake and Vicinity

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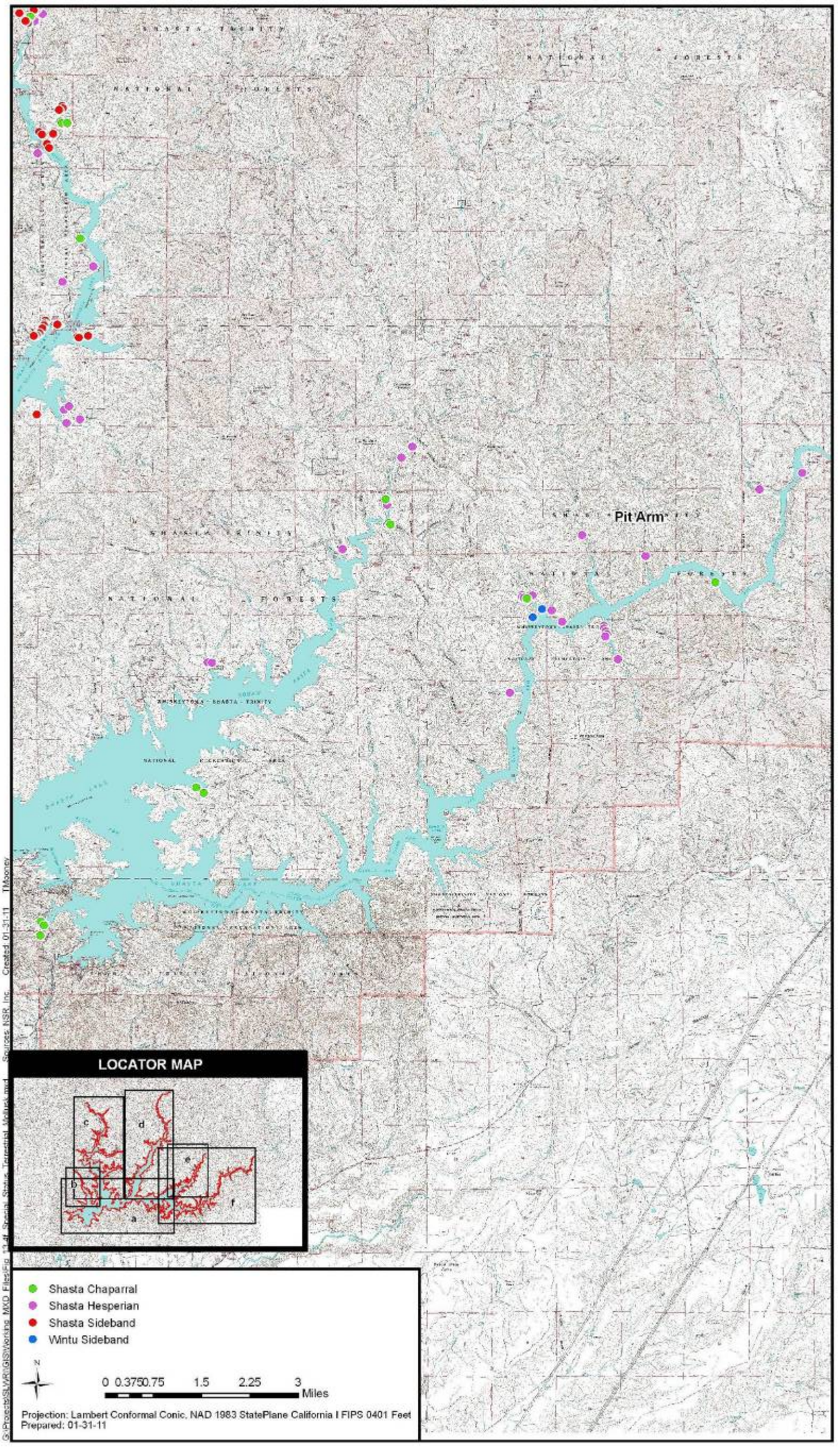


Figure 13-4f. Special-Status Terrestrial Mollusks Occurring in Shasta Lake and Vicinity

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Terrestrial Mollusk Surveys (Survey and Manage) Reclamation has conducted three survey efforts for survey and manage terrestrial mollusk species in the Shasta Lake and vicinity portion of the primary study area. These include protocol-level efforts during 2002 to 2003 and 2005 along selected portions of the Shasta Lake shoreline and current protocol-level efforts initiated in 2010 at the relocation areas. Additionally, many other terrestrial mollusk locations have been found incidentally during numerous other biological survey tasks throughout the Shasta Lake and vicinity portion of the primary study area. Four survey and manage terrestrial mollusk species have been found to date: Shasta sideband (*Monadenia troglodytes troglodytes*), Wintu sideband (*Monadenia troglodytes wintu),* Shasta chaparral (*Trilobopsis roperi*), and Shasta hesperian (*Vespericola shasta*). Collectively, 29, 2, 29, and 73 locations of Shasta sideband, Wintu sideband, Shasta chaparral, and Shasta hesperian, respectively, have been found (Figures 13-4a through 13-4f).

Shasta Salamander Surveys Reclamation has conducted three survey efforts for Shasta salamander in the Shasta Lake and vicinity portion of the primary study area. These include survey efforts during 2003 and 2006 to 2007 along selected portions of the Shasta Lake shoreline and current efforts initiated in 2010 at the relocation areas. Additionally, several other Shasta salamander locations have been found incidentally during other biological survey tasks throughout the Shasta Lake and vicinity portion of the primary study area. Shasta salamanders have been found at 39 locations. These findings and other known locations show that this species occurs in all arms of Shasta Lake in both limestone and nonlimestone habitats (Figures 13-3a through 13-3f).

Bald Eagle/Osprey Surveys Reclamation mapped all known bald eagle and osprey nests in the Shasta Lake and vicinity portion of the primary study area in 2007. Additional data including diameter of nest trees, nest tree height, nest height, proximity to the high-water mark, surrounding vegetation, and shoreline erosion rating were recorded for the bald eagle nests. Twenty-eight bald eagle nests were located and 54 osprey nests were located (Figures 13-3a through 13-3f). Reclamation is currently working with USFS to update this data set, because several bald eagle nesting pairs are no longer active and/or have moved to new locations.

Neotropical Migrant Bird Surveys Reclamation conducted a breeding bird survey in the Shasta Lake and vicinity portion of the primary study area in 2007. Additionally, focused surveys for purple martins and an analysis of purple martin habitat at Shasta Lake were conducted. These surveys provided information on use of the Shasta Lake and vicinity portion of the primary study area by breeding birds, including breeding neotropical migrant species. Sixty-seven bird species were detected during these surveys, including 38 neotropical migrant species.

These surveys also provided a basic understanding of the distribution and habitat use of purple martins in the Shasta Lake and vicinity portion of the

primary study area. Purple martin monitoring has continued through 2010 and provides additional distribution and habitat use information (Figures 13-3a through 13-3f). The Shasta Lake purple martin population has remained stable and has increased slightly over the monitoring period to date. The nesting purple martin population has totaled 18, 21, 24, and 28 pairs during 2007, 2008, 2009, and 2010, respectively. Most nest sites occur in flooded snags found in the reservoir; however, recent monitoring has shown a slight increase in use of upland nest sites.

Forest Carnivore Surveys Reclamation conducted surveys for sensitive forest carnivore species (forest carnivores) in the Shasta Lake and vicinity portion of the primary study area during 2003 to 2005. The specific sensitive forest carnivore species (i.e., "target species") surveyed included the Sierra Nevada red fox (*Vulpes vulpes necator*), American marten (*Martes americana*), Pacific fisher (*Martes pennanti*), and wolverine (*Gulo gulo*). One target forest carnivore species, the Pacific fisher, was detected. Pacific fisher was detected at 13 locations scattered in all areas of the Shasta Lake and vicinity portion of the primary study area, except the McCloud Arm (Figures 13-3a through 13-3f). Additionally, the ringtail, a California fully protected species, was detected in all areas of the Shasta Lake and vicinity portion of the primary study area.

The Pacific fisher survey results provide additional information on habitat use and distribution of the species in Northern California. The survey findings represent the southeastern-most Pacific fisher occurrences in the Klamath and Sierra/Cascade regions. Additionally, these findings show Pacific fishers in areas generally (previously) not considered suitable habitat in California, including open second-growth conifer, hardwood–conifer, and hardwood habitats that have extensive chaparral components. Pacific fishers were also detected in areas that had been barren or semi-barren 50 to 60 years ago because of copper smelting and near commercial, rural residential, and industrial development areas.

California Red-Legged Frog Assessment Reclamation conducted a California red-legged frog habitat assessment in the Shasta Lake and vicinity portion of the primary study area in 2010. In consultation with USFWS, an assessment area was developed and field surveys of aquatic habitats were conducted in accordance with *Revised Guidance on Site Assessments and Field Surveys for the California Red-Legged Frog* (USFWS 2005a). The results suggest only one feature may represent potential California red-legged frog breeding habitat. A California red-legged frog habitat assessment report is currently being completed for USFWS review.

Upper Sacramento River (Shasta Dam to Red Bluff)

A list of special-status wildlife species with the potential to occur in the primary study area from Shasta Dam to RBDD (Table 13-4) was compiled based on habitat suitability and known occurrences within the area covered in the Shasta Dam, Redding, Enterprise, Cottonwood, Ball's Ferry, Bend, and Red Bluff East

U.S. Geological Survey 7.5-minute quadrangle maps (CNDDB 2007; USFWS 2007a), as well as species considered sensitive by USFS. (See the *Wildlife Resources Technical Report* for a description of the life history of special-status wildlife species known or likely to occur in the area and figures depicting the recorded locations of special-status species.)

Table 13-4. Special-Status Wildlife Species Known or with Potential to Occur in the Primary Study Area, Along the Sacramento River from Shasta Dam to Red Bluff Diversion Dam

Common Name	Scientific Name	Status	Potential for Occurrence
Invertebrates			
Conservancy fairy shrimp	*Branchinecta conservatio*	FE, MSCS	Unlikely to occur. No suitable habitat is present along the river corridor.
Valley elderberry longhorn beetle	*Desmocerus californicus dimorphus*	FT, MSCS	Known to occur. Elderberry shrubs are present within the riparian woodland community along the Sacramento River.
Vernal pool tadpole shrimp	*Lepidurus packardi*	FE, MSCS	Unlikely to occur. No suitable habitat is present along the river corridor.
Vernal pool fairy shrimp	*Branchinecta lynchi*	FT, MSCS	Unlikely to occur. No suitable habitat is present along the river corridor.
Amphibians			
California red-legged frog	*Rana aurora draytonii*	FT, CSC, MSCS	Unlikely to occur. No longer occurs on the floor of the Central Valley.
Foothill yellow-legged frog	*Rana boylii*	CSC, USFS S, MSCS	Unlikely to occur in the Sacramento River due to lack of suitable substrate and hydrology.
Western spadefoot toad	*Spea hammondii*	CSC, MSCS	Unlikely to occur. No suitable habitat is present along the Sacramento River corridor.
Western tailed frog	*Ascaphus truei*	CSC	Unlikely to occur in mainstem of Sacramento River where flows could be altered.
Reptiles			
Giant garter snake	*Thamnophis gigas*	FT, CT, MSCS	Unlikely to occur in the primary study area; however, known to occur in the extended study area.
Northwestern pond turtle	*Clemmys marmorata marmorata*	CSC, USFS S, MSCS	Known to occur. Suitable habitat is present in the primary study area.

Table 13-4. Special-Status Wildlife Species Known or with Potential to Occur in the Primary Study Area, Along the Sacramento River from Shasta Dam to Red Bluff Diversion Dam (contd.)

Common Name	Scientific Name	Status	Potential for Occurrence
Birds			
Aleutian Canada goose	*Branta canadensis leucopareia*	FD, MSCS	Unlikely to occur within banks of the Sacramento River where flows could be altered.
American peregrine falcon (nesting)	*Falco peregrinus anatum*	CE, CP, USFS S, MSCS	Unlikely to nest in this portion of the study area; however, may forage in areas of open water with large concentrations of waterbirds.
Bald eagle (nesting and wintering)	*Haliaeetus leucocephalus*	FD, CE, CP, MSCS	Known to occur along the Sacramento River within the primary study area.
Bank swallow	*Riparia riparia*	CT, MSCS	Known to occur along the Sacramento river in the primary and extended study areas.
Black-crowned night heron (rookery)	*Nycticorax nycticorax*	BLM S, MSCS	Could nest in trees adjacent to the Sacramento River.
California gull	*Larus californicus*	MSCS	Not within breeding range. Could occur in the study area during winter or migration.
Cooper's hawk (nesting)	*Accipiter cooperii*	MSCS	Could occur. Suitable nesting and foraging habitat is present in the study area.
Double-crested cormorant (rookery)	*Phalacrocorax auritus*	MSCS	Could nest in trees adjacent to the Sacramento River.
Golden eagle	*Aquila chrysaetos*	CP, BLM S, MSCS	No suitable nesting habitat along the Sacramento River. Unlikely to forage along the river corridor.
Great blue heron (rookery)	*Ardea herodius*	MSCS	Could nest in trees adjacent to the Sacramento River.
Great egret (rookery)	*Casmerodius albus*	MSCS	Could nest in trees adjacent to the Sacramento River.
Greater sandhill crane	*Grus canadensis tabida*	CT, CP, MSCS	Unlikely to breed in the study area. Unlikely to use the Sacramento River corridor during winter or migration.
Least bittern (nesting)	*Ixobrychus exilis*	CSC, MSCS	Could nest along the Sacramento River if suitable habitat is present.
Lesser sandhill crane (wintering)	*Grus canadensis canadensis*	CSC	Does not breed in California. Unlikely to use the Sacramento River corridor during winter or migration.
Little willow flycatcher (nesting)	*Empidonax traillii brewsteri*	CE, USFS S, MSCS	Unlikely to breed in the study area due to elevation, but may use riparian woodlands during migration.
Loggerhead shrike (nesting)	*Lanius ludovidianus*	CSC	Likely to nest and forage in woodlands and scrub habitats in the study area.
Long-billed curlew	*Numenius americanus*	MSCS	Does not breed in the study area. Unlikely to use the Sacramento River corridor during winter or migration.
Long-eared owl (nesting)	*Asio otus*	CSC, MSCS	Does not nest in lowland Central Valley areas. Unlikely to forage along the Sacramento River corridor where flows would be altered.

Table 13-4. Special-Status Wildlife Species Known or with Potential to Occur in the Primary Study Area, Along the Sacramento River from Shasta Dam to Red Bluff Diversion Dam (contd.)

Common Name	Scientific Name	Status	Potential for Occurrence
Mountain plover (wintering)	*Charadrius montanus*	CSC, BLM S, MSCS	Does not nest in California. Unlikely to winter along the Sacramento River where flows would be altered.
Northern goshawk (nesting)	*Accipiter gentilis*	CSC, USFS S	Unlikely to occur along the Sacramento River corridor due to lack of suitable habitat.
Northern harrier (nesting)	*Circus cyaneus*	CSC, MSCS	Likely to occur. Suitable nesting and foraging habitat is present in the study area.
Northern spotted owl (nesting)	*Strix occidentalis caurina*	FT, MSCS	Unlikely to occur along the Sacramento River corridor due to lack of suitable habitat.
Osprey (nesting)	*Pandion haliaetus*	MSCS	Known to nest along the Sacramento River within the primary study area.
Purple martin (nesting)	*Progne subis*	CSC	Could occur. Potentially suitable habitat is present along the Sacramento River corridor.
Short-eared owl (nesting)	*Asio flammeus*	CSC, MSCS	Could occur. Potentially suitable habitat is present within the primary study area.
Snowy egret (rookery)	*Egretta thula*	MSCS	Could nest in trees adjacent to the Sacramento River.
Swainson's hawk (nesting)	*Buteo swainsoni*	CT, MSCS	Could occur. Suitable nesting and foraging habitat is present in the study area.
Tricolored blackbird (nesting)	*Agelaius tricolor*	CSC, MSCS	Could occur. Potentially suitable habitat is present in the primary study area.
Western yellow-billed cuckoo (nesting)	*Coccyzus americanus occidentalis*	FC, CE, USFS S, MSCS	Likely to nest and forage in the primary study area.
Western burrowing owl (burrow sites)	*Athene cunicularia hypugea*	CSC, MSCS	Unlikely to occur along the Sacramento River corridor due to a lack of suitable nesting habitat.
White-tailed kite (nesting)	*Elanus leucurus*	CP, MSCS	Likely to occur. Suitable nesting and foraging habitat is present in the study area.
Yellow-breasted chat (nesting)	*Icteria virens*	CSC, MSCS	Likely to nest and forage in the primary study area
Yellow warbler (nesting)	*Dendroica petechia*	CSC, MSCS	Could nest and forage in the primary study area. Likely to use riparian woodlands during migration.
Mammals			
American badger	*Taxidea taxus*	CSC	Could occur along the Sacramento River corridor.
American marten	*Martes americana*	USFS S	Unlikely to occur. No suitable habitat along the Sacramento River corridor.
Pacific fisher	*Martes pennanti*	FC, USFS S	Unlikely to occur. No suitable habitat along the Sacramento River corridor.
Pallid bat	*Antrozous pallidus (roosting)*	CSC, USFS S	Could occur. Potentially suitable habitat is present in woodland in the primary study area.
Ringtail	*Bassariscus astutus*	CP, MSCS	Could occur. Potentially suitable habitat is present along the Sacramento River corridor.

Table 13-4. Special-Status Wildlife Species Known or with Potential to Occur in the Primary Study Area, Along the Sacramento River from Shasta Dam to Red Bluff Diversion Dam (contd.)

Common Name	Scientific Name	Status	Potential for Occurrence
Spotted bat	*Euderma maculatum*	CSC	Unlikely to roost along the Sacramento River corridor because suitable roost sites are lacking.
Townsend's big-eared bat	*Corynorhinus townsendii townsendii (roosting)*	CSC, USFS S	Unlikely to roost along the Sacramento River corridor because suitable roost sites are lacking.
Western mastiff bat	*Eumops perotis californicus* (roosting)	CSC, MSCS	Unlikely to roost along the Sacramento River corridor because suitable roost sites are lacking.
Western red bat	*Lasiurus blossevillii*	CSC, USFS S	Could occur. Potentially suitable habitat is present in woodland in the primary study area.

Sources: CNDDB 2007; USFWS 2007a; USFS 2007; CALFED 2000b; Shuford and Gardali 2008

Key:
BLM S = U.S. Bureau of Land Management sensitive
CE = State-listed as endangered
CP = California fully protected
CSC = California species of special concern
CT = California Threatened
FC = Federal candidate for listing
FD = Federally delisted
FE = Federally listed as endangered
FT = Federally listed as threatened
MSCS = Multi-Species Conservation Strategy covered species
USFS S = USFS sensitive

Lower Sacramento River and Delta

Numerous special-status wildlife are associated with riparian, floodplain, and side channel wetland habitats along the Sacramento River and in the Delta, including those listed in Table 13-5. However, as stated above, the roughly 300 miles of the Sacramento River can be subdivided into distinct reaches. The reaches in the extended study area are discussed separately below because of differences in morphology, riparian vegetation, and habitat functions. The *Wildlife Resources Technical Report* contains a comprehensive list of all sensitive wildlife species in the extended study area that have been reported to the CNDDB.

Sacramento River from RBDD to the Delta Many of the special-status wildlife species described above for the upper Sacramento River corridor have the potential to occur in the middle and lower reaches of the Sacramento River. Wildlife species listed under the Federal Endangered Species Act (ESA) and/or California Endangered Species Act (CESA) that have potential to occur in a portion of the extended study area from RBDD to the Delta include valley elderberry longhorn beetle (*Desmocerus californicus dimorphus*), giant garter snake (*Thamnophis gigas*), bald eagle (*Haliaeetus leucocephalus*), Swainson's hawk (*Buteo swainsoni*), western yellow-billed cuckoo (*Coccyzus americanus*

occidentalis), willow flycatcher (*Empidonax traillii*), and bank swallow (*Riparia riparia*).

Table 13-5. Sensitive Wildlife Species of Riparian and Perennial Wetland Communities Along the Sacramento River and in the Delta

Species	Status[1]	Habitat Description
Invertebrates		
Valley elderberry longhorn beetle *Desmocerus californicus dimorphus*	FT	Elderberries in riparian woodlands or savanna communities.
Reptiles		
Western pond turtle *Actinemys marmorata*	CSC	Ponds, lakes, rivers, streams, creeks, marshes, and irrigation ditches with abundant vegetation and either rocky or muddy bottoms, in woodland, forest, and grassland.
Giant garter snake *Thamnophis giga*	FT CT	Marshes, sloughs, drainage canals, and irrigation ditches, especially around rice fields, and occasionally in slow-moving creeks from sea level to 400 feet. Prefers locations with vegetation close to the water for basking.
Birds		
Tricolored blackbird *Agelaius tricolor*	CSC	*Foraging:* On ground in croplands, grassy fields, flooded land, and along edges of ponds. *Nesting:* Dense cattails, tules, or thickets near fresh water.
Swainson's hawk *Buteo swainsoni*	CT	*Foraging:* Open desert, grassland, or cropland containing scattered, large trees or small groves. *Nesting:* Open riparian habitat, in scattered trees or small groves in sparsely vegetated flatlands. Usually found near water in the Central Valley.
Northern harrier *Circus cyaneus*	CSC	*Nesting:* Tall grasses and forbs in emergent wetland, along rivers or lakes, grasslands, grain fields, or on sagebrush flats several miles from water.
Western yellow-billed cuckoo *Coccyzus americanus occidentalis*	FC CE	*Nesting:* Extensive deciduous riparian thickets or forests with dense, low-level or understory foliage adjacent to slow-moving watercourses, backwaters, or seeps. Willow is almost always a dominant component of the vegetation. In the Sacramento Valley, also utilizes adjacent walnut orchards.
Yellow warbler *Dendroica petechia brewsteri*	CSC	*Nesting*: Low, open-canopy riparian deciduous woodlands with a heavy brush understory; sometimes in montane shrubbery in open conifer forests.
White-tailed kite *Elanus leucurus*	FP	*Foraging:* Undisturbed, open grasslands, meadows, farmlands, and emergent wetlands. *Nesting:* Large groves of dense, broad-leafed deciduous trees close to foraging areas.
Greater sandhill crane *Grus canadensis tabida*	CT FP	*Foraging:* Open grasslands, grain fields, and open wetlands. *Roosting:* In flocks standing in moist fields or in shallow water. *Nesting:* Open habitats with shallow lakes and fresh emergent wetlands.
Bald eagle *Haliaeetus leucocephalus*	CE FP	*Foraging:* Large bodies of water or free-flowing rivers with abundant fish and adjacent snags or other perches. *Nesting:* Large, old-growth trees or snags in remote, mixed stands near water.

Table 13-5. Sensitive Wildlife Species of Riparian and Perennial Wetland Communities Along the Sacramento River and in the Delta (contd.)

Species	Status[1]	Species
Yellow-breasted chat *Icteria virens*	CSC	*Foraging and nesting:* Riparian thickets of willow and other brushy thickets near streams or other watercourses.
California black rail *Laterallus jamaicensis coturniculus*	CT FP	*Foraging and nesting:* Tidal emergent wetlands dominated by pickleweed, in the high wetland zones near upper limit of tidal flooding, or in brackish marshes supporting bulrushes and pickleweed. In freshwater, usually found in bulrushes, cattails, and saltgrass adjacent to tidal sloughs.
Suisun song sparrow *Melospiza melodia maxillaries*	CSC	*Foraging:* The bare surface of tidally exposed mud among tules and along slough margins in brackish marshes. *Nesting:* Along edges of sloughs and bays supporting mixed stands of bulrush, cattail, and other emergent vegetation.
Bank swallow *Riparia riparia*	CT	*Foraging:* Open riparian areas, grassland, wetlands, water, and cropland. *Nesting:* Vertical banks and cliffs with fine-textured or sandy soils near streams, rivers, ponds, and lakes.
Yellow-headed blackbird *Xanthocephalus xanthocephalus*	CSC	*Foraging:* Fresh emergent wetland and sometimes along shorelines and in nearby open fields, preferably on moist ground. *Nesting:* Dense emergent wetland of cattails and tules, often along border of lake or pond.
Mammals		
Pallid bat *Antrozous pallidus*	CSC	*Foraging:* Relatively open oak woodlands, over water near riparian and upland forests and woodlands, and orchards and vineyards. *Roosting:* Rocky outcrops, cliffs, and crevices.
Western mastiff bat *Eumops perotis*	CSC	*Foraging:* Over water in broad, open areas near riparian and upland forests and woodlands. *Roosting:* Crevices in vertical cliffs, usually granite or consolidated sandstone, and in broken terrain with exposed rock faces.
Western red bat *Lasiurus blossevillii*	CSC	*Foraging:* Over water edges in open areas near riparian and upland forests and woodlands; orchards. *Roosting:* Trees along edges or in habitat mosaics in a variety of habitats and orchards.
Townsend's big-eared bat *Plecotus townsendii*	CSC	*Foraging:* Water edges in open areas near riparian and upland forests and woodlands. *Roosting:* Caves, mines, tunnels, buildings, or other human-made structures in woodlands. Prefers mesic habitats.
Salt-marsh harvest mouse *Reithrodontomys raviventris*	FE CE FP	Salt marsh dominated by pickleweed and salt grass. Generally requires nonsubmerged, salt-tolerant vegetation for escape during high tides.

Sources: CNDDB 2011

Note:

[1] Status definitions:
FC = federal candidate for listing
FE = Federally listed as endangered
FT = Federally listed as threatened
CE = California listed as endangered
CT = California listed as threatened
FP = California fully protected
CSC = California species of special concern

Sacramento–San Joaquin River Delta Many special-status species are known or are likely to occur in the Delta because of the presence of unique wetland habitats. Tidal marshes and emergent wetlands support several special-status wildlife species: California black rail (*Laterallus jamaicensis coturniculus*), California clapper rail (*Rallus longirostris obsoletus*), greater

sandhill crane (*Grus canadensis tabida*), salt marsh common yellowthroat (*Geothlypis trichas sinuosa*), salt marsh harvest mouse (*Reithrodontomys raviventris*), Suisun ornate shrew (*Sorex ornatus sinuosus*), Suisun song sparrow (*Melospiza melodia maxillaris*), and tricolored blackbird (*Agelaius tricolor*). The giant garter snake is known to inhabit sloughs, canals, and low-gradient streams and freshwater marshes in the Delta. Vernal pools and other freshwater seasonal wetlands support several special-status crustaceans, including vernal pool tadpole shrimp (*Lepidurus packardi*) and vernal pool fairy shrimp (*Branchinecta lynchi*). Although it is severely declining because of a dramatic shrinkage of suitable habitat, the valley elderberry longhorn beetle has been found in the Delta region on McCormack-Williamson and New Hope tracts (CNDDB 2007).

San Joaquin River Basin to the Delta The current wildlife habitat value of this area is somewhat limited by the predominance of agricultural lands, which support a relatively low diversity of wildlife species. Remnant native vegetation patches are likely to support a high diversity of wildlife species. More than 100 special-status wildlife and plants occur in the San Joaquin River region. Most of the special-status wildlife species are associated with grasslands, freshwater emergent wetlands, lakes, and rivers that occur on the valley floor. Many of the species have been listed by Federal and State wildlife agencies because of habitat losses associated with agricultural development and water projects.

CVP/SWP Service Areas

The CVP and SWP service areas are dominated by agricultural land and urban development, which can support many wildlife species, most of which are highly adapted to these disturbed environments. The conflict between urban growth and conservation of native habitat has resulted in the listing of a number of wildlife species that were threatened with extinction. The region also supports a variety of exotic species, some of which are detrimental to survival of native species.

The California condor (*Gymnogyps californianus*), lightfooted clapper rail (*Rallus longirostris levipes*), California least tern (*Sternula antillarum brownie*), least Bell's vireo (*Vireo bellii pusillus*), Belding's Savannah sparrow (*Passerculus sandwichensis beldingi*), southwestern willow flycatcher (*Empidonax traillii extimus*), California gnatcatcher (*Polioptila californica*), Mohave ground squirrel (*Spermophilus mohavensis*), and Morro Bay kangaroo rat (*Dipodomys heermanni morroensis*) are examples of species that have been listed as threatened or endangered under the ESA and that could occur within the CVP and SWP service areas.

13.1.3 Other Wildlife Resources

Shasta Lake and Vicinity

Critical Deer Range Critical black-tailed deer winter range for the McCloud Flats and Cow Creek herds is located in the Shasta Lake and vicinity portion of

the primary study area in all five arms of the lake. Critical fawning range also is found along the south-facing slopes of Little Sugarloaf Creek (DFG 1998). Critical deer winter range can include movement corridors, staging areas where deer congregate, and habitats with high-quality winter forage or other elements that help deer to survive the winter. Winter ranges are at lower elevations and are fewer in number than summer ranges, and thus are more vulnerable to human impact. Deer from different summer ranges may use common winter ranges when breeding typically occurs, which contributes to genetic diversity (DFG 1998).

USFWS Habitat Evaluation Procedure Analysis Reclamation is working with USFWS to complete a Habitat Evaluation Procedure analysis to help quantify potential project impacts and meet Fish and Wildlife Coordination Act consultation requirements. To date, Habitat Evaluation Procedure studies and analyses have been completed for part of the Shasta Lake and vicinity portion of the primary study area. Additional planning and coordination are ongoing.

Incidental Observations Reclamation has maintained a database of special-status wildlife species incidentally observed during all biological surveys performed since 2002. The incidental species observations include the foothill yellow-legged frog, northwestern pond turtle (*Actinemys marmorota marmorata*), osprey (*Pandion haliaetus*), yellow-breasted chat (*Icteria virens*), and yellow warbler (*Dendroica petechia brewsteri*) (Figures 13-3a through 13-3f).

Upper and Lower Sacramento River, Delta, and CVP/SWP Service Areas For the upper and lower Sacramento River, Delta, and CVP/SWP service areas, no other wildlife resources were evaluated in addition to wildlife habitats, wildlife, and special-status wildlife as described previously in Sections 13.1.1 and 13.1.2.

13.2 Regulatory Framework

Biological resources in California are protected and/or regulated by a variety of Federal and State laws and policies. Key regulatory and conservation planning issues applicable to the project and alternatives under consideration are discussed below.

13.2.1 Federal

Federal Endangered Species Act

Pursuant to the ESA, USFWS and NMFS have authority over projects that may result in "take" of a Federally listed species. In general, ESA Section 7 prohibits persons (including private parties) from "taking" listed endangered or threatened fish and wildlife species on private property, and from "taking" listed endangered or threatened plant species in areas under Federal jurisdiction or in

violation of State law (16 U.S. Code (USC) 1532, 50 Code of Federal Regulations (CFR) 17.3). Under the ESA, the definition of "take" is to "harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct" as part of an intentional or negligent act or omission. The term "harm" includes acts that result in death or injury to wildlife. Such acts may include significant habitat modification or degradation if it results in death or injury to wildlife by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering. Section 7(a) of the ESA, as amended, requires Federal agencies to evaluate their actions with respect to any species that is proposed for listing or is listed as endangered or threatened. Section 7(a)(2) requires Federal agencies to ensure that activities they authorize, fund, or carry out are not likely to jeopardize the continued existence of a listed species or to destroy or adversely modify its critical habitat. If a Federal action may affect a listed species or its critical habitat, the responsible Federal agency must enter into formal consultation with USFWS or NMFS, depending on the species.

As defined in the ESA, critical habitat is a specific geographic area that is essential for the conservation of a threatened or endangered species and that may require special management and protection. It may include an area that is not currently occupied by the species but that will be needed for its recovery. Critical habitats are designated to ensure that actions authorized by Federal agencies will not destroy or adversely modify critical habitat, thereby protecting areas necessary for the conservation of the species.

Fish and Wildlife Coordination Act

The Fish and Wildlife Coordination Act provides the basic authority for the involvement of USFWS in evaluating impacts on fish and wildlife from proposed water resource development projects. It requires that fish and wildlife resources receive consideration equal to that of other project features. It also requires Federal agencies that construct, license, or permit water resource development projects to first consult with USFWS (and NMFS in some instances) and State fish and wildlife agencies regarding the impacts of the proposed action on fish and wildlife resources and measures to mitigate these impacts.

Bald Eagle Protection Act

The bald eagle and golden eagle are Federally protected under the Bald Eagle Protection Act (16 USC 668–668c). It is illegal to take, possess, sell, purchase, barter, offer to sell or purchase or barter, transport, export, or import a live or dead bald or golden eagle or any eagle part, nest, or egg unless authorized by the Secretary of the Interior. The Bald Eagle Protection Act defines "take" as "pursue, shoot, shoot at, poison, wound, kill, capture, trap, collect, molest or disturb" (16 USC 668–668d). USFWS has defined "disturb" under the act as follows (72 Federal Register 31132–31140 (June 5, 2007)):

> *Disturb means to agitate or bother a bald or golden eagle to a degree that causes, or is likely to cause, based on the best scientific information available, (1) injury to an eagle; (2) a decrease in its productivity, by substantially interfering with normal breeding, feeding, or sheltering behavior; or (3) nest abandonment, by substantially interfering with normal breeding, feeding, or sheltering behavior.*

Active nest sites are also protected from disturbance during the breeding season, generally January through August.

USFWS has proposed new permit regulations to authorize the take of bald and golden eagles under the Bald Eagle Protection Act, generally where the take to be authorized is associated with otherwise lawful activities (72 Federal Register 31141–31155 (June 5, 2007). With the delisting of the bald eagle in 2007, this act is the primary law protecting bald eagles and golden eagles. Violators are subject to fines and/or imprisonment for up to 1 year.

Migratory Bird Treaty Act

Migratory birds are protected under the Migratory Bird Treaty Act (MBTA) of 1918 (16 USC 703–711). The MBTA makes it unlawful to take, possess, buy, sell, purchase, or barter any migratory bird listed in 50 CFR Part 10, including feathers or other parts, nests, eggs, or products, except as allowed by implementing regulations (50 CFR 21). This prohibition includes direct and indirect acts, although harassment and habitat modifications are not included unless they result in direct loss of birds, nests, or eggs. The current list of species protected by the MBTA, which can be found in Title 50, Section 10.13 of the CFR, includes several hundred species, essentially all native birds. Loss of nonnative species, such as house sparrows, European starlings, and rock pigeons, is not covered by this statute.

U.S. Forest Service Sensitive Species

The National Forest Management Act requires USFS to "provide for a diversity of plant and animal communities" (16 USC 1604(g)(3)(B)) as part of its multiple-use mandate. USFS must maintain "viable populations of existing native and desired nonnative species in the planning area" (36 CFR 219.19). The Sensitive Species program is designed to meet this mandate and to demonstrate USFS's commitment to maintaining biodiversity on National Forest System lands. The program is a proactive approach to conserving species to prevent a trend toward listing under the ESA and to ensure the continued existence of viable, well-distributed populations. A "Sensitive Species" is any species of plant or animal that has been recognized by the Regional Forester to need special management to prevent the species from becoming threatened or endangered.

Shasta-Trinity National Forest Land and Resource Management Plan

The *Shasta-Trinity National Forest Land and Resource Management Plan* contains forest goals, standards, and guidelines designed to guide the management of the Shasta-Trinity National Forest. The following goals, standards, and guidelines related to wildlife resource issues associated with the study area were excerpted from the *Shasta-Trinity National Forest Land and Resource Management Plan* (USFS 1995).

U.S. Forest Service Survey and Manage Standards and Guidelines

In 1994, BLM and USFS adopted standards and guidelines developed as part of the *Northwest Forest Plan*. These standards and guidelines address management of habitat for late-successional and old-growth forest related species within the range of the northern spotted owl. The *Northwest Forest Plan* was designed to address human and environmental needs served by the Federal forests of the western part of the Pacific Northwest and Northern California. The development of the *Northwest Forest Plan* was triggered in the early 1990s by the listing of the northern spotted owl and marbled murrelet as threatened under the ESA.

To mitigate potential impacts on plant and wildlife species that have the potential to occur within the range of the northern spotted owl, surveys are required for species thought to be rare, or whose status is unknown because of a lack of information. These species became known as the Survey and Manage species. The *Northwest Forest Plan* has gone through several revisions since its implementation in 1994, including the elimination of the Survey and Manage Mitigation Measure Standards and Guidelines in 2004. However, these guidelines were reinstated in January 2006 as the result of a court order.

Biological Diversity

Goals (LRMP, p. 4-4) Integrate multiple resource management on a landscape level to provide and maintain diversity and quality of habitats that support viable populations of plants, fish, and wildlife.

Standards and Guidelines (LRMP, p. 4-14)

- **Natural Openings** – Management of natural openings will be determined at the project level consistent with desired future conditions.

- **Snags** – Over time, provide the necessary number of replacement snags to meet density requirements as prescribed for each land allocation and/or management prescription. Live, green culls and trees exhibiting decadence and/or active wildlife use are preferred.

- **Hardwood** – Apply the following standards in existing hardwood types:

    - Manage hardwood types for sustainability.

- Conversion to conifers will only take place to meet desired future ecosystem conditions.
- Where hardwoods occur naturally within existing conifer types on suitable timber lands, manage for a desired future condition for hardwoods as identified during ecosystem analysis consistent with management prescription standards and guidelines. Retain groups of hardwoods over single trees.

Threatened, Endangered, and Sensitive Species (Plants and Animals)

Goals (LRMP, p. 4-5)

- Monitor and protect habitat for Federally listed Threatened and Endangered and candidate species. Assist in recovery efforts for Threatened and Endangered species. Cooperate with the State to meet objectives for State-listed species.

- Manage habitat for sensitive plants and animals in a manner that will prevent any species from becoming a candidate for Threatened and Endangered status.

Goals (LRMP, p. 4-6)

- Meet habitat or population objectives established for management indicators.

- Cooperate with Federal, State, and local agencies to maintain or improve wildlife habitat.

- Maintain natural wildlife species diversity by continuing to provide special habitat elements within Forest ecosystems.

Standards and Guidelines (LRMP, pp. 4-29 through 4-30)

- Minimize accidental electrocution of raptors by ensuring that newly constructed overhead power lines meet safe design standards.

- Consider transplants, introductions, or reintroductions of wildlife species only after ecosystem analysis and coordination with other agencies and the public.

- Manage habitat for Neotropical migrant birds to maintain viable population levels.

- Develop interpretation/view sites for wildlife viewing, photography, and study. Provide pamphlets, slide shows, and other educational material that enhance the watchable wildlife and other interpretive programs.

- Maintain and/or enhance habitat for Federally listed threatened and endangered or USFS sensitive species consistent with individual species recovery plans.

Management Guide for the Shasta and Trinity Units of the Whiskeytown-Shasta-Trinity National Recreation Area

The *Management Guide for the Whiskeytown-Shasta-Trinity National Recreation Area*, including the Shasta Unit of the National Recreation Area, contains management strategies intended to achieve or maintain a desired condition. These strategies take into account opportunities, management recommendations for specific projects, and mitigation measures needed to achieve specific goals. The following strategies relative to wildlife resource issues associated with the project site were excerpted from the management guide (USFS 1996).

Vegetation (Management Guide, pp. IV-18 through IV-19)

- Prescribed burning, fuel break construction, and other forms of vegetation manipulation will be used to reduce fire hazards and improve forest health.

- Recreation sites will be inventoried and vegetative management plans will be developed to ensure healthy and safe vegetation complexes are maintained over time.

- Bald eagle nest territories will be inventoried and vegetation management plans will be developed to ensure that suitable nest and perch trees are maintained over time.

- Chaparral and woodland habitat management will occur to meet wildlife objectives.

- Interpretive materials will address the need to conserve rare plant communities in accordance with the National Recreation Area Interpretive Plan.

- Diversity of native species will be emphasized. Eradication program will be implemented for nonnative, introduced species in areas where healthy, botanically diverse plant communities are necessary to meet ecosystem management objectives.

Wildlife (Management Guide, pp. IV-19 through IV-20)

- Management activities will assure population viability for all native and nonnative desirable species. Management to insure viability will occur within occupied habitat for bald eagle, peregrine falcon, northern spotted owl, northern goshawk, willow flycatcher, northwestern pond turtle, Pacific fisher, Shasta salamander, and

candidate species in accordance with species and/or territory management plans, Forest Orders, and appropriate laws and policy.

- Surveys will continue within potential suitable habitats to determine occupancy status for Threatened, Endangered, sensitive, and candidate species.

- Cooperation will continue with the DFG and the USFWS regarding habitat management of wildlife species inhabiting the National Recreation Area. Consultation with USFWS will continue regarding habitat management for threatened and endangered species.

Section 404 of the Clean Water Act

USACE regulates discharges of dredged or fill materials into waters of the United States under Section 404 of the Clean Water Act. Waters of the United States include lakes, rivers, streams, and relatively permanent tributaries and adjacent wetlands. Wetlands are defined under Section 404 as areas that are inundated or saturated by surface water or groundwater at a frequency and duration sufficient to support (and that do support under normal circumstances) a prevalence of vegetation typically adapted for life in saturated soil conditions. Activities that require a permit under Section 404 include, but are not limited to, placing fill or riprap, grading, mechanized land clearing, and dredging. Any activity that results in the deposit of dredged or fill material below the ordinary high-water mark of waters of the United States or within a jurisdictional wetland usually requires a Section 404 permit, even if the area is dry at the time the activity takes place.

Executive Order 11312: Invasive Species

Executive Order 13112 directs Federal agencies to use relevant programs and authorities to do all of the following:

- Prevent the introduction of invasive species

- Detect and respond rapidly to and control populations of such species in a cost-effective and environmentally sound manner

- Monitor invasive species populations accurately and reliably

- Provide for restoration of native species and habitat conditions in ecosystems that have been invaded

- Conduct research on invasive species and develop technologies to prevent introduction and provide for environmentally sound control of invasive species

- Promote public education on invasive species and the means to address them

- Refrain from authorizing, funding, or carrying out actions that it believes are likely to cause or promote the introduction or spread of invasive species in the United States or elsewhere unless, pursuant to guidelines that it has prescribed, the agency has determined and made public its determination that the benefits of such actions clearly outweigh the potential harm caused by invasive species; and that all feasible and prudent measures to minimize risk of harm will be taken in conjunction with the actions.

Executive Order 11312 established a national Invasive Species Council made up of Federal agencies and departments and a supporting Invasive Species Advisory Committee composed of State, local, and private entities. The Invasive Species Council and Advisory Committee oversee and facilitate implementation of the executive order, including preparation of a national invasive species management plan.

Executive Order 11990: Protection of Wetlands

Executive Order 11990 established the protection of wetlands and riparian systems as the official policy of the Federal government. It requires all Federal agencies to consider wetland protection as an important part of their policies and take action to minimize the destruction, loss, or degradation of wetlands, and to preserve and enhance the natural and beneficial values of wetlands.

Executive Order 13186: Migratory Birds

Executive Order 13186 directs executive departments and agencies to take certain actions to further implement the MBTA. It requires that each Federal agency taking actions that have, or are likely to have, a measurable negative effect on migratory bird populations develop and implement a memorandum of understanding with USFWS that shall promote the conservation of migratory bird populations.

Executive Order 13443: Facilitation of Hunting Heritage and Wildlife Conservation

Executive Order 13443 directs Federal agencies that have programs and activities that have a measurable effect on public land management, outdoor recreation, and wildlife management, including the U.S. Department of the Interior and the U.S. Department of Agriculture, to facilitate the expansion and enhancement of hunting opportunities and the management of game species and their habitat.

13.2.2 State

California Endangered Species Act

Under the CESA, DFG has the responsibility for maintaining a list of endangered and threatened species (California Fish and Game Code, Section 2070). DFG also maintains a list of "candidate species," which are species for which DFG has issued a formal notice that they are under review for addition to

the list of endangered or threatened species. In addition, DFG maintains lists of "species of special concern," which serve as species "watch lists." Pursuant to the requirements of CESA, an agency reviewing a proposed project within its jurisdiction must determine whether any State-listed endangered or threatened species may be present in the project study area and, if so, whether the proposed project would have a potentially significant impact on any of these species. In addition, DFG encourages informal consultation on any proposed project that may affect a species that is a candidate for state listing.

Project-related impacts on species listed as endangered or threatened under the CESA would be considered significant. State-listed species are fully protected under the mandates of the CESA. "Take" of protected species incidental to otherwise lawful management activities may be authorized under Section 2081 of the California Fish and Game Code. Under the CESA, "take" is defined as an activity that would directly or indirectly kill an individual of a species, but the definition does not include "harm" or "harass," as the Federal act does. As a result, the threshold for take under the CESA is higher than that under the ESA.

Authorization from DFG would be in the form of an incidental take permit or as a consistency determination (Section 2080.1(a) of the Fish and Game Code). Section 2080.1(a) of the Fish and Game Code authorizes DFG to accept a Federal biological opinion (BO) as the take authorization for a state-listed species when a species is listed under both the ESA and the CESA.

Sections 3503 and 3513 of the California Fish and Game Code—Protection of Birds of Prey

Under Section 3503 of the California Fish and Game Code, it is unlawful to take, possess, or needlessly destroy the nest or eggs of any bird. Section 3503.5 specifically states that it is unlawful to take, possess, or destroy any raptors (birds in the order of Falconiformes or Strigiformes (birds of prey)—i.e., eagles, hawks, owls, and falcons), including their nests or eggs. Section 3513 provides for adoption of the MBTA's provisions. It states that it is unlawful to take or possess any migratory nongame bird as designated in the MBTA or any part of such migratory nongame bird. These State codes offer no statutory or regulatory mechanism for obtaining an incidental take permit for the loss of nongame, migratory birds. Typical violations include destruction of active raptor nests resulting from removal of vegetation in which the nests are located. Violation of Sections 3503.5 and 3513 could also include disturbance of nesting pairs that results in failure of an active raptor nest.

Fully Protected Species under the Fish and Game Code

Protection of fully protected species is described in four sections of the Fish and Game Code (Sections 3511, 4700, 5050, and 5515) that list 37 fully protected species. These statutes prohibit take or possession at any time of fully protected species. DFG is unable to authorize incidental take of fully protected species when activities are proposed in areas inhabited by those species. DFG has

informed non-Federal agencies and private parties that they must avoid take of any fully protected species in carrying out projects.

Section 1602 of the California Fish and Game Code—Streambed Alteration

Diversions, obstructions, or changes to the natural flow or bed, channel, or bank of any river, stream, or lake in California that supports wildlife resources are subject to regulation by DFG, pursuant to Section 1602 of the California Fish and Game Code. The regulatory definition of a stream is a body of water that flows at least periodically or intermittently through a bed or channel having banks and supports wildlife, fish, or other aquatic life. This includes watercourses that have a surface or subsurface flow that supports or has supported riparian vegetation. DFG's jurisdiction within altered or artificial waterways is based on the value of those waterways to fish and wildlife. A DFG streambed alteration agreement must be obtained for a project that would result in an impact on a river, stream, or lake.

Section 401 Water Quality Certification/Porter-Cologne Water Quality Control Act

Under Section 401 of the Clean Water Act, an applicant for a Section 404 permit must obtain a certificate from the appropriate State agency stating that the intended dredging or filling activity is consistent with the State's water quality standards and criteria. In California, the authority to grant water quality certification is delegated by the State Water Resources Control Board to the nine Regional Water Quality Control Boards (RWQCB). Each of the RWQCBs must prepare and periodically update basin plans for water quality control in accordance with the Porter-Cologne Water Quality Control Act. Each basin plan sets forth water quality standards for surface water and groundwater, as well as actions to control nonpoint and point sources of pollution to achieve and maintain these standards. Basin plans offer an opportunity to protect wetlands through the establishment of water quality objectives. The RWQCB's jurisdiction includes Federally protected waters as well as areas that meet the definition of "waters of the state." A water of the State is defined as any surface water or groundwater, including saline waters, within the boundaries of California. The RWQCB has the discretion to take jurisdiction over areas not Federally protected under Section 401, provided that those areas meet the definition of waters of the State. Mitigation requiring no net loss of wetlands functions and values of waters of the State is typically required by the RWQCB.

California Department of Fish and Game Species Designations

DFG maintains an informal list of species called "species of special concern." These are broadly defined as plant and wildlife species that are of concern to DFG because of population declines and restricted distributions, and/or because they are associated with habitats that are declining in California. These species are inventoried in the CNDDB regardless of their legal status. Impacts on species of special concern may be considered significant.

13.2.3 Regional and Local

Shasta, Tehama, Glenn, Sutter, Sacramento, and Yolo counties and the cities of Redding, Colusa, and Sacramento have established codes and policies that address protection of natural resources, including vegetation, sensitive species, and trees, and are applicable to the project.

Shasta County's general plan emphasizes that the maintenance and enhancement of quality fish and wildlife habitat is critical to the recreation and tourism industry, and acknowledges that any adverse and prolonged decline of these resources could result in negative impacts on an otherwise vibrant industry. The general plan identifies efforts to protect and restore these habitats to sustain the long-term viability of the tourism and recreation industry (Shasta County 2004).

The City of Redding's general plan strives to strike a balance between development and conservation by implementing several measures such as creek-corridor protection, sensitive hillside development, habitat protection, and protection of prominent ridge lines that provide a backdrop to the city (City of Redding 2000).

Tehama County's general plan update provides an overarching guide to future development and establishes goals, policies, and implementation measures designed to address potential changes in county land use and development. The general plan identifies the importance of retaining agriculture as one of the primary uses of land in Tehama County (Tehama County 2009).

Glenn County's general plan provides a comprehensive plan for growth and development in Glenn County for the next 20 years (2007–2027). This plan recognizes that public lands purchased for wildlife preservation generate economic activity as scientists and members of the public come to view and study remnant ecosystems (Glenn County 1993).

The City of Colusa's general plan seeks to promote its natural resources through increased awareness and improved public access (City of Colusa 2007).

Sutter County's general plan contains policies that generally address preservation of natural vegetation, including wetlands. It requires that new development mitigate the loss of Federally protected wetlands to achieve "no net loss," but it does not include any other specific requirements (Sutter County 2010).

Sacramento County's general plan contains policies that promote protection of marsh and riparian areas, including specification of setbacks and "no net loss" of riparian woodland or marsh acreage (Sacramento County 1993). It also addresses the need to conserve vernal pools and ephemeral wetlands to ensure no net loss of vernal pool acreage. Several policies specifically promote protection of native oak trees, and, in some areas of the county, seek to ensure

that there is no net loss of canopy area. The general plan for the County of Sacramento is currently under revision.

Chapter 12.56, "Trees Generally," of the City of Sacramento Municipal Code addresses the protection of trees within the city boundaries, including general protection of all trees on city property and specific protection of heritage trees (City of Sacramento 2011).

Yolo County's general plan aims to provide an active and productive buffer of farmland and open space separating the Bay Area from Sacramento, and integrating green spaces into its communities (Yolo County 2009).

13.2.4 Federal, State, and Local Programs and Projects

California Bay-Delta Authority

The California Bay-Delta Authority was established as a State agency in 2003 to oversee implementation of CALFED for the 25 Federal and State agencies working cooperatively to improve the quality and reliability of California's water supplies while restoring the Bay-Delta ecosystem. The CALFED Ecosystem Restoration Program has provided a funding source for projects that include those involving acquisition of lands within the Sacramento River Conservation Area, initial baseline monitoring and preliminary restoration planning, and preparation of long-term habitat restoration management and monitoring plans.

Cantara Trustee Council

The Cantara Trustee Council administers a grant program that has provided funding for numerous environmental restoration projects in the primary study area, including programs in the Fall River watershed, Sulphur Creek, the upper Sacramento River, Middle Creek, lower Clear Creek, Battle Creek, Salt Creek, and Olney Creek. The Cantara Trustee Council is a potential local sponsor for future restoration actions in the primary study area. The Cantara Trustee Council includes representatives from DFG, USFWS, the Central Valley RWQCB, the California Sportfishing Protection Alliance, and the Shasta Cascade Wonderland Association.

Resource Conservation Districts

There are numerous resource conservation districts (RCD) within the study area. Once known as soil conservation districts, RCDs were established under California law with a primary purpose to implement local conservation measures. Although RCDs are locally governed agencies with locally appointed, independent boards of directors, they often have close ties to county agencies and the U.S. National Resources Conservation Service. RCDs are empowered to conserve resources within their districts by implementing projects on public and private lands and to educate landowners and the public about resource conservation. They are often involved in the formation and coordination of watershed working groups and other conservation alliances. In

the Shasta Lake and upper Sacramento River vicinity, districts include the Western Shasta County RCD and the Tehama County RCD. To the east are the Fall River and Pit River RCDs, and to the west and north are the Trinity County and Shasta Valley RCDs.

Riparian Habitat Joint Venture

The Riparian Habitat Joint Venture (RHJV) was initiated in 1994 and includes signatories from 18 Federal, State, and private agencies. The RHJV promotes conservation and the restoration of riparian habitat to support native bird population through three goals:

- Promote an understanding of the issues affecting riparian habitat through data collection and analysis.
- Double riparian habitat in California by funding and promoting on-the-ground conservation projects.
- Guide land managers and organizations to prioritize conservation actions.

RHJV conservation and action plans are documented in *The Riparian Bird Conservation Plan* (RHJV 2004). The conservation plan targets 14 "indicator" species of riparian-associated birds and provides recommendations for habitat protection, restoration, management, monitoring, and policy. The report notes habitat loss and degradation as one of the most important factors causing the decline of riparian birds in California. The RHJV has participated in monitoring efforts within the Sacramento National Wildlife Refuge Complex and other conservation areas. The RHJV's conservation plan identifies lower Clear Creek as a prime breeding area for yellow warblers and song sparrows, advocating a continuous riparian corridor along lower Clear Creek.

Sacramento River Advisory Council

In 1986 the California Legislature passed Senate Bill 1086, which called for a management plan for the Sacramento River and its tributaries to protect, restore, and enhance fisheries and riparian habitat in an area stretching from the confluence of the Sacramento River with the Feather River and continuing northward to Keswick Dam, about 4 miles north of Redding. The law established an advisory council that included representatives of Federal and State agencies, county supervisors, and representatives of landowners, water contractors, commercial and sport fisheries, and general wildlife and conservation interests. Responsibilities of the advisory council included development of the *Sacramento River Conservation Area Forum Handbook* to guide management of riparian habitat and agricultural uses along the river (Resources Agency 2003). This action also resulted in formation in May 2000 of the Sacramento River Conservation Area Forum, a nonprofit, public benefit corporation with a board of directors that includes private landowners and public interest representatives from a seven-county area, an appointee of the

California Resources Agency, and ex-officio members from six Federal and State resource agencies. The work of the organization is generally focused on planning actions and river management within the Sacramento River Conservation Area planning area.

Sacramento River Conservation Area Program

Senate Bill 1086 called for a management plan for the Sacramento River and its tributaries to protect, restore, and enhance both fisheries and riparian habitat. The Sacramento River Conservation Area Program has an overall goal of preserving remaining riparian habitat and reestablishing a continuous riparian ecosystem along the Sacramento River between Redding and Chico, and reestablishing riparian vegetation along the river from Chico to Verona. The program is to be accomplished through an incentive-based, voluntary river management plan. The *Upper Sacramento River Fisheries and Riparian Habitat Management Plan* (Resources Agency 1989), identifies specific actions to help restore the Sacramento River fishery and riparian habitat between the Feather River and Keswick Dam. The *Sacramento River Conservation Area Forum Handbook* (Resources Agency 2003) is a guide to implementing the program. The Keswick Dam to Red Bluff portion of the conservation area includes areas within the 100-year floodplain, existing riparian bottomlands, and areas of contiguous valley oak woodland, totaling approximately 22,000 acres. The 1989 fisheries restoration plan recommended several actions specific to the study area:

- Fish passage improvements at RBDD (recently completed)
- Modification of the Spring Creek Tunnel intake for temperature control (completed)
- Spawning gravel replacement program (ongoing)
- Development of side-channel spawning areas, such as those at Turtle Bay in Redding (ongoing)
- Structural modifications to the Anderson-Cottonwood Irrigation District Dam to eliminate short-term flow fluctuations (completed)
- Maintaining instream flows through coordinated operation of water facilities (ongoing)
- Improvements at the Coleman National Fish Hatchery (partially complete)
- Measures to reduce acute toxicity caused by acid mine drainage and heavy metals (ongoing)
- Various fisheries improvements on Clear Creek (partially complete)

- Flow increases, fish screens, and revised gravel removal practices on Battle Creek (beginning summer 2006, ongoing monitoring)

- Control of gravel mining, improvements of spawning areas, improvements of land management practices in the watershed, and protection and restoration of riparian vegetation along Cottonwood Creek (ongoing)

Sacramento River National Wildlife Refuge

The Sacramento River National Wildlife Refuge (SRNWR) is composed of many units between the cities of Red Bluff and Princeton. The SRNWR along the middle Sacramento River is part of the Sacramento National Wildlife Refuge Complex, consisting of five refuges and three wildlife management areas within the Sacramento Valley. Reaches and subreaches of the river are delineated based generally on transitions in fluvial geomorphic riverine conditions, although county boundaries were considered as well. The middle Sacramento River region between Red Bluff and Colusa includes three units within the Chico Landing Subreach that contain restoration project sites addressed in the *Sacramento River–Chico Landing Subreach Habitat Restoration Draft Environmental Impact Report* (CBDA 2005). In addition, three areas proposed for restoration in this area occur within the larger SRNWR units that were evaluated in the *Environmental Assessment for Proposed Restoration Activities on the Sacramento River National Wildlife Refuge* (USFWS 2001; CBDA 2005).

In June 2005, USFWS issued the *Sacramento River National Wildlife Refuge Final Comprehensive Conservation Plan and Environmental Assessment and Finding of No Significant Impact* (USFWS 2005b) to serve as an integrated management plan for land that it acquires and manages for inclusion in the SRNWR. The SRNWR final comprehensive conservation plan includes goals, objectives, and strategies to guide management of lands within the SRNWR. It also includes assessments of and establishes parameters for "compatible uses," which are uses that are considered compatible with the primary purposes for which the area was established. Riparian habitat restoration projects are being implemented under cooperative agreements between USFWS and other entities such as The Nature Conservancy (TNC) in accordance with the SRNWR final comprehensive conservation plan.

Sacramento River Wildlife Area

The Sacramento River Wildlife Area is managed by DFG and consists of approximately 3,770 acres of important riparian habitat located along a 70-mile reach of the lower Sacramento River. These lands are managed to protect and enhance habitat for wildlife species, and to provide the public with compatible, wildlife-related recreational uses. This management is guided by the *Sacramento River Comprehensive Management Plan* prepared in 2004.

Sacramento River Preservation Trust

The Sacramento River Preservation Trust is a private, nonprofit organization active in environmental education and advocacy to preserve the natural environmental values of the Sacramento River. The trust has participated in various conservation and land acquisition projects, including securing lands for the SRNWR. The group is pursuing designation of a portion of the Sacramento River between Redding and Red Bluff as a national conservation area.

Sacramento River Watershed Program

The Sacramento River Watershed Program is an effort to bring stakeholders together to share information and work together to address water quality and other water-related issues within the Sacramento River watershed. The group is funded congressionally through the U.S. Environmental Protection Agency. The program's primary goal is "to ensure that current and potential uses of Sacramento River watershed resources are sustained, restored, and where possible, enhanced while promoting the long-term social and economic vitality of the region." The Sacramento River Watershed Program manages grants for the Sacramento River Toxic Pollutants Control Program; performs extensive water quality monitoring, data collection, and data management for the watershed; and is instrumental in the study and monitoring of toxic pollutants. Although the program does not implement restoration projects, it is a potential partner for coordinating research and monitoring through consensus-based collaborative partnerships and promoting mutual education among the stakeholders of the Sacramento River watershed.

Sacramento Watersheds Action Group

The Sacramento Watersheds Action Group is a nonprofit corporation that secures funding for, designs, and implements projects that provide watershed restoration, streambank and slope stabilization, erosion control, watershed analysis, and road removal. The Sacramento Watersheds Action Group has successfully worked with local groups, agencies, and organizations to fund and complete restoration projects on the Sacramento River and tributaries downstream from Keswick Dam. Their projects include development of the *Sulphur Creek Watershed Analysis and Action Plan*, the Whiskeytown Reservoir Shoreline Erosion Control Project, the Sulphur Creek Crossing Restoration Project, and the Lower Sulphur Creek Realignment and Riparian Habitat Enhancement Project. The Sacramento Watersheds Action Group is a potential local sponsor for watershed restoration actions in the study area.

Shasta Land Trust

The Shasta Land Trust is a regional, nonprofit organization dedicated to conserving open space, wildlife habitat, and agricultural land. This organization works with public agencies and private landowners and is funded primarily through membership dues and donations. It employs various voluntary programs to protect and conserve valuable lands using conservation easements, land donations, and property acquisitions. The trust is a potential local partner for restoration activities in the Shasta Dam to Red Bluff area.

The Nature Conservancy

TNC is a private, nonprofit organization involved in environmental restoration and conservation throughout the United States and the world. TNC approaches environmental restoration primarily through strategic land acquisition from willing sellers and obtaining conservation easements. Some of the lands are retained by TNC for active restoration, research, or monitoring activities, while others are turned over to government agencies such as USFWS or DFG for long-term management. Lower in the Sacramento River basin, TNC has been instrumental in acquiring and restoring lands in the SRNWR and managing several properties along the Sacramento River. It also has pursued conservation easements on various properties at tributary confluences, including Cottonwood and Battle creeks.

The Trust for Public Land

The Trust for Public Land is a national, nonprofit organization involved in preserving lands with natural, historic, cultural, or recreational value, primarily through conservation real estate. This organization's Western Rivers Program has been involved in conservation efforts along the Sacramento River between Redding and Red Bluff (BLM's Sacramento River Bend Management Area), Battle Creek, Paynes Creek, Inks Creek, and Fenwood Ranch in Shasta County. The group promotes public ownership of conservation lands to ensure public access and enjoyment.

13.3 Environmental Consequences and Mitigation Measures

This section describes the environmental evaluation methods, assumptions, and specific criteria used to determine significance for each resource area, and discusses impacts and proposed mitigation measures. This impacts assessment evaluates the project's compliance with requirements outlined in the *Wildlife Resources Technical Report*. Mitigation measures are presented (as needed) to reduce impacts to a less than significant level.

13.3.1 Methods and Assumptions

The following sections describe the methods, processes, procedures, and assumptions used to formulate and conduct the environmental impact analysis.

This analysis of impacts on wildlife resources resulting from implementation of the project alternatives under consideration is based on review of existing documentation that addresses biological resources in or near the primary and extended study areas and on geographic information systems analysis.

Where specific habitat data were not available, suitable habitat data defined by California Wildlife Habitat Relationships (CWHR) were used to determine impacts.

The following assumptions about activity at Shasta Lake and vicinity have been made for the purposes of the impact analysis:

- Activity areas (construction areas for infrastructure and relocation areas) would be completely cleared.
- Cutting/clearing of vegetation would be conducted from late summer through late winter, to the extent feasible.
- Removal of cleared material could occur during the typical breeding season for birds in Shasta County.
- Removal of cleared vegetation would be done using conventional yarding systems and aerial (helicopter) systems.
- With the exception of Arbuckle Flat, no vegetation would be removed along the Pit Arm upstream from Painter Creek.
- No blasting would be required for the mining of materials within the current boundary of Shasta Lake.

For the upper Sacramento River and extended study area, the project has the potential to affect common wildlife and special-status wildlife species through the following impact mechanisms:

- Change in inundated width of the river from spring through fall
- Reduced frequency, duration, or magnitude of intermediate to large flows
- Altered geomorphic processes (e.g., meander, channel avulsion) along rivers
- Altered availability of groundwater
- Altered vegetative communities within the river corridor
- Temporary or permanent disturbance of habitat at Reading Island and gravel augmentation sites
- Mortality of individuals of special-status species at Reading Island and gravel augmentation sites

Potential effects on the upper Sacramento River and extended study area resulting from these impact mechanisms were assessed for common wildlife and special-status wildlife species associated with riparian and wetland habitats located between Shasta Dam and RBDD and within the extended study area that may be affected by altered hydrologic flows. It is assumed that construction-

related activities, their effects, and mitigation were considered in the "Shasta Lake and Vicinity" section. The assessment in this section was based in part on the potential effects on vegetation communities provided in Chapter 12, "Botanical Resources and Wetlands."

13.3.2 Criteria for Determining Significance of Effects

Significance criteria used to analyze the potential impacts of the project on wildlife resources include factual and scientific information and regulatory standards of county, State, and Federal agencies, including the State CEQA Guidelines. These criteria have been developed to establish thresholds to determine the significance of impacts pursuant to CEQA (Section 15064.7) and should not be confused with a "take" or adverse effect under the ESA. An environmental document prepared to comply with NEPA must consider the context and intensity of the environmental effects that would be caused by, or result from, the proposed action. Under NEPA, the significance of an effect is used solely to determine whether an environmental impact statement must be prepared. An EIS must identify reasonable means to "mitigate adverse environmental impacts" (40 E 1502.16(h)). An environmental document prepared to comply with CEQA must identify the potentially significant environmental effects of a proposed project. A "[s]ignificant effect on the environment" means a substantial, or potentially substantial, adverse change in any of the physical conditions within the area affected by the project" (State CEQA Guidelines, Section 15382). CEQA also requires that the environmental document propose feasible measures to avoid or substantially reduce significant environmental effects (State CEQA Guidelines, Section 15126.4(a)).

The following significance criteria were developed based on guidance provided by the State CEQA Guidelines, and consider the context and intensity of the environmental effects as required under NEPA. Impacts of an alternative on wildlife would be significant if project implementation would do any of the following:

- Result in mortality of State-listed or Federally listed wildlife species, or species that are candidates for listing or proposed for listing
- Have the potential to substantially reduce the habitat of any wildlife species, including those that are listed as endangered or threatened or are candidates or proposed for endangered or threatened status
- Have the potential to cause a wildlife population to drop below self-sustaining levels
- Have a substantial adverse effect, either directly or through habitat modifications, on any non-special-status wildlife species
- Substantially adversely affect, either directly or through habitat modifications, any wildlife species identified as a candidate, sensitive,

or special-status species in local or regional plans, policies, or regulations or by DFG or USFWS

- Interfere substantially with the movement of any native resident or migratory wildlife species or with established native resident or migratory wildlife corridors, or impede the use of native wildlife nursery sites

- Conflict with or violate the provisions of an adopted habitat conservation plan, natural community conservation plan, or other approved local, regional, State, or Federal habitat conservation plan relating to the protection of wildlife species

- Conflict with any State or local policies or ordinances protecting biological resources, such as a tree preservation policy or ordinance

- Substantially reduce the habitat of a wildlife species, cause a wildlife species to drop below self-sustaining levels, threaten to eliminate an animal community, or substantially reduce the number or restrict the range of an endangered, rare, or threatened species

Significance statements are relative to both existing conditions (2005) and future conditions (2030) unless stated otherwise. Impact conclusions are made using the significance criteria described above and include consideration of the "context" of the action and the "intensity" (severity) of its effects in accordance with NEPA guidance (40 CFR 1508.27).

13.3.3 Topics Eliminated from Further Consideration

No topics related to wildlife resources that are included in the significance criteria listed above were eliminated from further consideration. All relevant topics are analyzed below.

13.3.4 Direct and Indirect Effects

This section identifies how wildlife could be affected by the project. The project could affect wildlife by doing any of the following:

- Causing construction-related effects at Shasta Dam and around Shasta Lake

- Altering flow regimes downstream from Shasta Lake and downstream from other reservoirs with altered operations

- Increasing water supply reliability, which in turn could contribute to human population growth or changes in agricultural land uses in the CVP and SWP service areas

By altering storage and reservoir operations, the project would change flow regimes in downstream waterways. In turn, these alterations to the flow regime could affect wildlife, particularly by affecting their riparian and wetland habitats along several waterways.

No-Action Alternative

Under the No-Action Alternative, Reclamation would not pursue an action to enlarge Shasta Dam. No new facilities would be constructed at Shasta Dam and no facilities around Shasta Lake would be relocated to accommodate higher lake levels; thus, there would be no construction-related impacts. In addition, releases from Shasta Dam or other CVP reservoirs would not change as a result of a Shasta Dam enlargement. Reasonably foreseeable projects identified elsewhere in this PDEIS, however, would occur and have effects on wildlife but those effects are unknown, largely speculative for many such projects, and therefore are not addressed in detail below.

Shasta Lake and Vicinity

Impact Wild-1 (No-Action): Take and Loss of Habitat for the Shasta Salamander No direct take of the Shasta salamander or loss of its habitat would occur because the project would not be constructed. No impact would occur. Mitigation is not required for the No-Action Alternative.

Impact Wild-2 (No-Action): Impacts on the Foothill Yellow-Legged Frog and Tailed Frog and Their Habitat No impacts or loss of habitat for the foothill yellow-legged frog or tailed frog would occur because the project would not be constructed. No impact would occur. Mitigation is not required for the No-Action Alternative.

Impact Wild-3 (No-Action): Impacts on the Northwestern Pond Turtle and Its Habitat No direct take or decrease of habitat quality for the northwestern pond turtle would occur because the project would not be constructed. No impact would occur. Mitigation is not required for the No-Action Alternative.

Impact Wild-4 (No-Action): Impacts on the American Peregrine Falcon No impact on the American peregrine falcon would occur because the project would not be constructed. No impact would occur. Mitigation is not required for the No-Action Alternative.

Impact Wild-5 (No-Action): Take and Loss of Habitat for the Bald Eagle No take of loss of habitat for the bald eagle would occur because the project would not be constructed. No impact would occur. Mitigation is not required for the No-Action Alternative.

Impact Wild-6 (No-Action): Take and Loss of Nesting and Foraging Habitat for the Northern Spotted Owl No take or loss of nesting and foraging habitat for the northern spotted owl would occur because the project would not be

constructed. No impact would occur. Mitigation is not required for the No-Action Alternative.

Impact Wild-7 (No-Action): Impacts on the Purple Martin and Its Nesting Habitat No impacts or loss of nesting habitat for the purple martin would occur because the project would not be constructed. No impact would occur. Mitigation for this impact is not needed, and thus not proposed.

Impact Wild-8 (No-Action): Impacts on the Willow Flycatcher, Vaux's Swift, Yellow Warbler, and Yellow-Breasted Chat and Their Foraging and Nesting Habitat No impacts or loss of foraging and nesting habitat for the willow flycatcher, Vaux's swift, yellow warbler, and yellow-breasted chat would occur because the project would not be constructed. No impact would occur. Mitigation is not required for the No-Action Alternative.

Impact Wild-9 (No-Action): Impacts on the Long-Eared Owl, Northern Goshawk, Cooper's Hawk, Great Blue Heron, and Osprey and Their Foraging and Nesting Habitat No impact or loss of foraging and nesting habitat for the long-eared owl, northern goshawk, Cooper's hawk, great blue heron, and osprey would occur because the project would not be implemented. No impact would occur. Mitigation is not required for the No-Action Alternative.

Impact Wild-10 (No-Action): Take and Loss of Habitat for the Pacific Fisher No take or loss of habitat for the Pacific fisher would occur because the project would not be implemented. No impact would occur. Mitigation is not required for the No-Action Alternative.

Impact Wild-11 (No-Action): Impacts on Special-Status Bats (Pallid Bat, Spotted Bat, Western Red Bat, Western Mastiff Bat, Townsend's Big-Eared Bat, Long-Eared Myotis, and Yuma Myotis), the American Marten, and Ringtail and Their Habitat No impact or loss of habitat for special-status bats (the pallid bat, spotted bat, western red bat, western mastiff bat, Townsend's big-eared bat, long-eared myotis, and Yuma myotis), the American marten, and ringtail would occur because the project would not be implemented. No impact would occur. Mitigation is not required for the No-Action Alternative.

Impact Wild-12 (No-Action): Impacts on Special-Status Terrestrial Mollusks (Shasta Sideband, Wintu Sideband, Shasta Chaparral, and Shasta Hesperian) and Their Habitat No impact or loss of habitat for special-status terrestrial mollusks (Shasta sideband, Wintu sideband, Shasta chaparral, and Shasta hesperian) would occur because the project would not be implemented. No impact would occur. Mitigation is not required for the No-Action Alternative.

Impact Wild-13 (No-Action): Permanent Loss of Wildlife Habitat No permanent loss of habitat would occur because the project would not be implemented. No impact would occur. Mitigation is not required for the No-Action Alternative.

Impact Wild-14 (No-Action): Impacts on Other Birds of Prey (i.e., red-tailed hawk and red-shouldered hawk) and Migratory Bird Species(i.e., American robin, Anna's hummingbird) and their Foraging and Nesting Habitat No impact or loss of foraging and nesting habitat for other birds of prey and migratory bird species would occur because the project would not be implemented. No impact would occur. Mitigation is not required for the No-Action Alternative.

Impact Wild-15 (No-Action): Loss of Critical Deer Winter and Fawning Range No loss of deer winter and fawning range would occur because the project would not be implemented. No impact would occur. Mitigation is not required for the No-Action Alternative.

Impact Wild-16 (No-Action): Take and Loss of California Red-Legged Frog No loss of California red-legged frog habitat would occur because the project would not be implemented. No impact would occur. Mitigation is not required for the No-Action Alternative.

Upper Sacramento River (Shasta Dam to Red Bluff)

Impact Wild-17 (No-Action): Impacts on Riparian-Associated Special-Status Wildlife Resulting from Modifications to the Existing Flow Regime in the Primary Study Area Effects on riparian vegetation in the upper Sacramento River area from continuing the existing dam operation under the No-Action Alternative would not have a substantial adverse effect on special-status wildlife. This impact would be less than significant.

Implementing the No-Action Alternative would not result in changes to existing facilities or reservoir operations. The No-Action Alternative would continue to alter the structure and species composition of riparian vegetation resulting from continued operation of the existing Shasta Dam, as described in Chapter 12, "Botanical Resources and Wetlands." Operation of the dam has decreased early successional riparian communities and increased the extent of mid-successional riparian communities. Although early and mid-sucessional riparian vegetation provides different habitat values and some shifts in species use may occur, implementing the No-Action Alternative would not have a substantial adverse effect on special-status wildlife associated with riparian vegetation, nor would it be likely to cause a population to be eliminated. Therefore, this impact would be less than significant. Mitigation is not required for the No-Action Alternative.

Impact Wild-18 (No-Action): Impacts on Bank Swallow in the Primary Study Area Resulting from Modifications of Geomorphic Processes Future conditions for bank swallows are not expected to differ substantially from existing conditions because of the restoration projects being implemented on the Sacramento River. This impact would be less than significant.

Dam operations under the No-Action Alternative would continue to alter geomorphic processes. Loss of eroding banks during winter flood flows could

limit the formation of suitable nesting habitat for bank swallow. However, future conditions for bank swallows are not expected to differ substantially from existing conditions because of the restoration projects being implemented on the Sacramento River. Therefore, this impact would be less than significant. Mitigation is not required for the No-Action Alternative.

Impact Wild-19 (No-Action): Disturbance or Removal of Vernal Pool Habitat for Special-Status Wildlife from Changes in Flow Regime No adverse effects on vernal pool-associated wildlife species would occur. This impact would be less than significant.

The No-Action Alternative would not affect the hydrology of vernal pools or have an adverse effect on vernal pool–associated wildlife species. Therefore, this impact would be less than significant. Mitigation is not required for the No-Action Alternative.

Impact Wild-20 (No-Action): Consistency with Local and Regional Plans with Goals of Promoting Riparian Habitat in the Primary Study Area Riparian habitat conditions would not differ from baseline conditions. This impact would be less than significant.

The No-Action Alternative would not conflict with existing plans promoting riparian habitat because conditions would not differ from the existing baseline. Therefore, this impact would be less than significant. Mitigation is not required for the No-Action Alternative.

Impact Wild-21 (No-Action): Impacts on Riparian-Associated Special-Status Wildlife Resulting from the Gravel Augmentation Program Under the No-Action Alternative, the gravel augmentation program would not be implemented. There would be no impact. Mitigation is not required for the No-Action Alternative.

Impact Wild-22 (No-Action): Impacts on Riparian-Associated Special-Status Wildlife Species Resulting from Restoration of Reading Island Under the No-Action Alternative there would be no Reading Island restoration. Thus, there would be no impact. Mitigation is not required for the No-Action Alternative.

Lower Sacramento River and Delta

Impact Wild-23 (No-Action): Impacts on Riparian-Associated and Aquatic Special-Status Wildlife Resulting from Modifications to Existing Flow Regimes in the Lower Sacramento River and Delta Effects on riparian vegetation in the lower Sacramento River and Delta areas from continuing the existing dam operation under the No-Action Alternative would not have a substantial adverse effect on special-status wildlife. This impact would be less than significant.

This impact would be similar to Impact Wild-17 (No-Action) for the primary study area. The No-Action Alternative would continue to alter the structure and species composition of riparian habitat along the lower Sacramento River and

into the Delta resulting from continued operation of Shasta Dam. Dam operation, which has led to a decrease in early successional riparian communities and an increase in the extent of mid-successional riparian communities, would continue under the No-Action Alternative. Thus, the No-Action Alternative would affect habitats used by special-status wildlife species because early- and mid-successional riparian vegetation provide different habitat values. However, this change is expected to be small and is not likely to have a substantial adverse effect on special-status species, nor would it be likely to cause a population to be eliminated. Therefore, this impact would be less than significant. Mitigation is not required for the No-Action Alternative.

Impact Wild-24 (No-Action): Impacts on Bank Swallow Along the Lower Sacramento River Resulting from Modifications of Geomorphic Processes Future conditions for bank swallows along the lower Sacramento River are not expected to differ substantially from existing conditions because of the restoration projects being implemented on the Sacramento River. This impact would be less than significant.

This impact would be similar to Impact Wild-18 (No-Action) for the primary study area. Dam operations under the No-Action Alternative would continue to alter geomorphic processes along the lower Sacramento River. Loss of eroding banks during winter flood flows could limit the formation of suitable nesting habitat for bank swallow. However, future conditions for bank swallows are not expected to differ substantially from existing conditions because of the restoration projects being implemented on the Sacramento River. Therefore, this impact would be less than significant. Mitigation is not required for the No-Action Alternative.

Impact Wild-25 (No-Action): Disturbance or Removal of Vernal Pool Habitat for Special-Status Wildlife Along the Lower Sacramento River and in the Delta from Changes in Flow Regime of the Sacramento River and Affected Tributaries, and Changes in Seasonal Water Availability No adverse effects on vernal pool–associated wildlife species along the lower Sacramento River and in the Delta would occur. This impact would be less than significant.

This impact would be similar to Impact Wild-19 (No-Action) for the primary study area. The No-Action Alternative would not affect the hydrology of vernal pools or have an adverse effect on vernal pool–associated wildlife species. Therefore, this impact would be less than significant. Mitigation is not required for the No-Action Alternative.

Impact Wild-26 (No-Action): Consistency with Local and Regional Plans with Goals of Promoting Riparian Habitat along the Lower Sacramento River and in the Delta No adverse effects on vernal pool–associated wildlife species along the lower Sacramento River and in the Delta would occur. This impact would be less than significant.

This impact would be similar to Impact Wild-20 (No-Action) for the primary study area. The No-Action Alternative would not conflict with existing plans promoting riparian habitat along the lower Sacramento River and in the Delta because conditions would not differ from the existing baseline. Therefore, this impact would be less than significant. Mitigation is not required for the No-Action Alternative.

CVP/SWP Service Areas

Impact Wild-27 (No-Action): Impacts on Riparian-Associated or Aquatic Special-Status Wildlife in the CVP/SWP Service Areas Resulting from Modifications to Existing Flow Regimes Changes to CVP and SWP water deliveries that would occur while the existing dam operation continues under the No-Action Alternative would not have a substantial adverse effect on special-status wildlife. This impact would be less than significant.

This impact would be similar to Impact Wild-17 (No-Action) for the primary study area and Impact Wild-21 (No-Action) for the lower Sacramento River and Delta. Although Shasta Dam would not be altered under the No-Action Alternative, CVP and SWP water storage, conveyance, and deliveries to the CVP and SWP service areas would change because of several reasonably foreseeable projects that would occur with or without enlarging Shasta Dam. CVP and SWP deliveries could increase or decrease based on any number of factors between now and 2030. Given environmental regulations to protect sensitive habitats and species, these changes are not likely to have a substantial adverse effect on special-status species, nor would they be likely to cause a population to be eliminated. This impact would be less than significant. Mitigation is not required for the No-Action Alternative.

CP1 – 6.5-Foot Dam Raise, Anadromous Fish Survival and Water Supply Reliability

CP1 focuses on increasing water supply reliability while contributing to increased survival of anadromous fish, actions that are consistent with the 2000 CALFED ROD. In addition to the common features above, CP1 primarily involves raising Shasta Dam 6.5 feet, an elevation change that would increase the reservoir's full pool by 8.5 feet and would enlarge the total storage space in the reservoir by 256,000 acre-feet. Under this plan, Shasta Dam operational guidelines would continue unchanged, with the additional storage retained for water supply reliability and increased anadromous fish survival.

Shasta Lake and Vicinity

Impact Wild-1 (CP1): Take and Loss of Habitat for the Shasta Salamander
Ground-disturbing activities and vegetation removal associated with dam construction activities, construction activities in the relocation areas, and removal of various amounts of vegetation in the impoundment areas could result in direct take of the Shasta salamander, a State-listed species, USFS sensitive species, survey and manage species, MSCS-covered species, and BLM sensitive species. Operation of equipment in or removal of suitable habitat

during the wet season could result in direct impacts on this species. In addition, the raising of Shasta Dam would result in the inundation of habitat for this species. This impact would be significant.

Collectively, 39 sites are known to occur within the areas surveyed by NSR (impoundment and relocation areas). Individuals were observed in both limestone and nonlimestone habitats in each arm. Within the impoundment area, presence of the Shasta salamander is presumed in all CHWR habitat types where it has been located. Shasta salamanders present will not be able to move out of the inundation area and will drown during the inundation period. This impact would be significant.

Inundation resulting from a 6.5-foot dam raise would result in a loss of 7 acres of limestone habitat and 1,197 acres of nonlimestone habitat. Impacts on limestone and nonlimestone habitat by CWHR type providing suitable habitat in the impoundment area are summarized in Table 13-6.

Table 13-6. Impacts on Suitable Habitat for the Shasta Salamander in the Impoundment Area (6.5-Foot Dam Raise)

Habitat	Area (acres*)					
	Main Body	Big Backbone Arm	Sacramento Arm	McCloud Arm	Squaw Creek Arm	Pit Arm
Limestone	0.00	0.82	0.00	5.17	0.00	1.50
Nonlimestone	222.14	42.84	348.85	203.70	122.02	257.57
Total	222.14	43.66	348.85	208.87	122.02	259.07

Source: Data compiled by North State Resources, Inc., in 2011 based on habitat assessments and mapping
Note:
*Acres are approximate.

Direct mortality of Shasta salamanders would occur in areas of suitable habitat where complete vegetation clearing is implemented and/or mechanized construction equipment is employed if these activities occur during the wet season when salamanders are on the surface. Construction activities in relocation areas would result in a loss of 35 acres of limestone habitat and 2,870 acres of nonlimestone habitat. This impact would be significant. Impacts on limestone and nonlimestone habitat by CWHR type providing suitable habitat in the relocation areas are summarized in Table 13-7.

Table 13-7. Impacts on Suitable Habitat for the Shasta Salamander in Relocation Areas

Habitat	Area (acres*)					
	Main Body	Big Backbone Arm	Sacramento Arm	McCloud Arm	Squaw Creek Arm	Pit Arm
Limestone	0.00	0.00	0.00	35.71	0.00	0.00
Nonlimestone	388.18	0.00	1083.45	1020.46	100.34	278.00
Total	388.18	0.00	1083.45	1056.17	100.34	278.00

Source: Data compiled by North State Resources, Inc., in 2011 based on habitat assessments and mapping
Note:
*Acres are approximate.

Implementation of the project would take place over 3 to 4 years. Mortality of individuals could occur over multiple years if ground-disturbing activities are conducted during the wet season. This impact would be significant.

Additional analysis of impacts will be conducted in relation to suitable habitats available in the Shasta Lake watershed or in the species range (if appropriate). Shasta salamander surveys are ongoing and it is anticipated that protocol-level surveys will be conducted within the dam construction footprint and all relocation area footprints. Protocol-level surveys would provide specific information about the presence or absence of Shasta salamanders within individual construction footprints. Direct and indirect impacts based on those results will be reported in the FEIS. Additionally, other indirect and temporary impacts will be analyzed in the FEIS. Mitigation for this impact is proposed in Section 13.3.5.

Impact Wild-2 (CP1): Impact on the Foothill Yellow-Legged Frog and Tailed Frog and Their Habitat Ground-disturbing activities and vegetation removal associated with dam construction activities, construction activities in the relocation areas, and removal of various amounts of vegetation in the impoundment areas could result in direct take of the foothill yellow-legged frog, a California species of special concern, a USFS sensitive species, an MSCS-covered species, and a BLM sensitive species, and the tailed frog, a California species of special concern. Operation of equipment in or adjacent to riverine or riparian habitat would result in direct impacts on this species. In addition, inundation caused by the raising of Shasta Dam would result in the conversion of suitable riverine and riparian habitat to unsuitable lacustrine habitat. These impacts would be potentially significant.

Foothill yellow-legged frogs occur in many perennial streams within the impoundment area. They have been found in streams on all arms and the main body of the lake. Tailed frogs have not been found during surveys, but there are known occurrences in the McCloud and upper Sacramento arms. CWHR habitat types, montane riparian and riverine, are suitable habitat where these species might occur.

Individual foothill yellow-legged frog and tailed frogs will not be affected by the inundation caused by the raise of the dam. These animals will be able to swim upstream to suitable habitat.

Although frogs may move out of harms way, direct take of foothill yellow-legged frog and tailed frog could also occur as a result of project-associated construction activities in or near suitable aquatic habitat. Potential construction impacts include mortality of individuals because of equipment use and vehicle traffic within suitable aquatic and upland habitat. The potential for direct take would be temporary, occurring only during project construction. Project implementation could result in the degradation of suitable aquatic habitat

because of increased erosion, sedimentation, or accidental fuel leaks and spills. These impacts would be potentially significant.

Implementation of the project would take place over 3 to 4 years. Mortality of individuals could occur over multiple years if construction activities are conducted in perennial streams. This impact would be potentially significant.

Implementation of a 6.5-foot dam raise would result in inundation of 33 acres of habitat for the foothill yellow-legged frog and tailed frog. A total of 19 acres of suitable habitat would be lost because of vegetation removal associated with dam construction and construction in the relocation areas. Summaries of suitable habitat loss by arm are presented in Table 13-8.

Additional analysis of impacts will be conducted in relation to suitable habitats available in the Shasta Lake watershed or in the species range (if appropriate). Indirect and temporary impacts will be analyzed in the FEIS. Mitigation for this impact is proposed in Section 13.3.5.

Table 13-8. Impacts on Suitable Habitat for the Foothill Yellow-Legged and Tailed Frog in the Impoundment Area and Relocation Areas (6.5-Foot Dam Raise)

	Area (acres*)					
Habitat	**Main Body**	**Big Backbone Arm**	**Sacramento Arm**	**McCloud Arm**	**Squaw Creek Arm**	**Pit Arm**
Impoundment Area						
Montane riparian	1.54	2.48	15.92	4.60	0.58	0.80
Riverine	0.00	0.35	2.30	3.81	0.59	0.00
Total	1.54	2.83	18.22	8.41	1.17	0.80
Relocation Areas						
Montane riparian	0.34	0.00	4.72	8.02	0.23	1.45
Riverine	0.00	0.00	0.39	3.75	0.00	0.00
Total	0.34	0.00	5.11	11.77	0.23	1.45

Source: Data compiled by North State Resources, Inc., in 2011 based on habitat assessments and mapping
Note:
*Acres are approximate

Impact Wild-3 (CP1): Impact on the Northwestern Pond Turtle and Its Habitat
Ground-disturbing activities and vegetation removal associated with dam construction activities, construction activities in the relocation areas, and removal of various amounts of vegetation in the impoundment areas could result in direct take of the northwestern pond turtle, a California species of special concern, a USFS sensitive species, and an MSCS-covered species. These impacts would be potentially significant.

Individual northwestern pond turtles will not be impacted by the inundation caused by the raise of the dam. Lacustrine is suitable habitat for the northwestern pond turtle.

The northwestern pond turtle occurs throughout the perimeter of the impoundment area. In addition to aquatic habitats, this species uses upland habitats for nesting and overwintering. Nests are generally located on southfacing slopes of less than 60 degrees averaging 200 meters (660 feet) from an aquatic site (DFG 1994). Thus, loss of upland habitats adjacent to suitable aquatic habitat (within approximately 660 feet) could adversely affect this species.

Direct take of northern pond turtle eggs or juveniles could occur during the first inundation of habitat above 1,070 feet above msl. Turtles may lay eggs in suitable habitat that subsequently becomes inundated, resulting in the death of the eggs or overwintering juveniles. In addition, inundation caused by the raising of Shasta Dam would result in the conversion of suitable habitat to unsuitable lacustrine habitat. These impacts would be potentially significant.

Direct take of northwestern pond turtles could also occur as a result of project-associated construction activities in or near suitable aquatic and upland habitat. Potential construction impacts include mortality of individuals because of equipment use and vehicle traffic within suitable aquatic and upland habitat. In addition, project implementation could result in the degradation of suitable aquatic habitat because of increased erosion, sedimentation, or accidental fuel leaks and spills. Additionally, it is assumed that all vegetation will be removed within the relocation areas.

Implementation of the project would occur over 3 to 4 years. Mortality of individuals could occur over multiple years if construction activities are conducted in suitable aquatic and upland habitat. This impact would be potentially significant.

Implementation of a 6.5-foot raise of the dam would result in a loss of 33 acres of suitable habitat for the northwestern pond turtle (montane riparian, fresh emergent, lacustrine, and riverine). Seven acres of riverine habitat would be converted to lacustrine habitat. Because there are equally valuable components lost or gained in either habitat, the quality of the habitat would not be compromised. However, maximum lake elevation is infrequent and would not benefit the species throughout the remainder of the year. Thus, the conversion of suitable habitats to lacustrine habitat remains an impact on northwestern pond turtle habitat.

A total of 19 acres of suitable aquatic habitat would be lost because of vegetation removal associated with dam construction and construction of the relocation areas. Summaries of suitable habitat lost by arm are presented in Table 13-9.

Table 13-9. Impacts on Suitable Habitat for the Northwestern Pond Turtle in the Impoundment Area and Relocation Areas (6.5-Foot Dam Raise)

Habitat	Area (acres*)					
	Main Body	Big Backbone Arm	Sacramento Arm	McCloud Arm	Squaw Creek Arm	Pit Arm
Impoundment Area						
Lacustrine	0.00	0.00	0.00	0.00	0.00	0.00
Montane riparian	1.54	2.48	15.92	4.60	0.58	0.80
Riverine	0.00	0.35	2.30	3.81	0.59	0.00
Total	1.54	2.83	18.22	8.41	1.17	0.80
Relocation Areas						
Montane riparian	0.34	0.00	4.72	8.02	0.23	1.45
Riverine	0.00	0.00	0.39	3.75	0.00	0.00
Total	0.34	0.00	5.11	44.41	0.23	1.45

Source: Data compiled by North State Resources, Inc., in 2011 based on habitat assessments and mapping
Note:
*Acres are approximate.

Additional analysis of impacts will be conducted in relation to suitable habitats available in the Shasta Lake watershed or in the species range (if appropriate). Impacts on upland habitats will be quantified based on proximity to aquatic habitat. Upland habitats will be quantified based on suitable slope, soil composition, and proximity to aquatic habitats. Indirect and temporary impacts will be analyzed in the FEIS. Mitigation for this impact is proposed in Section 13.3.5.

Impact Wild-4 (CP1): Impact on the American Peregrine Falcon Construction activities and vegetation removal associated with dam construction activities, construction activities in the relocation areas, and removal of various amounts of vegetation in the impoundment areas during the nesting season could result in the incidental loss of fertile eggs or nestlings or otherwise lead to the abandonment of nests of American peregrine falcons, a State fully protected and MSCS-covered species. This impact would be potentially significant.

Cliffs within the Shasta Lake and vicinity portion of the primary study area provide suitable nesting habitat for the peregrine falcon. Overstory and complete vegetation removal is expected to occur within the impoundment area in suitable cliff habitat. Thus, overstory vegetation removal occurring in or near suitable cliff habitat during the nesting season could result in the incidental loss of fertile eggs or nestlings or otherwise lead to the abandonment of nests. Additionally, because of the steep terrain, trees would be yarded by helicopter. Noise generated by chainsaws and helicopter yarding could cause the abandonment of nests, resulting in the incidental loss of fertile eggs or nestlings. This impact would be potentially significant.

No known eyries would be inundated by a 6.5-foot raise in lake elevation; however, 8.5 vertical feet (full pool) of cliff habitat would be inundated. Peregrine falcons nest on sheer cliffs ranging in height from 75 to 2,000 feet. Eyries are generally located between 40 and 80 percent of total cliff height

(Pagel 1992). Based on the large area required for suitable nesting habitat for peregrine falcons, impacts on suitable cliff habitat for nesting would be less than significant. The conversion of uplands to lacustrine habitat would not adversely affect foraging habitat for the species because they frequently forage over water.

Implementation of the project would occur over 3 to 4 years. Impacts on nesting American peregrine falcons could occur over multiple years if construction activities were conducted in or adjacent to active nests. This impact would be potentially significant.

Because American peregrine falcons nest on vertical cliffs, construction or vegetation removal related to relocation areas is not anticipated to occur in suitable cliff habitat.

Additional analysis of impacts will be conducted in relation to suitable habitats available in the Shasta Lake watershed or in the species range (if appropriate). Suitable cliff habitats will be quantified and impacts on cliff habitats will be assessed. Indirect and temporary impacts will be analyzed in the FEIS. Mitigation for this impact is proposed in Section 13.3.5.

Impact Wild-5 (CP1): Take and Loss of Habitat for the Bald Eagle Ground-disturbing activities and vegetation removal associated with dam construction activities, construction activities in the relocation areas, and removal of various amounts of vegetation in the impoundment areas in addition to inundation caused by the raising of Shasta Dam during the nesting season would result in the loss of nest and perch trees used by the bald eagle, a State-listed, fully protected, and USFS sensitive species, MSCS-covered species, and a BLM sensitive species. This impact would be significant.

Typically, 24 to 28 pairs nest in the vicinity of Shasta Lake. Vegetation removal within the impoundment area during the nesting season could result in the incidental loss of fertile eggs or nestlings or otherwise lead to the abandonment of bald eagle nests. Noise generated by vegetation removal, such as noise caused by helicopter yarding and chainsaw use, could also lead to nest abandonment, resulting in the incidental loss of fertile eggs or nestlings. The loss of nesting and foraging habitat would be a potentially significant impact.

Between eight and 14 nest trees may be impacted by any raise in elevation. Nest trees may be inundated by any of the three alternatives. If inundation of the impoundment area were to occur, nest trees within the impoundment area would die. Because peak inundation generally occurs in late April or early June, nest trees would be flooded toward the end of the nesting season. If eagles were nesting in these trees, it would be likely that young would fledge before the nest tree died from the effects of inundation. Because of inundation timing, it is not likely that individuals would be affected. Because bald eagles generally use the same nest for multiple years, the loss of nest trees would be a significant impact.

Inundation could also affect erosion and bank stability, which could affect nest trees that are in close proximity to the impoundment area. This would be a potentially significant impact.

The increase in lake elevation may increase access to eagle nests by recreational boaters. The increase in noise and human disturbance may lead to nest abandonment and the incidental loss of fertile eggs or young. Additionally, habitat inundated within the impoundment area would result in a loss of roosting and potential nest trees. This impact would be significant.

One eagle nest is located in the relocation area at Gregory Beach. Removal of nest trees would be a potentially significant impact. Additionally, one nest occurs near the Bailey Cove trail, which could be impacted by noise generated by vegetation removal activities. Vegetation removal and additional construction activities in the relocation areas would result in the same impacts on nesting bald eagles as described for vegetation removal activities proposed in the impoundment areas. This impact would be significant.

Implementation of the project would occur over 3 to 4 years. Impacts on nesting bald eagles could occur over multiple years if construction activities are conducted in or adjacent to active nests. This impact would be significant.

Dam construction, vegetation removal and construction in the relocation areas, and inundation resulting from a 6.5-foot dam raise would result in a loss of 2,492 acres in the impoundment area and 2,387 acres in the relocation areas of nesting and roosting habitat for the bald eagle. Potential nest and roost trees occur in blue oak woodland, blue oak–foothill pine, Douglas-fir, montane hardwood, montane hardwood–conifer, montane riparian, and ponderosa pine habitats with tree diameters larger than 24 inches. Impacts on suitable bald eagle habitat by CWHR type in the impoundment area and relocation areas are summarized in Table 13-10.

Additional analysis of impacts will be conducted in relation to suitable habitats available in the Shasta Lake watershed. Bald eagle nesting activity changes from year to year. The number of bald eagle nests is subject to change based on eagle activity at the time of construction and the subsequent inundation. Reclamation is currently working with the USFS to determine the current eagle activity to revise the number of nest trees that may be impacted. Indirect and temporary impacts will be analyzed in the FEIS. Mitigation for this impact is proposed in Section 13.3.5.

Table 13-10. Impacts on Suitable Habitat for the Bald Eagle in the Impoundment Area and Relocation Areas (6.5-Foot Dam Raise)

Habitat	Area (acres*)					
	Main Body	Big Backbone Arm	Sacramento Arm	McCloud Arm	Squaw Creek Arm	Pit Arm
Impoundment Area						
Blue oak woodland	0.00	0.00	0.00	0.00	0.00	1.32
Blue oak–foothill pine	4.96	0.00	0.00	0.00	1.40	4.04
Douglas-fir	0.00	0.00	0.00	0.01	0.00	0.00
Montane hardwood	39.08	18.13	86.75	32.23	9.44	1.28
Montane hardwood–conifer	34.65	0.50	69.23	68.73	55.70	5.68
Montane riparian	1.54	2.48	15.92	4.60	0.58	0.80
Ponderosa pine	108.93	15.36	84.75	81.24	25.06	29.93
Total	189.17	36.46	256.65	186.82	92.18	43.05
Relocation Areas						
Blue oak woodland	0.00	0.00	0.00	3.89	0.00	2.28
Blue oak–foothill pine	3.61	0.00	0.00	0.00	0.00	13.47
Douglas-fir	0.00	0.00	0.00	3.18	0.00	0.00
Montane hardwood	48.21	0.00	198.56	214.87	6.34	3.44
Montane hardwood–conifer	121.63	0.00	205.41	316.45	42.22	42.28
Montane riparian	0.34	0.00	4.72	8.02	0.23	1.45
Ponderosa pine	185.06	0.00	466.94	406.43	43.08	45.30
Total	358.84	0.00	875.63	952.85	91.87	108.21

Source: Data compiled by North State Resources, Inc., in 2011 based on habitat assessments and mapping

Note:

*Acreages are approximate and will be revised based on habitat containing suitable tree diameters.

Impact Wild-6 (CP1): Take and Loss of Nesting and Foraging Habitat for the Northern Spotted Owl Construction activities and vegetation removal associated with the dam construction activities, construction activities in the relocation areas, and removal of various amounts of vegetation in the impoundment areas during the nesting season could result in the incidental loss of fertile eggs or nestlings or otherwise lead to the abandonment of nests of the northern spotted owl, a Federally listed as threatened species and MSCS-covered species. In addition, inundation caused by the raising of Shasta Dam could result in inundation of nest trees and would result in the loss of habitat, including critical habitat for this species. This impact would be potentially significant.

Vegetation removal within the impoundment area during the nesting season could result in the incidental loss of fertile eggs or nestlings or otherwise lead to the abandonment of nests of the northern spotted owl. Noise generated by vegetation removal activities including helicopter yarding and chainsaw use could also lead to nest abandonment resulting in the incidental loss of fertile eggs or nestlings. This impact would be potentially significant. Additionally, portions of upper Squaw Creek and Pit arms have been designated as critical habitat for the northern spotted owl. The loss of nesting, foraging and critical habitat would be a potentially significant impact.

A 6.5-foot dam raise could result in inundation of nest trees and would result in the loss of nesting and foraging habitat for this species. Once inundation of the impoundment area occurs, nest trees within the impoundment area would die. Because peak inundation generally occurs in late April or early June, nest trees would be flooded toward the end of the nesting season. If owls were nesting in these trees, it is likely that young would fledge before the nest tree dies from the effects of inundation. Because of inundation timing, it is not likely that individuals would be affected.

The increase in lake elevation could increase access to owl nests by recreational boaters. The increase in noise and human disturbance could lead to nest abandonment and the incidental loss of fertile eggs or young. This would be a potentially significant impact.

Additionally, construction activities and vegetation removal in relocation areas would also result in a loss of northern spotted owl nesting and foraging habitat. This would be a potentially significant impact.

Implementation of the project would occur over 3 to 4 years. Impacts on nesting northern spotted owls could occur over multiple years if construction activities were conducted in or adjacent to active nests. This impact would be potentially significant.

Dam construction, vegetation removal and construction in the relocation areas, and inundation resulting from a 6.5-foot dam raise would result in a loss of 767 acres (20 acres of critical habitat) in the impoundment area and 2,349 acres in the relocation areas (19 acres of critical habitat) of nesting and foraging habitat for the northern spotted owl. CWHR types are a general representation of suitable nesting, roosting, and foraging habitat for northern spotted owl. Impacts on suitable spotted owl habitat by CWHR type in the impoundment area and relocation areas are summarized in Table 13-11. The California Forest Practice Rules specify parameters for northern spotted owl nesting, roosting, and foraging habitats. Delineations of habitats defined by California Practice Rules are not available for this impact analysis.

Additional analysis of impacts will be conducted in relation to suitable habitats available in the Shasta Lake watershed. An analysis of indirect and temporary impacts will be completed in subsequent documents. Mitigation for this impact is proposed in Section 13.3.5.

Table 13-11. Impacts on Suitable Habitat for the Northern Spotted Owl in the Impoundment Area and Relocation Areas (6.5-Foot Dam Raise)

Habitat	Area (acres*)					
	Main Body	Big Backbone Arm	Sacramento Arm	McCloud Arm	Squaw Creek Arm	Pit Arm
Impoundment Area						
Douglas-fir	0.00	0.00	0.00	0.01	0.00	0.00
Montane hardwood	39.08	18.13	86.75	32.23	9.44	1.28
Montane hardwood–conifer	34.65	0.50	69.23	68.73	55.70	5.68
Ponderosa pine	108.93	15.36	84.75	81.24	25.06	29.93
Total	182.66	33.99	240.73	182.21	90.20	36.89
Relocation Areas						
Douglas-fir	0.00	0.00	0.00	3.18	0.00	0.00
Montane hardwood	48.21	0.00	198.56	214.87	6.34	3.44
Montane hardwood–conifer	121.63	0.00	205.41	316.45	42.22	42.28
Ponderosa pine	185.06	0.00	466.94	406.43	43.08	45.30
Total	354.90	0.00	870.91	940.93	91.64	91.02

Source: Data compiled by North State Resources, Inc., in 2011 based on habitat assessments and mapping
*Note: *Acres are approximate.*

Impact Wild-7 (CP1): Impact on the Purple Martin and Its Nesting Habitat
Construction activities and vegetation removal associated with the construction of raising the dam, construction activities in the relocation areas, and removal of various amounts of vegetation in the impoundment areas during the nesting season could result in the incidental loss of fertile eggs or nestlings or otherwise lead to the abandonment of nests of purple martins, a California species of special concern. In addition, inundation caused by the raising of Shasta Dam would result in the loss of nest trees. This impact would be significant.

Based on data collected between 2007 and 2010, the number of purple martin nesting pairs ranged between 18 and 28. Shasta Lake is one of only two known interior breeding locations for purple martins in California. Purple martins nest only in snags (upslope and in the lake) in the vicinity of the Clikapudi Trail and east up the Pit Arm of the Shasta Lake vicinity of the primary study area. Overstory vegetation removal is proposed for the relocation of the Clikapudi Trail. With the exception of Arbuckle Flat, no vegetation would be removed from the Painter Creek inlet east on the Pit Arm.

Inundation of the impoundment area could result in the loss of nest trees in the lake and two known upland nest trees. Each nest tree contains several potential nest cavities at various heights above the water. Therefore, with an increase in inundation levels, potentially fewer nest cavities could be available from year to year. Loss of nest trees would be temporary, as trees that are inundated would die and become snags. New nesting snags would develop as dying trees are used by woodpeckers and cavities become available for purple martins. The temporal loss of nesting snags would be a significant impact.

Overstory vegetation removal is proposed for the relocation of the Clikapudi Trail. This could include removal of snags that are actively used for nesting or could provide nesting habitat for purple martin. Construction activities such as tree removal, site grading, and excavation and vegetation removal, including noise caused by helicopter yarding and chainsaw use during the nesting season, could result in the incidental loss of fertile eggs or nestlings or otherwise lead to nest abandonment. Loss of fertile eggs or nesting adults, or any activities resulting in nest abandonment, would be significant.

Implementation of the project would occur over 3 to 4 years. Impacts on nesting purple martins could occur over multiple years if construction activities were conducted in or adjacent to active nests. This impact would be significant.

Purple martins forage high in the air and above the tree canopy. Conversion of upland habitats to lacustrine habitat would not have an effect on foraging habitat. Therefore, there would be no impact on foraging habitat.

Additional analysis of impacts will be conducted in relation to suitable habitats available in the Shasta Lake watershed. An analysis of indirect and temporary impacts will be completed in subsequent documents. Mitigation for this impact is proposed in Section 13.3.5.

Impact Wild-8 (CP1): Impacts on the Willow Flycatcher, Vaux's Swift, Yellow Warbler, and Yellow-Breasted Chat and Their Foraging and Nesting Habitat
Construction activities and vegetation removal associated with dam construction activities, construction activities in the relocation areas, and removal of various amounts of vegetation in the impoundment areas during the nesting season could result in the incidental loss of fertile eggs or nestlings or otherwise lead to the abandonment of nests of the willow flycatcher, a State-listed endangered, USFS sensitive, and MSCS-covered species; the Vaux's swift, a California species of special concern; and the yellow warbler and yellow-breasted chat, both California species of special concern and MSCS-covered species. In addition, the raising of Shasta Dam would result in the loss of habitat, including nesting habitat, for these species. This impact would be potentially significant.

Vegetation removal within the impoundment area during the nesting season could result in the incidental loss of fertile eggs or nestlings or otherwise lead to the abandonment of nests of these species. Noise generated by vegetation removal activities including helicopter yarding and chainsaw use could also lead to nest abandonment, resulting in the incidental loss of fertile eggs or nestlings. This impact would be potentially significant. The loss of nesting and foraging habitat would be a potentially significant impact.

A 6.5-foot dam raise would result in inundation of nesting and foraging habitat for these species. Understory vegetation in 15 percent of the impoundment area would be removed before inundation; the remainder would not survive the inundation. Therefore, inundation of the impoundment area would reduce the

nesting habitat for these species. If removal were completed outside of the breeding season, suitable nesting habitat would not be available and nesting would not be affected. However, 63 percent of vegetation would not be removed and would be inundated. Because peak inundation generally occurs in late April through early June, active nests established before and while lake levels were rising could be flooded. The loss of nests and nesting and foraging habitat from inundation would be a potentially significant impact.

Construction activities such as tree removal, site grading, and excavation and vegetation removal at the dam and in relocation areas during the nesting season could result in the incidental loss of fertile eggs or nestlings or otherwise lead to nest abandonment. Additionally, noise generated by project construction activities and vegetation removal, including helicopter yarding and chainsaw use, could lead to nest abandonment resulting in the incidental loss of fertile eggs or nestlings. Vegetation removal in relocation areas would also result in a loss of nesting and foraging habitat. This would be a potentially significant impact.

Implementation of the project would occur over 3 to 4 years. Impacts on these species could occur over multiple years if construction activities were conducted adjacent to active nests. This impact would be potentially significant.

Dam construction, vegetation removal and construction in the relocation areas, and inundation resulting from a 6.5-foot dam raise would result in a loss of 792 acres in the impoundment area and 2,364 acres in the relocation areas of nesting and foraging habitat for the Vaux's swift (Douglas-fir, montane hardwood, montane hardwood–conifer, montane riparian, and ponderosa pine). It would result in a loss of 26 acres in the impoundment area and 15 acres in the relocation areas for the willow flycatcher, yellow warbler, and yellow-breasted chat (montane riparian).

Impacts on suitable willow flycatcher, Vaux's swifts, yellow warblers, and yellow-breasted chats habitat by CWHR type in the impoundment area and relocation areas are summarized in Table 13-12.

Additional analysis of impacts will be conducted in relation to suitable habitats available in the Shasta Lake watershed. An analysis of indirect and temporary impacts will be completed in subsequent documents. Mitigation for this impact is proposed in Section 13.3.5.

Impact Wild-9 (CP1): Impacts on the Long-Eared Owl, Northern Goshawk, Cooper's Hawk, Great Blue Heron, and Osprey and Their Foraging and Nesting Habitat Construction activities and vegetation removal associated with the dam construction activities, construction activities in the relocation areas, and removal of various amounts of vegetation in the impoundment areas during the nesting season could result in the incidental loss of fertile eggs or nestlings or otherwise lead to the abandonment of nests of the long-eared owl, a

Table 13-12. Impacts on Suitable Habitat for the Willow Flycatcher, Vaux's Swift, Yellow Warbler, and Yellow-Breasted Chat in the Impoundment Area and Relocation Areas (6.5-Foot Dam Raise)

Habitat	Area (acres*)					
	Main Body	Big Backbone Arm	Sacramento Arm	McCloud Arm	Squaw Creek Arm	Pit Arm
Impoundment Area						
Vaux's Swift						
Douglas-fir	0.00	0.00	0.00	0.01	0.00	0.00
Montane hardwood	39.08	18.13	86.75	32.23	9.44	1.28
Montane hardwood–conifer	34.65	0.50	69.23	68.73	55.70	5.68
Montane riparian	1.54	2.48	15.92	4.60	0.58	0.80
Ponderosa pine	108.93	15.36	84.75	81.24	25.06	29.93
Total Vaux's Swift Habitat	184.20	36.47	256.65	186.80	90.78	37.69
Willow Flycatcher, Yellow Warbler, and Yellow-Breasted Chat						
Montane riparian	1.54	2.48	15.92	4.60	0.58	0.80
Total Habitat	1.54	2.48	15.92	4.60	0.58	0.80
Relocation Areas						
Vaux's Swift						
Douglas-fir	0.00	0.00	0.00	3.18	0.00	0.00
Montane hardwood	48.21	0.00	198.56	214.87	6.34	3.44
Montane hardwood–conifer	121.63	0.00	205.41	316.45	42.22	42.28
Montane riparian	0.34	0.00	4.72	8.02	0.23	1.45
Ponderosa pine	185.06	0.00	466.94	406.43	43.08	45.30
Total Vaux's Swift Habitat	355.24	0.00	875.63	948.95	91.87	92.47
Willow Flycatcher, Yellow Warbler, and Yellow-Breasted Chat						
Montane riparian	0.34	0.00	4.72	8.02	0.23	1.45
Total Habitat	0.34	0.00	4.72	8.02	0.23	1.45

Source: Data compiled by North State Resources, Inc., in 2011 based on habitat assessments and mapping

Note:

*Acres are approximate.

California species of special concern and an MSCS-covered species; northern goshawk, a California species of special concern, a USFS sensitive species, and a BLM sensitive species; the Cooper's hawk, an MSCS-covered species; the great blue heron, an MSCS-covered species; and the osprey, an MSCS-covered species. In addition, higher lake levels caused by raising Shasta Dam would result in the loss of foraging and nesting habitat for these species. This impact would be potentially significant.

Vegetation removal within the impoundment area during the nesting season could result in the incidental loss of fertile eggs or nestlings or otherwise lead to the abandonment of nests of these species. Noise generated by vegetation removal activities, including helicopter yarding and chainsaw use, could also lead to nest abandonment, resulting in the incidental loss of fertile eggs or nestlings. This impact would be potentially significant. The loss of nesting and foraging habitat would be a potentially significant impact.

A 6.5-foot dam raise could result in inundation of nest trees and would result in the loss of nesting and foraging habitat for this species. If inundation of the impoundment area were to occur, nest trees within the impoundment area would die. Because peak inundation generally occurs in late April through early June, nest trees would be flooded toward the end of the nesting season. If these species were nesting in these trees, it is likely that young would fledge before the nest tree dies from the effects of inundation. Because of inundation timing, it is not likely that individuals would be affected. However, the loss of nesting and foraging habitat would be a potentially significant impact.

The increase in lake elevation could increase access to nests by recreational boaters. The increase in noise and human disturbance could lead to nest abandonment and the incidental loss of fertile eggs or young. This would be a potentially significant impact.

Construction activities such as tree removal, site grading, and excavation and vegetation removal at the dam and in relocation areas during the nesting season could result in the incidental loss of fertile eggs or nestlings or otherwise lead to nest abandonment. Additionally, noise generated by project construction activities and vegetation removal, including helicopter yarding and chainsaw use, could lead to nest abandonment, resulting in the incidental loss of fertile eggs or nestlings. Vegetation removal in relocation areas would also result in a loss of nesting and foraging habitat. This would be a potentially significant impact.

Implementation of the project would occur over 3 to 4 years. Impacts on these species could occur over multiple years if construction activities were conducted adjacent to active nests. This impact would be potentially significant.

Dam construction, vegetation removal and construction in the relocation areas, and inundation resulting from a 6.5-foot dam raise would result in a loss of 580 acres in the impoundment area and 1,878 acres in the relocation areas of nesting and foraging habitat (Douglas-fir, montane hardwood–conifer, and ponderosa pine) for the long-eared owl and northern goshawk. There would be a loss of 1,050 acres in the impoundment area and 2,483 acres in the relocation areas of nesting and foraging habitat for the Cooper’s hawk and great blue heron (blue oak–foothill pine, closed-cone pine-cypress, Douglas-fir, montane hardwood, montane hardwood–conifer, montane riparian, and ponderosa pine).

Impacts on suitable habitat by CWHR type in the impoundment area and relocation areas are summarized in Table 13-13.

Impacts on osprey are similar to those described for the bald eagle (Impact Wild-5 (CP1) and the other raptors addressed above).

Table 13-13. Impacts on Suitable Habitat for the Long-Eared Owl, Northern Goshawk, Cooper's Hawk, and Great Blue Heron in the Impoundment Area and Relocation Areas (6.5-Foot Dam Raise)

Habitat	Area (acres*)					
	Main Body	Big Backbone Arm	Sacramento Arm	McCloud Arm	Squaw Creek Arm	Pit Arm
Impoundment Area						
Long-Eared Owl and Northern Goshawk						
Douglas-fir	0.00	0.00	0.00	0.01	0.00	0.00
Montane hardwood–conifer	34.65	0.50	69.23	68.73	55.70	5.68
Ponderosa pine	108.93	15.36	84.75	81.24	25.06	29.93
Total Habitat	143.59	15.86	153.98	149.98	80.76	35.61
Cooper's Hawk and Great Blue Heron						
Blue oak–foothill pine	4.96	0.00	0.00	0.00	1.40	4.04
Closed-cone pine-cypress	17.75	0.00	6.30	10.74	23.95	188.29
Douglas-fir	0.00	0.00	0.00	0.01	0.00	0.00
Montane hardwood	39.08	18.13	86.75	32.23	9.44	1.28
Montane hardwood–conifer	34.65	0.50	69.23	68.73	55.70	5.68
Montane riparian	1.54	2.48	15.92	4.60	0.58	0.80
Ponderosa pine	108.93	15.36	84.75	81.24	25.06	29.93
Total Habitat	206.91	36.46	262.95	197.55	116.13	230.03
Relocation Areas						
Long-Eared Owl and Northern Goshawk						
Douglas-fir	0.00	0.00	0.00	3.18	0.00	0.00
Montane hardwood–conifer	121.63	0.00	205.41	316.45	42.22	42.28
Ponderosa pine	185.06	0.00	466.94	406.43	43.08	45.30
Total Habitat	306.68	0.00	672.35	726.07	85.30	87.58
Cooper's Hawk and Great Blue Heron						
Blue oak–foothill pine	3.61	0.00	0.00	0.00	0.00	13.74
Closed-cone pine-cypress	0.11	0.00	56.90	8.95	1.94	33.72
Douglas-fir	0.00	0.00	0.00	3.18	0.00	0.00
Montane hardwood	48.21	0.00	198.56	214.87	6.34	3.44
Montane hardwood–conifer	121.63	0.00	205.41	316.45	42.22	42.28
Montane riparian	0.34	0.00	4.72	8.02	0.23	1.45
Ponderosa pine	185.06	0.00	466.94	406.43	43.08	45.30
Total Habitat	358.96	0.00	932.53	957.90	93.81	139.93

Source: Data compiled by North State Resources, Inc., in 2011 based on habitat assessments and mapping

Note:
*Acres are approximate

There are 54 osprey nests within the perimeter of Shasta Lake. Six nest trees would be affected by a 6.5-foot dam raise. Eleven osprey nests are located in

relocation areas. Removal of nest trees would be a potentially significant impact. Because osprey generally use the same nest for multiple years, the loss of 17 nest trees (31 percent) collectively between the impoundment area and relocation areas would be a potentially significant impact.

Osprey nests also occur on towers and structures around the dam, otherwise, there is no suitable habitat for raptors near the dam. Blasting may occur in the vicinity of the dam. This would have a similar impact on nesting ospreys as noise generated by helicopter yarding or large construction equipment, which could result in nest abandonment and the loss of fertile eggs or young. This would be a potentially significant impact.

Additional analysis of impacts will be conducted in relation to suitable habitats available in the Shasta Lake watershed. Osprey nesting activity changes from year to year. The number of osprey nests is subject to change based on osprey activity at the time of construction and the subsequent inundation. An analysis of indirect and temporary impacts will be completed in subsequent documents. Mitigation for this impact is proposed in Section 13.3.5.

Impact Wild-10 (CP1): Take and Loss of Habitat for the Pacific Fisher
Construction activities and vegetation removal associated with the construction of raising the dam, construction activities in the relocation areas, and removal of various amounts of vegetation in the impoundment areas would result in a loss of habitat for the Pacific fisher, a Federal candidate for listing, a California species of special concern, a USFS sensitive species, and a BLM sensitive species. Furthermore, take (including mortality of individuals because of destruction or disturbance of active roost sites or dens) could result from construction activities and vegetation clearing. This impact would be potentially significant.

Vegetation removal within the impoundment area while kits (i.e., young) are in natal den trees could result in the incidental loss of kits. Noise generated by vegetation removal activities including helicopter yarding and chainsaw use may also lead to abandonment of young. However, females frequently move kits if the natal den is disturbed or threatened. Because females will move kits, it is not likely that individuals would be affected. However, the loss of denning, resting, and foraging habitat would be a potentially significant impact.

A 6.5-foot dam raise could result in inundation of natal den trees and would result in the loss of denning, resting, and foraging habitat for this species. If inundation of the impoundment area were to occur, nest trees within the impoundment area would die. Females frequently move kits if threatened or disturbed. Because females will move kits, it is not likely that individuals would be affected. However, the loss of denning, resting, and foraging habitat would be a potentially significant impact.

Construction activities such as tree removal, site grading, and excavation and vegetation removal at the dam and in relocation areas while kits are in natal den trees could result in the incidental loss of kits. Impacts on habitat would be the same as described for the impoundment area. This would be a potentially significant impact.

Implementation of the project would occur over 3 to 4 years. Impacts on the Pacific fisher could occur over multiple years if construction activities were conducted adjacent to denning or resting habitat. This impact would be potentially significant.

Dam construction, vegetation removal and construction in the relocation areas, and inundation resulting from a 6.5-foot dam raise would result in a loss of 605 acres in the impoundment area and 1,893 acres in the relocation areas of habitat (Douglas-fir, montane hardwood-conifer, montane riparian, and ponderosa pine) for the Pacific fisher. This impact would be potentially significant.

Impacts on suitable habitat by CWHR type in the impoundment area and relocation areas are summarized in Table 13-14.

Table 13-14. Impacts on Suitable Habitat for the Pacific Fisher in the Impoundment Area and Relocation Areas (6.5-Foot Dam Raise)

Habitat	Area (acres*)					
	Main Body	Big Backbone Arm	Sacramento Arm	McCloud Arm	Squaw Creek Arm	Pit Arm
Impoundment Area						
Douglas-fir	0.00	0.00	0.00	0.01	0.00	0.00
Montane hardwood–conifer	34.65	0.50	69.23	68.73	55.70	5.68
Montane riparian	1.54	2.48	15.92	4.60	0.58	0.80
Ponderosa pine	108.93	15.36	84.75	81.24	25.06	29.93
Total Habitat	145.13	18.34	169.90	154.59	81.34	36.41
Relocation Areas						
Douglas-fir	0.00	0.00	0.00	3.18	0.00	0.00
Montane hardwood–conifer	121.63	0.00	205.41	316.45	42.22	42.28
Montane riparian	0.34	0.00	4.72	8.02	0.23	1.45
Ponderosa pine	185.06	0.00	466.94	406.43	43.08	45.30
Total Habitat	307.03	0.00	677.07	734.08	85.53	89.03

Source: Data compiled by North State Resources, Inc., in 2011 based on habitat assessments and mapping

Note:
*Acres are approximate

Additional analysis of impacts will be conducted in relation to suitable habitats available in the Shasta Lake watershed. An analysis of indirect and temporary impacts will be completed in subsequent documents. Mitigation for this impact is proposed in Section 13.3.5.

Impact Wild-11 (CP1): Impacts on Special-Status Bats (Pallid Bat, Spotted Bat, Western Red Bat, Western Mastiff Bat, Townsend's Big-Eared Bat, Long-Eared Myotis, and Yuma Myotis), the American Marten, and Ringtail and Their Habitat Construction activities and vegetation removal associated with the construction of raising the dam, construction activities in the relocation areas, and removal of various amounts of vegetation in the impoundment areas would result in a loss of habitat for the pallid bat, a California species of special concern, a USFS sensitive species, and a BLM sensitive species; the western red bat, a USFS sensitive species; the western mastiff bat, a California species of special concern, an MSCS-covered species, and a BLM sensitive species; the Townsend's big-eared bat, a California species of special concern, a USFS sensitive species, and a BLM sensitive species; the long-eared Myotis, a BLM sensitive species; the Yuma Myotis, a BLM sensitive species; the American marten, a USFS sensitive species; and the ringtail, a State fully protected and MSCS-covered species. Furthermore, take (including mortality of individuals because of destruction or disturbance of active roost sites or dens) could result from construction activities and vegetation clearing. This impact would be potentially significant.

Vegetation removal within the impoundment area while young bats are in maternity colonies or kits are in natal den trees could result in the incidental loss of young. Noise generated by vegetation removal activities including helicopter yarding and chainsaw use could also lead to young abandonment. Furthermore, depending on the season, the removal of large trees with cavities could result in the loss of pallid bat and Townsend's big-eared bat colonies. Potential direct impacts include the take of a maternity colony (females and young) and the take of individuals in a hibernaculum, which could eliminate an entire colony because of the loss of pregnant females. Mortality of young and the loss of reproductive and foraging habitat would be a potentially significant impact.

Inundation of a 6.5-foot dam raise would result in a loss of roosting and foraging habitat for special-status bats (pallid bat, spotted bat, western red bat, western mastiff bat, Townsend's big-eared bat, long-eared myotis, and Yuma myotis) that roost in hollow trees, snags, bridges, and caves. Loss of young could occur during the first inundation (above 1,070 feet msl) of bat maternity colony habitat because active maternity colonies could be flooded before young are volant (capable of flight). American marten and ringtails, which also use snags, hollow logs, and debris piles for reproduction and cover, could also be impacted. This impact would be potentially significant.

Two known caves, one occupied by Townsend's big-eared bats, are located on the Big Backbone Arm and would be wholly or partially inundated if the dam

were raised. Inundation of cave/cliff habitat could result in the loss of Townsend's big-eared bat, western mastiff bat, and long-eared myotis colonies. Potential direct impacts include the take of a maternity colony and the take of individuals in a hibernaculum, which could eliminate an entire colony because of the loss of pregnant females.

Spotted bats and long-eared myotis could also roost in crevices and caves in the Shasta Lake and vicinity portion of the primary study area. However, inundation of cave/cliff habitat is less likely to result in a significant impact on this population, because they do not roost colonially; thus, inundation of a cave would not result in the loss of an entire maternity colony.

Special-status bats may roost in bridges and could also be affected by bridge modification or removal. Direct impacts including mortality and the loss of roosting habitat would be significant.

Construction activities such as tree removal, site grading, and excavation and vegetation removal at the dam and in relocation areas while young bats are in maternity colonies or kits are in natal den trees could result in the incidental loss of young. Impacts on habitat would be the same as described for the impoundment area. This would be a potentially significant impact.

Implementation of the project would occur over 3 to 4 years. Impacts on these species could occur over multiple years if construction activities are conducted in or adjacent to reproductive habitat. This impact would be potentially significant.

Bats typically forage in open areas within the CWHR types listed as foraging habitat. Foraging habitat for the pallid bat, spotted bat, western mastiff bat, and Townsend's big-eared bat includes Douglas-fir, fresh emergent wetland, lacustrine, montane hardwood, montane hardwood–conifer, montane riparian, and ponderosa pine. These habitats are regionally abundant and therefore impacts on foraging habitat by inundation or vegetation removal in the relocation areas would be less than significant.

Dam construction, vegetation removal, and construction in the relocation areas, and inundation resulting from a 6.5-foot dam raise would result in the loss of 13 acres in the impoundment area and 24 acres in the relocation areas of habitat for the pallid bat, spotted bat, western mastiff bat, Townsend's big-eared bat and Yuma myotis (barren, blue oak woodland, and blue oak-foothill pine). There would be a loss of 1,194 acres in the impoundment area and 2,821 acres in the relocation areas of habitat for the western red bat, long-eared myotis, and ringtail (barren, blue oak woodland, blue oak–foothill pine, closed-cone pine-cypress, Douglas-fir, mixed chaparral, montane hardwood, montane hardwood-conifer, montane riparian, and ponderosa pine); and a loss of 605 acres in the impoundment area and 1,893 acres in the relocation areas of habitat for the

American marten (Douglas-fir, montane hardwood-conifer, montane riparian, and ponderosa pine). This impact would be potentially significant.

Impacts on suitable habitat by CWHR type in the impoundment area and relocation areas are summarized in Table 13-15.

Table 13-15. Impacts on Suitable Habitat for Special-Status Bats, American Marten, and Ringtail in the Impoundment Area and Relocation Areas (6.5-Foot Dam Raise)

Habitat	Area (acres*)					
	Main Body	Big Backbone Arm	Sacramento Arm	McCloud Arm	Squaw Creek Arm	Pit Arm
Impoundment Area						
Pallid Bat, Spotted Bat, Western Mastiff Bat, Townsend's Big-Eared Bat, and Yuma myotis						
Barren	0.57	0.00	0.25	0.00	0.00	0.00
Blue oak woodland	0.00	0.00	0.00	0.00	0.00	1.32
Blue oak–foothill pine	4.96	0.00	0.00	0.00	1.40	4.04
Total Habitat	5.53	0.00	0.25	0.00	1.40	5.36
Western Red Bat, Long-Eared Myotis and Ringtail						
Barren	0.57	0.00	0.25	0.00	0.00	0.00
Blue oak woodland	0.00	0.00	0.00	0.00	0.00	1.32
Blue oak–foothill pine	4.96	0.00	0.00	0.00	1.40	4.04
Closed-cone pine-cypress	17.75	0.00	6.30	10.74	23.95	188.29
Douglas-fir	0.00	0.00	0.00	0.01	0.00	0.00
Mixed chaparral	14.83	6.83	80.01	7.28	5.43	27.73
Montane hardwood	39.08	18.13	86.75	32.23	9.44	1.28
Montane hardwood–conifer	34.65	0.50	69.23	68.73	55.70	5.68
Montane riparian	1.54	2.48	15.92	4.60	0.58	0.80
Ponderosa pine	108.93	15.36	84.75	81.24	25.06	29.93
Total Habitat	222.31	43.30	34321	204.84	121.56	259.07
American Marten						
Douglas-fir	0.00	0.00	0.00	0.01	0.00	0.00
Montane hardwood–conifer	34.65	0.50	69.23	68.73	55.70	5.68
Montane riparian	1.54	2.48	15.92	4.60	0.58	0.80
Ponderosa pine	108.93	15.36	84.75	81.24	25.06	29.93
Total Habitat	145.13	18.34	169.90	154.59	81.34	36.41

Table 13-15. Impacts on Suitable Habitat for Special-Status Bats, American Marten, and Ringtail in the Impoundment Area and Relocation Areas (6.5-Foot Dam Raise) (contd.)

Habitat	Area (acres*)					
	Main Body	Big Backbone Arm	Sacramento Arm	McCloud Arm	Squaw Creek Arm	Pit Arm
Relocation Areas						
Townsend's Big-Eared Bat, Spotted Bat, Pallid Bat, Western Mastiff Bat, and Yuma Myotis						
Barren	0.00	0.00	0.00	0.82	0.00	0.00
Blue oak woodland	0.00	0.00	0.00	3.89	0.00	2.28
Blue oak–foothill pine	3.61	0.00	0.00	0.00	0.00	13.74
Total Habitat	3.61	0.00	0.00	4.71	0.00	15.75
Western Red Bat, Long-Eared Myotis, and Ringtail						
Barren	0.00	0.00	0.00	0.82	0.00	0.00
Blue oak woodland	0.00	0.00	0.00	3.89	0.00	2.28
Blue oak–foothill pine	3.61	0.00	0.00	0.00	0.00	13.74
Closed-cone pine-cypress	0.00	0.00	56.90	8.95	1.94	33.72
Douglas-fir	0.00	0.00	0.00	3.18	0.00	0.00
Mixed chaparral	25.68	0.00	120.00	46.36	4.44	134.82
Montane hardwood	48.21	0.00	198.56	214.87	6.34	3.44
Montane hardwood–conifer	121.63	0.00	205.41	316.45	42.22	42.28
Montane riparian	0.34	0.00	4.72	8.02	0.23	1.45
Ponderosa pine	185.06	0.00	466.94	406.43	43.08	45.30
Total Habitat	384.64	0.00	1052.52	1008.98	98.24	276.75
American Marten						
Douglas-fir	0.00	0.00	0.00	3.18	0.00	0.00
Montane hardwood–conifer	121.63	0.00	205.41	316.45	42.22	42.28
Montane riparian	0.34	0.00	4.72	8.02	0.23	1.45
Ponderosa pine	185.06	0.00	466.94	406.43	43.08	45.30
Total Habitat	307.03	0.00	677.07	734.08	85.53	89.03

Source: Data compiled by North State Resources, Inc., in 2011 based on habitat assessments and mapping

Note:
*Acreages are approximate.

Additional analysis of impacts will be conducted in relation to suitable habitats available in the Shasta Lake watershed. An analysis of indirect and temporary impacts will be completed in subsequent documents. Mitigation for this impact is proposed in Section 13.3.5.

Impact Wild-12 (CP1): Impacts on Special-Status Terrestrial Mollusks (Shasta Sideband, Wintu Sideband, Shasta Chaparral, and Shasta Hesperian) and Their Habitat All of these species are designated USFS sensitive and survey and manage species and are proposed for Federal listing. The Shasta sideband is also an MSCS-covered species. Ground-disturbing activities and vegetation removal associated with the construction of raising the dam, construction activities in the relocation areas, and removal of various amounts of vegetation in the impoundment areas could result in direct take and/or loss of suitable habitat for special-status terrestrial mollusks. In addition, the raising of Shasta Dam would result in the inundation of suitable habitat and direct take of these species. This impact would be significant.

These species are found in nearly all CWHR habitats along the lake. The Shasta sideband and Wintu sideband are associated with limestone formations in the McCloud River and in the Pit and Squaw Creek arms, respectively. Shasta chaparral is widespread and Shasta hesperian is found in mesic or riparian inclusions in most CWHR habitats.

Vegetation removal in the impoundment areas and construction activities such as tree removal, site grading, and excavation and vegetation removal at the dam and in relocation areas in suitable habitat could result in direct take. In addition, these activities and the inundation caused by a 6.5-foot dam raise would result in the mortality of individuals and the permanent loss of suitable habitat.

Dam construction, vegetation removal and construction in the relocation areas, and inundation resulting from a 6.5-foot dam raise would result in the loss of 1,195 acres in the impoundment area and 2,868 acres in the relocation areas of habitat for Shasta chaparral (annual grassland, barren, blue oak woodland, blue oak–foothill pine, closed-cone pine-cypress, Douglas-fir, mixed chaparral, montane hardwood, montane hardwood–conifer, montane riparian, and ponderosa pine), 260 acres in the impoundment area and 2,870 acres in the relocation areas for Shasta hesperian (Douglas-fir, montane hardwood conifer, and montane riparian), 5.17 acres of limestone habitat in the impoundment area and 35.71 acres in the relocation areas for the Shasta sideband, and 1.50 acres of limestone habitat in the impoundment area and no limestone habitat in the relocation areas for Wintu sideband. This impact would be potentially significant.

Impacts on suitable habitat by CWHR type in the impoundment area and relocation areas are summarized in Table 13-16.

Additional analysis of impacts will be conducted in relation to suitable habitats available in the Shasta Lake watershed. An analysis of indirect and temporary impacts will be provided in the FEIS. Mitigation for this impact is proposed in Section 13.3.5.

Table 13-16. Impacts on Suitable Habitat for Special-Status Terrestrial Mollusks in the Impoundment Area and Relocation Areas (6.5-Foot Dam Raise)

Habitat	Area (acres*)					
	Main Body	Big Backbone Arm	Sacramento Arm	McCloud Arm	Squaw Creek Arm	Pit Arm
Impoundment Area: Shasta Sideband						
Limestone	0.00	0.00	0.00	5.17	0.00	0.00
Impoundment Area: Wintu Sideband						
Limestone	0.00	0.00	0.00	0.00	0.00	1.50
Impoundment Area: Shasta Chaparral						
Annual grassland	0.07	0.00	0.96	0.37	0.00	0.00
Barren	0.57	0.00	0.25	0.00	0.00	0.00
Blue oak woodland	0.00	0.00	0.00	0.00	0.00	1.32
Blue oak–foothill pine	4.96	0.00	0.00	0.00	1.40	4.04
Closed-cone pine–cypress	17.75	0.00	6.30	10.74	23.95	188.29
Douglas-fir	0.00	0.00	0.00	0.01	0.00	0.00
Mixed chaparral	14.83	6.83	80.01	7.28	5.43	27.73
Montane hardwood	39.08	18.13	86.75	32.23	9.44	1.28
Montane hardwood–conifer	34.65	0.50	69.23	68.73	55.70	5.68
Montane riparian	1.54	2.48	15.92	4.60	0.58	0.80
Ponderosa pine	108.93	15.36	84.75	81.24	25.06	29.93
Total Habitat	222.38	43.30	344.18	205.21	121.56	259.07
Impoundment Area: Shasta Hesperian						
Douglas-fir	0.00	0.00	0.00	0.01	0.00	0.00
Montane hardwood–conifer	34.65	0.50	69.23	68.73	55.70	5.68
Montane riparian	1.54	2.48	15.92	4.60	0.58	0.80
Total Habitat	36.19	2.98	85.15	73.34	56.28	6.48
Relocation Areas: Shasta Sideband						
Limestone	0.00	0.00	0.00	35.71	0.00	0.00
Relocation Areas: Wintu Sideband						
Limestone	0.00	0.00	0.00	0.00	0.00	0.00
Relocation Areas: Shasta Chaparral						
Annual grassland	5.05		29.02	10.65	1.29	1.25
Barren	0.00	0.00	0.00	0.81	0.00	0.00
Blue oak woodland	0.00	0.00	0.00	3.89	0.00	2.28
Blue oak–foothill pine	3.61	0.00	0.00	0.00	0.00	13.74
Closed-cone pine–cypress	0.11	0.00	56.90	8.95	1.94	33.72
Douglas-fir	0.00	0.00	0.00	3.18	0.00	0.00

Table 13-16. Impacts on Suitable Habitat for Special-Status Terrestrial Mollusks in the Impoundment Area and Relocation Areas (6.5-Foot Dam Raise) (contd.)

Habitat	Area (acres*)					
	Main Body	Big Backbone Arm	Sacramento Arm	McCloud Arm	Squaw Creek Arm	Pit Arm
Mixed chaparral	25.68	0.00	120.00	46.36	4.44	134.82
Montane hardwood	48.21	0.00	198.56	214.87	6.34	3.44
Montane hardwood–conifer	121.63	0.00	205.41	316.45	42.22	42.28
Montane riparian	0.34	0.00	4.72	8.02	0.23	1.45
Ponderosa pine	185.06	0.00	466.94	406.43	43.08	45.30
Total Habitat	389.69	0.00	1081.54	1019.62	99.53	278.00
Relocation Areas: Shasta Hesperian						
Douglas-fir	0.00	0.00	0.00	3.18	0.00	0.00
Montane hardwood–conifer	121.63	0.00	205.41	316.45	42.22	42.28
Montane riparian	0.34	0.00	4.72	8.02	0.23	1.45
Total Habitat	121.97	0.00	210.13	327.65	42.45	43.73

Source: Data compiled by North State Resources, Inc., in 2011 based on habitat assessments and mapping

Note:
**Acres are approximate.*

Impact Wild-13 (CP1): Permanent Loss of General Wildlife Habitat
Construction activities and vegetation removal associated with the construction of raising the dam, construction activities in the relocation areas, and removal of various amounts of vegetation in the impoundment areas would result in a permanent loss of habitat. In addition, inundation caused by the raising of Shasta Dam would result in the permanent loss of habitat. This would be a potentially significant impact.

Dam construction, vegetation removal and construction in the relocation areas, and inundation resulting from a 6.5-foot dam raise would result in a loss of 1,221 acres of general wildlife habitat in the impoundment area and 3,127 acres of general wildlife habitat in the relocation areas. Impacts on general wildlife habitat by CWHR type in the impoundment area and relocation areas are summarized in Tables 13-17 and 13-18.

Additional analysis of impacts will be conducted in relation to suitable habitats available in the Shasta Lake watershed. An analysis of indirect impacts and temporary impacts will be completed in subsequent documents. Mitigation for this impact is proposed in Section 13.3.5.

Table 13-17. Impacts on CWHR Habitats in the Impoundment Area (6.5-Foot Dam Raise)

Habitat	Area (acres*)					
	Main Body	Big Backbone Arm	Sacramento Arm	McCloud Arm	Squaw Creek Arm	Pit Arm
Annual grassland	0.07	0.00	0.96	0.37	0.00	0.00
Barren	0.57	0.00	0.25	0.00	0.00	0.00
Blue oak–foothill pine	4.96	0.00	0.00	0.00	1.40	4.04
Blue oak woodland	0.00	0.00	0.00	0.00	0.00	1.32
Closed-cone pine–cypress	17.75	0.00	6.30	10.74	23.95	188.29
Douglas-fir	0.00	0.00	0.00	0.01	0.00	0.00
Mixed chaparral	14.83	6.83	80.01	7.28	5.43	27.73
Montane hardwood	39.08	18.13	86.75	32.23	9.44	1.28
Montane hardwood–conifer	34.65	0.50	69.23	68.73	55.70	5.68
Montane riparian	1.54	2.48	15.92	4.60	0.58	0.80
Ponderosa pine	108.93	15.36	84.75	81.24	25.06	29.93
Riverine	0.00	0.35	2.30	3.81	0.59	0.00
Urban	10.95	0.00	1.37	4.74	0.00	0.75
Total	233.33	43.65	347.84	213.75	122.14	259.82

Source: Data compiled by North State Resources, Inc., in 2011 based on habitat assessments and mapping
Note:
*Acreage values are approximate.

Table 13-18. Impacts on CWHR Habitats in the Relocation Areas

Habitat	Area (acres*)					
	Main Body	Big Backbone Arm	Sacramento Arm	McCloud Arm	Squaw Creek Arm	Pit Arm
Annual grassland	5.05	0.00	29.02	10.65	1.29	1.25
Barren	0.00	0.00	0.00	0.82	0.00	0.00
Blue oak–foothill pine	3.61	0.00	0.00	0.00	0.00	13.74
Blue oak woodland	0.00	0.00	0.00	3.89	0.00	2.28
Closed-cone pine–cypress	0.11	0.00	56.90	8.95	1.94	33.72
Douglas-fir	0.00	0.00	0.00	3.18	0.00	0.00
Mixed chaparral	25.68	0.00	120.00	46.36	4.44	134.82
Montane hardwood	48.21	0.00	198.56	214.87	6.34	3.44
Montane hardwood–conifer	121.63	0.00	205.41	316.45	42.22	42.28
Montane riparian	0.34	0.00	4.72	8.02	0.23	1.45
Ponderosa pine	185.06	0.00	466.94	406.43	43.08	45.30
Riverine	0.00	0.00	0.39	3.75	0.00	0.00
Urban	21.05	0.00	230.58	0.48	0.00	2.49
Total	410.74	0.00	1312.51	1023.85	99.53	280.48

Source: Data compiled by North State Resources, Inc., in 2011 based on habitat assessments and mapping
Note:
**Acreage values are approximate.*

Impact Wild-14 (CP1): Impacts on Other Birds of Prey (i.e., red-tailed hawk and red-shouldered hawk) and Migratory Bird Species (i.e., American robin, Anna's hummingbird) and their Foraging and Nesting Habitat Construction activities and vegetation removal associated with the construction of raising the dam, construction activities in the relocation areas, and removal of various amounts of vegetation in the impoundment areas during the nesting season could result in the incidental loss of fertile eggs or nestlings or otherwise lead to the abandonment of nests of other birds of prey and migratory bird species. In addition, inundation caused by the raising of Shasta Dam would result in the

loss of active nests and habitat for these species. This impact would be potentially significant.

Approximately 36 percent of the impoundment area would have either complete (15 percent) or overstory (21 percent) vegetation removal. If vegetation removal were to occur prior to or after the breeding season, there would be no impact on migratory birds or raptors. If inundation of the impoundment area were to occur, nest trees within the impoundment area would die. Because peak inundation generally occurs between late April and early June, nest trees would be flooded toward the end of the nesting season. If raptors were nesting in these trees, it is likely young would fledge before the nest tree died from the effects of inundation. However, approximately 84 percent of understory vegetation inundated could have ground or shrub nesting birds that would be impacted by inundation. Impacts on ground or understory nesters would be potentially significant.

Maximum inundation would occur in late April through early June during the breeding season and many nests could be established before and while lake levels are rising. In the portions of the impoundment where vegetation removal is not implemented, active bird nests would flood, resulting in mortality of young still dependent on the nest. This would be a potentially significant impact.

Additionally, removal of structures providing for raptor nests (e.g., power poles in the relocation areas could result in mortality of young. This would be a potentially significant impact.

Vegetation in relocation areas would be completely removed. If vegetation removal were to occur prior to or after the breeding season, there would be no impact on migratory birds or raptors.

Implementation of the project would occur over 3 to 4 years. Impacts on these species could occur over multiple years if construction activities were conducted in or adjacent to reproductive habitat. This impact would be potentially significant.

Additional analysis of impacts will be conducted in relation to suitable habitats available in the Shasta Lake watershed. An analysis of indirect impacts and temporary impacts will be completed in subsequent documents. Mitigation for this impact is proposed in Section 13.3.5.

Impact Wild-15 (CP1): Loss of Critical Deer Winter and Fawning Range
Construction activities and vegetation removal associated with the construction of raising the dam, construction activities in the relocation areas, and removal of various amounts of vegetation in the impoundment areas would result in a loss of critical deer winter and fawning range. In addition, inundation caused by the

raising of Shasta Dam would result in the loss of critical deer range. This impact would be potentially significant.

Critical winter range is located on the west side of each arm of the lake, and critical fawning is located on the south-facing slope of Little Sugarloaf Creek. Critical range describes a deer corridor rather than specific habitats. Vegetation removal in the relocation areas and inundation of the impoundment area would result in the loss of critical winter and fawning range. This impact would be potentially significant.

Additional analysis of impacts will be conducted in relation to suitable habitats available in the Shasta Lake watershed. An analysis of indirect impacts and temporary impacts will be completed in the FEIS. Mitigation for this impact is proposed in Section 13.3.5.

Impact Wild-16 (CP1): Take and Loss of the California Red-Legged Frog
Reclamation is concurrently completing an assessment of California red-legged frog habitat, which will be submitted to USFWS for review. Using the results of this assessment, USFWS will determine whether surveys are needed. Impacts on the California red-legged frog will be assessed if surveys are conducted and the California red-legged frog is found. Impacts for each alternative will not be assessed until USFWS has determined whether suitable habitat is present and whether surveys would be required. Mitigation for this impact is proposed in Section 13.3.5.

Upper Sacramento River (Shasta Dam to Red Bluff)
Impact Wild-17 (CP1): Impacts on Riparian-Associated Special-Status Wildlife Resulting from Modifications to the Existing Flow Regime in the Primary Study Area Implementation of CP1 would result in a modified flow regime that would reduce the frequency, duration, and magnitude of intermediate to large flows below Shasta Dam during winter and spring in some years, and would increase the volume of flows from spring through fall of most years. This change in surface and subsurface hydrology could affect habitats adjacent to the river channel and the formation of off-channel habitats. Reduced formation of off-channel habitat would be a substantial long-term effect on the habitat of western pond turtle. Also, although the total amount of riparian vegetation would not be substantially altered, the portion of riparian vegetation in early successional stages would be reduced. These early successional stages provide habitat for some special-status wildlife species. In particular, these changes could result in substantial effects on the distribution or abundance of riparian-nesting special-status bird species. Therefore, this impact would be potentially significant.

The operation of Shasta Dam has substantially modified the natural flow regime within the primary study area. Construction and operation of the dam has limited the frequency and magnitude of intermediate to large flows in winter and spring, and has increased flow volumes during the active growing season

(primarily March through October). Project implementation would be expected to amplify these effects. Reducing the magnitude, frequency, and duration of intermediate to large flows could alter the dynamics and structure of wetland and riparian habitats that support special-status wildlife species along the Sacramento River, downstream from Shasta Dam, throughout the primary study area (see Chapter 12, "Botanical Resources," for more information). The effects of modified flow regimes would be attenuated downstream because of the cumulative tributary flow adding to the Sacramento River.

Special-status wildlife that could be affected by these changes includes special-status invertebrates, reptiles, amphibians, birds, and mammals, as discussed below.

- **Invertebrates** – Blue elderberry shrubs, the host plant for the valley elderberry longhorn beetle, are found throughout much of the Sacramento River's riparian corridor. Shrubs within the corridor are unlikely to be affected by modification of the existing flow regimes. Elderberry shrubs are not commonly found growing immediately next to the river's edge, but are often found on terraces or higher up the bank. Most of the effect on flow regime, including inundation during the growing season, would be concentrated in a narrow strip along the river channel that is already subjected to seasonal inundation. Because elderberry growing in these areas are already experience seasonal inundation periodically, the project is not likely to prevent establishment or substantially reduce the vigor of existing elderberry shrubs in the primary study area; therefore, this impact would be less than significant.

- **Reptiles and Amphibians** – The western pond turtle has been documented within the Sacramento River, and suitable habitat for the species is provided within the primary study area, including tributaries. Western pond turtles rely on habitat types (e.g., oxbow lakes) that have relatively slow rates of formation. Creation of new off-channel water bodies requires the periodic intermediate to large fall and winter flow events that drive the processes of meander migration and channel cutoff. Similarly, off-channel water bodies gradually "terrestrialize" (become terrestrial habitats) as they fill with sediment and organic detritus, and as they are colonized by vegetation. Consequently, activities that prevent the formation of off-channel water bodies (e.g., construction of levees and installation of bank armor) over the long term reduce the extent this important type of habitat for pond turtles. The increase in mean stage elevation resulting from project implementation could provide additional aquatic habitat for the species during some months of some years. However, less aquatic habitat could be available for northwestern pond turtle during winter, spring, and drought periods. Modifying the flow regime could also reduce the formation of off-channel water bodies over the long term. These

changes in habitat availability could reduce the size of the population along the Sacramento River over the long term. Therefore, alteration of habitat for the northwestern pond turtle would be a potentially significant impact.

- **Birds** – The riparian and wetland habitats along the Sacramento River floodway provide potential nesting and foraging habitat for western yellow-billed cuckoo, California yellow warbler, and yellow-breasted chat, all of which are special-status birds that nest in riparian vegetation. In addition, northern harrier and short-eared owl may nest in marshes in or adjacent to the stream channel. Other raptors—Cooper's hawk, Swainson's hawk, white-tailed kite, bald eagle, and osprey—may nest in trees in the riparian or oak woodlands in the study area. As described above, altering the flow regime could alter some existing riparian habitat. Over time, there would be less early successional (willow, cottonwood, and herbaceous dominated) and more mid-successional (mixed woodland) vegetation and a smaller amount of acreage recently disturbed by erosion or scouring after intermediate to large flows, as described in Chapter 12, "Botanical Resources." These long-term changes to the structure of riparian vegetation are expected to result in a reduction of habitat value sufficient to cause the loss of nesting territories or affect the reproductive success of some riparian foraging and nesting birds. The birds most affected by this alteration would be those that make the most extensive use of willow thickets and cottonwood and willow-dominated riparian forests. This impact on special-status bird species that nest in riparian vegetation would be potentially significant.

- **Mammals** – Special-status mammals potentially occurring in the project area include pallid bat, western red bat, and ringtail. Riparian habitat can provide important foraging and roosting habitat for bats, but these species are not typically dependent on riparian habitats. The amount of potential foraging habitat would not decrease, and available riparian habitats – even if modified by the new flow regime below Shasta Dam – would still be sufficient for roosting habitat such that impacts on special-status bats would be less than significant. Potential changes in riparian vegetation along the river channel in the study area would not substantially reduce habitat for ringtail. Therefore, impacts on special-status mammals would be less than significant.

Because of substantial long-term effects on the habitat of northwestern pond turtle and some riparian-nesting special-status bird species, this impact would be potentially significant. Mitigation for this impact is proposed in Section 13.3.5.

Impact Wild-18 (CP1): Impacts on Bank Swallow in the Primary Study Area Resulting from Modifications of Geomorphic Processes CP1 would cause a

small reduction in the magnitude, duration, and frequency of intermediate to large flows, which also would alter the geomorphic processes along the Sacramento River, including the rate of bank erosion in the primary study area. However, the length of eroding banks would not be substantially altered, and thus, nesting habitat for bank swallows would not be substantially reduced. High flows during the nesting season that may cause localized nest failure would not be increased. The impact on habitat for bank swallow nesting colonies would be less than significant.

There are five known colonies of bank swallow along the Sacramento River in the primary study area (CNDDB 2007). The bank swallow forms nesting colonies in steep-cut, eroding, river banks. Bank revetment has been preferentially applied to actively migrating bends which would otherwise be among the most suitable sites for bank swallow nests. The small reduction in intermediate to large flows by CP1 would cause a small reduction in the rate of erosion at the cut banks that remain unprotected by revetment. This alteration would not reduce the amount of bank swallow nesting habitat in the short or long term. Spring flows would remain comparable to existing and no-action conditions, and thus, the potential for spring flows to cause localized nest failure would remain comparable to existing and no-action conditions. Therefore, the impact to bank swallow would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact Wild-19 (CP1): Disturbance or Removal of Vernal Pool Habitat for Special-Status Wildlife from Changes in Flow Regime Construction-related disturbances at Shasta Dam are not anticipated to disturb or permanently remove vernal pool habitat for special-status wildlife species along the upper Sacramento River. Altered flow regimes resulting from project-related dam operation are also not anticipated to temporarily disturb or permanently remove vernal pool habitat for special-status wildlife species. This impact would be less than significant.

Vernal pools are present in upland areas near the Sacramento River and its tributaries in the primary study area. These pools provide habitat for numerous special-status species, such as vernal pool tadpole shrimp, vernal pool fairy shrimp, and western spadefoot toad. Critical habitat for three special-status wildlife species – Conservancy fairy shrimp, vernal pool fairy shrimp, and vernal pool tadpole shrimp – Is located within the primary study area. Critical habitat for these species in the primary study area is confined to vernal pool communities (USFWS 2006).

Vernal pools are generally not present within the active floodplain of regulated rivers in the primary study area; thus, vernal pools are not anticipated to be affected by dam construction, use of staging areas, and/or movement of heavy equipment during construction. Changes in flow regime in the primary study area likely would not affect vernal pool special-status species. Therefore, this

impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact Wild-20 (CP1): Consistency with Local and Regional Plans with Goals of Promoting Riparian Habitat in the Primary Study Area Several conservation and management plans have been adopted in the primary and extended study areas with goals of promoting riparian habitat along the Sacramento River. Because flow regimes and riverine geomorphic processes could be altered with project implementation, riparian habitat could be affected in such a manner that the goals of the local and regional plans would be less likely to be attained. This potential conflict between the project and local and regional plans to promote riparian habitat would be a potentially significant impact.

Several local and regional plans have been developed and adopted to promote conservation and enhancement of riparian habitat in the primary and extended study areas: the RHJV, Sacramento River Advisory Council Forum, Sacramento River Conservation Area Program, SRNWR comprehensive conservation plan and environmental assessment, and others. (See Section 13.2, "Regulatory Setting.")

Because the project may have a potentially significant impact on riparian vegetation within the primary and extended study areas, the quality of riparian habitat may be reduced or distribution may be limited. This potential consequence of the project could conflict with the goals developed in local and regional conservation plans for the Sacramento River. Conflict of the project with the local and regional plans would be a potentially significant impact. Mitigation for this impact is proposed in Section 13.3.5.

Impact Wild-21 (CP1): Impacts on Riparian-Associated Special-Status Wildlife Resulting from the Gravel Augmentation Program CP1 would not include the gravel augmentation program. There would be no impact. Mitigation for this impact is not needed, and thus not proposed.

Impact Wild-22 (CP1): Impacts on Riparian-Associated Special-Status Wildlife Species Resulting from Restoration of Reading Island CP1 would not include Reading Island restoration. There would be no impact. Mitigation for this impact is not needed, and thus not proposed.

Lower Sacramento River and Delta By altering storage and operations at several reservoirs, CP1 would change flow regimes in several downstream waterways. In turn, these alterations to the flow regime could particularly affect riparian and wetland habitats along these waterways. The potential effects on wildlife are similar to those discussed for the primary study area above. However, potential effects on flow and stages of the middle Sacramento River would be smaller than on the upper Sacramento River; changes in flows and

stages would diminish downstream from Red Bluff because of the effects of inflows from tributaries, and the effects of diversions and flood bypasses.

Impact Wild-23 (CP1): Impacts on Riparian-Associated and Aquatic Special-Status Wildlife Resulting from Modifications to Existing Flow Regimes in the Lower Sacramento River and Delta Implementation of CP1 would modify the flow regime and would reduce the frequency, duration, and magnitude of intermediate to large flows in the lower Sacramento River during winter and spring in some years, and would increase the volume of flows from spring through fall of most years. Although this change in surface and subsurface hydrology would be less than in the upper Sacramento River, it could affect habitats adjacent to the river channel and the formation of off-channel habitats along the middle Sacramento River. Reduced formation of off-channel habitat would be a substantial long-term effect on the habitat of western pond turtle. Also, although the total amount of riparian vegetation would not be substantially altered, the portion of riparian vegetation in early successional stages would be reduced. These early successional stages provide habitat for some special-status wildlife species. In particular, these changes could result in substantial effects on the distribution or abundance of riparian-nesting special-status bird species. Therefore, this impact would be potentially significant.

This impact would be similar to Impact Wild-17 (CP1). However, the effect of CP1 on flow in the Sacramento River would attenuate below RBDD because of the inflows from tributaries, and because of other diversions and flood bypasses. Nonetheless, along the middle Sacramento River, flow alterations could be sufficient to substantially affect habitat of western pond turtle and riparian-nesting birds as described for the upper Sacramento River. This impact would be potentially significant.

Flow alterations may not be sufficient to measurably affect special-status wildlife in the bypasses, along the Sacramento River below Colusa, or in the Delta. Flow alterations are more attenuated downstream by tributaries, diversions, and bypasses, and CalSim modeling indicated little change in the frequency and duration of bypass inundation. Also, downstream from Colusa, the river is confined to a narrow channel closely bordered by levees lined with riprap, and thus geomorphic processes (and thus riparian habitats) are relatively unresponsive to small changes in river flows. Furthermore, effects of flow alterations are also unlikely to extend to the Delta because the Central Valley's reservoirs and diversions are managed as a single integrated system (consisting of the CVP and SWP). The guidelines for this management, which are described in the Long-Term Operations Criteria and Plan (OCAP), have been designed to maintain standards for Delta inflow. CVP and SWP operations must be consistent with the OCAP to allow coverage by USFWS's and NMFS's OCAP BOs. Thus, this project is not anticipated to cause an alteration in Sacramento River flow to the Delta sufficient to alter habitat for special-status wildlife species in the lower Sacramento River and Delta portion of the extended study area.

Because of the potential for substantial effects on western pond turtle and riparian-nesting birds in the middle Sacramento River (i.e., RBDD to Colusa), this impact would be potentially significant. Mitigation for this impact is proposed in Section 13.3.5.

Impact Wild-24 (CP1): Impacts on Bank Swallow Along the Lower Sacramento River Resulting from Modifications of Geomorphic Processes The effect of CP1on bank swallow habitat along the lower Sacramento River would be similar to the effect along the upper Sacramento River, but smaller because the effect of CP1 on river flows would attenuate with distance downstream. The rate of bank erosion would be reduced, but the length of eroding banks would not be substantially altered, and thus, nesting habitat for bank swallows would not be substantially reduced. High flows during the nesting season that may cause localized bank and nest failure would not be increased. The impact on habitat for bank swallow nesting colonies would be less than significant.

There are more than 100 presumed extant colonies of bank swallow in Butte, Glenn, Colusa, Yuba, Yolo, Sutter, and Sacramento counties (CNDDB 2007). The effect on bank swallow along the lower Sacramento River would be similar to that described for the upper Sacramento River: a small reduction in the rate of erosion, but not a substantial change in the amount of bank swallow nesting habitat, or in spring flows that may cause localized nest failure. However, the effect of altered flow regimes on bank swallow nesting habitat along the lower Sacramento River would be smaller than along the upper Sacramento River, because flow alterations would be attenuated in the Sacramento River below RBDD because of the inflows from tributaries, and because of other diversions and flood bypasses. This impact on bank swallow would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact Wild-25 (CP1): Disturbance or Removal of Vernal Pool Habitat for Special-Status Wildlife Along the Lower Sacramento River and in the Delta from Changes in Flow Regime of the Sacramento River and Affected Tributaries, and Changes in Seasonal Water Availability Altered flow regimes as a result of dam operation associated with the project are not anticipated to temporarily disturb or permanently remove vernal pool habitat for special-status wildlife species in the lower Sacramento River and Delta portion of the extended study area. This impact would be less than significant.

Vernal pools are present in upland areas near the Sacramento River and its tributaries in the extended study area. These pools provide habitat for numerous special-status species. Critical habitat for three special-status species – vernal pool fairy shrimp, vernal pool tadpole shrimp, and Conservancy fairy shrimp – Is located within the extended study area. Critical habitat for these species is confined to vernal pool communities (USFWS 2006).

Vernal pools are generally not present within the active floodplain of regulated rivers along the lower Sacramento River and in the Delta. Vernal pool special-

status species would also not likely be affected by changes in flow regime in the extended study area. Therefore, this impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact Wild-26 (CP1): Consistency with Local and Regional Plans with Goals of Promoting Riparian Habitat Along the Lower Sacramento River and in the Delta Several conservation and management plans have been adopted in the primary and extended study areas with goals of promoting riparian habitat along the Sacramento River. Because flow regimes and riverine geomorphic processes could be altered with project implementation, riparian habitat could be affected in such a manner that the goals of the local and regional plans would be less likely to be attained. This potential conflict between the project and local and regional plans to promote riparian habitat would be a potentially significant impact.

As discussed in Impact Wild-20 (CP1) for the upper Sacramento River, several local and regional plans have been developed and adopted to promote conservation and enhancement of riparian habitat in the primary and extended study areas: the RHJV, Sacramento River Advisory Council Forum, Sacramento River Conservation Area Program, SRNWR comprehensive conservation plan and environmental assessment, and others. (See Section 13.2, “Regulatory Framework.”)

Because the project may have a potentially significant impact on riparian vegetation within the primary and extended study areas, the quality of riparian habitat may be reduced or distribution may be limited. This potential consequence of the project could conflict with the goals developed in local and regional conservation plans for the Sacramento River. Conflict of the project with the local and regional plans would be a potentially significant impact.

CVP/SWP Service Areas Increased water supplies or increased supply reliability could reduce a limitation on growth or on other activities that could affect wildlife in the primary and extended study areas, potentially resulting in significant effects. The effects of this growth would be analyzed in general plan Environmental Impact Reports and in project-level CEQA compliance documents for the local jurisdictions in which the growth would occur. Mitigation of these effects would be the responsibility of these local jurisdictions, and not of Reclamation. The expected increase in water yield relative to the entire CVP/SWP service areas would be small, however. Assuming that this new yield could be provided to any number of geographic areas within the CVP and SWP service areas, the project’s impact on growth that could affect vegetation would be minor. Similarly, projects potentially affecting most aquatic habitats and listed species would require permits from DFG, USACE, and USFWS; it is anticipated that effects on these resources would be avoided, minimized, and/or mitigated during those agency consultations. Because the extent, location, and timing of induced growth is currently highly uncertain, and in the future the effects of this growth would be

analyzed and mitigated during land use planning and environmental review for specific projects, growth-inducing effects on wildlife are not discussed further in this chapter. However, additional discussion of growth-inducing effects specific to the project alternatives is provided in Section 26.4, "Growth-Inducing Impacts," in Chapter 26, "Other Required Disclosures."

Impact Wild-27 (CP1): Impacts on Riparian-Associated or Aquatic Special-Status Wildlife in the CVP/SWP Service Areas Resulting from Modifications to Existing Flow Regimes By altering storage and operations at several reservoirs associated with the CVP and SWP service areas, CP1 would change flow regimes in several downstream waterways. Modified flow regimes would reduce the frequency, duration, and magnitude of intermediate to large flows along the Sacramento River. However, based on the CalSim-II modeling results, the hydrologic effects on tributaries with CVP and SWP dams are expected to be less than effects on the Sacramento River. Most potential noticeable changes in flows and stages would diminish downstream from Red Bluff. The change in surface and subsurface hydrology could affect habitats adjacent to the river channel that provide habitat for special-status wildlife species. These changes are unlikely to result in substantial effects on the distribution or abundance of riparian-associated or aquatic special-status wildlife species in the CVP and SWP service areas outside of the primary study area. Therefore, this impact would be less than significant.

Several riparian-associated or aquatic special-status wildlife species may be present in the CVP and SWP service areas, such as least Bell's vireo and arroyo toad. As discussed under Impact Wild-17 (CP1) for the upper Sacramento River and Impact Wild-21 (CP1) for the lower Sacramento River and Delta portion of the extended study area, construction and operation of Shasta Dam has limited the frequency and magnitude of intermediate to large flows in winter and spring, and has increased flow volumes during the active growing season (primarily March–October). Project implementation would be expected to amplify these effects. However, the effect of altered flow regimes by the project would attenuate in the Sacramento River below RBDD because of the inflows from tributaries, and because of other diversions and flood bypasses. Effects of flow alterations from Shasta Dam are also unlikely to extend to the CVP and SWP service areas because the reservoirs and diversions are managed as a single integrated system (consisting of the CVP and SWP). The guidelines for this management, which are described in the OCAP, have been designed to maintain standards for Delta inflow. CVP and SWP operations must be consistent with the OCAP to allow coverage by the OCAP biological opinion. Thus, this project is not anticipated to sufficiently alter flow to the CVP/SWP service areas to have a substantial effect on riparian habitat upon which special-status wildlife species depend. Therefore, this impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

CP2 – 12.5-Foot Dam Raise, Anadromous Fish Survival and Water Supply Reliability

Like CP1, this comprehensive plan focuses on enlarging Shasta Dam and Shasta Lake consistent with the goals of the 2000 CALFED ROD, and was formulated for the primary purposes of increased water supply reliability and increased survival of anadromous fish. In addition to the common features above, CP2 involves raising Shasta Dam 12.5 feet, an elevation change that would raise the full pool by 14.5 feet (6 feet higher than under CP1) and would enlarge the total storage space in the reservoir by 443,000 acre-feet.

With respect to wildlife impacts, dam construction activities for CP1 through CP5 would be so similar that they are considered to be identical for purposes of this analysis. Because CP2 would result in higher lake levels than CP1, CP2 would also require more relocation of utilities, public service facilities, and recreational facilities than CP1. However, the wildlife impact analysis for CP1 assumes maximum impacts related to mechanized vegetation clearing and construction within the relocation areas. Therefore, vegetation clearing and construction impacts within the relocation areas would be identical for CP1–CP5. Because CP2 would result in higher lake levels than CP1, CP2 would result in a larger (and deeper) area of inundation than CP1, in turn requiring more vegetation clearing within the inundation area than CP1.

Shasta Lake and Vicinity

Impact Wild-1 (CP2): Take and Loss of Habitat for the Shasta Salamander

Ground-disturbing activities associated with construction could result in direct take of the Shasta salamander, a State-listed species, USFS sensitive species, survey and manage species, MSCS-covered species, and BLM sensitive species. In addition, the raising of Shasta Dam would result in the inundation of habitat for this species. This impact would be significant.

Impacts caused by construction and vegetation clearing for the dam and relocation areas would be similar to CP1. However, inundation caused by a 12.5-foot raise of Shasta Dam would result in a greater loss of suitable habitat for the Shasta salamander. This impact would be significant.

Inundation resulting from a 12.5-foot dam raise would result in a loss of 10 acres of limestone habitat and 1,689 acres of nonlimestone habitat. Impacts on limestone and nonlimestone by CWHR type providing suitable habitat in the impoundment area are summarized in Table 13-19.

Additional analysis of impacts will be conducted in relation to suitable habitats available in the Shasta Lake watershed or in the species range (if appropriate). Surveys of the Shasta salamander are ongoing and it is anticipated that protocol-level surveys will be conducted within the dam construction footprint and all relocation area footprints. Protocol-level surveys would provide specific information about the presence or absence of Shasta salamanders within individual construction footprints. Mitigation for acres affected would then be

refined based on these results. Direct and indirect impacts based on those results will be reported in the FEIS. Additionally, other indirect and temporary impacts will be analyzed in the FEIS. Mitigation for this impact is proposed in Section 13.3.5.

Table 13-19. Impacts on Suitable Habitat for the Shasta Salamander in the Impoundment Area (12.5-Foot Dam Raise)

Habitat	Area (acres*)					
	Main Body	Big Backbone Arm	Sacramento Arm	McCloud Arm	Squaw Creek Arm	Pit Arm
Limestone	0.00	1.14	0.00	7.29	0.00	2.06
Nonlimestone	310.46	60.07	494.61	292.21	171.03	358.92
Total	310.46	61.21	494.61	299.50	171.03	360.98

Source: Data compiled by North State Resources, Inc., in 2011 based on habitat assessments and mapping
Note:
*Acreage values are approximate.

Impact Wild-2 (CP2): Impact on the Foothill Yellow-Legged Frog and Tailed Frog and Their Habitat Ground-disturbing activities associated with construction could result in direct take (e.g., because of operation of equipment in or adjacent to riverine or riparian habitat) of the foothill yellow-legged frog, a California species of special concern, a USFS sensitive species, an MSCS-covered species, and a BLM sensitive species, and of the tailed frog, a California species of special concern. In addition, the raising of Shasta Dam would result in the conversion of suitable riverine and riparian habitat to unsuitable lacustrine habitat. This impact would be potentially significant.

Impacts caused by construction and vegetation clearing for the dam and relocation areas would be similar to CP1. However, inundation caused by a 12.5-foot raise of Shasta Dam would result in a greater loss of suitable habitat for the foothill yellow-legged and tailed frogs. This impact would be potentially significant.

Implementation of a 12.5-foot raise of the dam would result in inundation of 45 acres of habitat for the foothill yellow-legged frog and tailed frog. A summary of suitable habitat loss by arm is presented in Table 13-20.

Additional analysis of impacts will be conducted in relation to suitable habitats available in the Shasta Lake watershed. An analysis of indirect impacts and temporary impacts will be completed in subsequent documents. Mitigation for this impact is proposed in Section 13.3.5.

Table 13-20. Impacts on Suitable Habitat for the Foothill Yellow-Legged and Tailed Frog in the Impoundment Area (12.5-Foot Dam Raise)

Habitat	Area (acres*)					
	Main Body	Big Backbone Arm	Sacramento Arm	McCloud Arm	Squaw Creek Arm	Pit Arm
Montane riparian	2.72	3.23	20.57	6.12	1.00	1.19
Riverine	0.00	0.42	4.02	4.51	0.84	0.00
Total	2.72	3.65	24.59	10.63	1.84	1.19

Source: Data compiled by North State Resources, Inc., in 2011 based on habitat assessments and mapping
Note:
*Acreage values are approximate.

Impact Wild-3 (CP2): Impact on the Northwestern Pond Turtle and Its Habitat
Ground-disturbing activities associated with construction could result in direct take (e.g., because of operation of equipment in or adjacent to riverine or riparian habitat) of the northwestern pond turtle, an MSCS-covered species, a California species of special concern, and a USFS sensitive species. In addition, project implementation could result in the degradation of suitable aquatic habitat because of increased erosion and sedimentation. This impact would be potentially significant.

Impacts caused by construction and vegetation clearing for the dam and relocation areas would be similar to CP1. However, inundation caused by a 12.5-foot raise of Shasta Dam would result in a greater loss of suitable habitat for the northwestern pond turtle. This impact would be potentially significant.

Implementation of a 12.5-foot raise of the dam would result in conversion of 35 acres of montane riparian and 10 acres of riverine habitat to lacustrine habitat. Because there are equally valuable components lost or gained in either habitat, the quality of the habitat would not be compromised. However, maximum lake inundation would be infrequent (at most 1 month per year) and would not benefit the species throughout the remainder of the year. Thus, the conversion to lacustrine remains an impact on northwestern pond turtle habitat. A summary of suitable habitat loss by arm is presented in Table 13-21.

Additional analysis of impacts will be conducted in relation to suitable habitats available in the Shasta Lake watershed or in the species range. Analysis impacts on upland habitats will be quantified. An analysis of indirect impacts and temporary impacts will be completed in subsequent documents. Mitigation for this impact is proposed in Section 13.3.5.

Table 13-21. Impacts on Suitable Habitat for the Northwestern Pond Turtle in the Impoundment Area (12.5-Foot Dam Raise)

Habitat	Area (acres*)					
	Main Body	Big Backbone Arm	Sacramento Arm	McCloud Arm	Squaw Creek Arm	Pit Arm
Montane riparian	2.72	3.23	20.57	6.12	1.00	1.19
Riverine	0.00	0.42	4.02	4.51	0.84	0.00
Total	2.72	3.65	24.59	10.63	1.84	1.19

Source: Data compiled by North State Resources, Inc., in 2011 based on habitat assessments and mapping
Note:
*Acreage values are approximate.

Impact Wild-4 (CP2): Impact on the American Peregrine Falcon Construction activities and vegetation removal associated with the construction of raising the dam, construction activities in the relocation areas, and removal of various amounts of vegetation in the impoundment areas during the nesting season could result in the incidental loss of fertile eggs or nestlings or otherwise lead to the abandonment of nests of American peregrine falcons, a State fully protected species and MSCS-covered species. This impact would be potentially significant.

Impacts caused by construction and vegetation clearing for the dam and relocation areas would be similar to CP1. However, inundation caused by a 12.5-foot raise of Shasta Dam would result in a greater loss of suitable habitat for the American peregrine falcon.

Similar to CP1, overstory and complete vegetation removal is expected to occur within the impoundment area in suitable cliff habitat. Thus, overstory vegetation removal occurring in or near suitable cliff habitat during the nesting season could result in the incidental loss of fertile eggs or nestlings or otherwise lead to the abandonment of nests. Additionally, because of the steep terrain, trees would be yarded by helicopter. Noise generated by chainsaws and helicopter yarding could cause the abandonment of nests, resulting in the incidental loss of fertile eggs or nestlings. This impact would be potentially significant.

No known eyries would be inundated with a 12.5-foot raise in lake elevation; however, 14.5 vertical feet (full pool) of cliff habitat would be inundated. Based on the large area required for suitable nesting habitat for peregrine falcons, impacts on suitable cliff habitat for nesting would be less than significant. The conversion of uplands to lacustrine habitat would not adversely affect foraging habitat for the species because they frequently forage over water. Mitigation for this impact is proposed in Section 13.3.5.

Impact Wild-5 (CP2): Take and Loss of Habitat for the Bald Eagle Construction activities and vegetation removal associated with the construction of raising the dam, construction activities in the relocation areas, and removal of various amounts of vegetation in the impoundment areas in addition to

inundation caused by the raising of Shasta Dam during the nesting season would result in the loss of nest and perch trees used by the bald eagle, a State-listed species, fully protected species, and USFS sensitive species, an MSCSMSCS-covered species, and a BLM sensitive species. This impact would be significant.

Impacts caused by construction and vegetation clearing for the dam and relocation areas would be similar to CP1. However, inundation caused by a 12.5-foot raise of Shasta Dam would result in a greater loss of suitable habitat for the bald eagle. This impact would be potentially significant.

Any raise in elevation would inundate between 8 and 14 nest trees. If inundation were to occur, nest trees within the impoundment area would die. Because peak inundation generally occurs in late April or early June, nest trees would be flooded toward the end of the nesting season. If eagles were nesting in these trees, it would be likely that young would fledge before the nest tree died from the effects of inundation. Because of inundation timing, it is not likely that individuals would be affected. Because bald eagles generally use the same nest for multiple years, the loss of nest trees would be a significant impact.

Inundation could also affect erosion and bank stability, which could affect nest trees that are in close proximity to the impoundment area. This would be a potentially significant impact.

Inundation resulting from a 12.5-foot dam raise would result in a loss 1,132 acres of nesting and roosting habitat for the bald eagle. Potential nest and roost trees are located in blue oak woodland, blue oak–foothill pine, Douglas-fir, montane hardwood, montane hardwood–conifer, montane riparian, and ponderosa pine habitats with tree diameters larger than 24 inches. Impacts on suitable spotted owl habitat by CWHR type in the impoundment area are summarized in Table 13-22.

Additional analysis of impacts will be conducted in relation to suitable habitats available in the Shasta Lake watershed. Bald eagle nesting activity changes from year to year. The number of bald eagle nests is subject to change based on eagle activity at the time of construction and the subsequent inundation. Reclamation is currently working with the USFS to determine the current eagle activity to revise the number of nest trees that may be impacted. Indirect and temporary impacts will be analyzed in the FEIS. Mitigation for this impact is proposed in Section 13.3.5.

Table 13-22. Impacts on Suitable Habitat for the Bald Eagle in the Impoundment Area (12.5-Foot Dam Raise)

Habitat	Area (acres*)					
	Main Body	Big Backbone Arm	Sacramento Arm	McCloud Arm	Squaw Creek Arm	Pit Arm
Blue oak woodland	0.00	0.00	0.00	0.00	0.00	1.65
Blue oak–foothill pine	7.05	0.00	0.00	0.00	2.46	5.27
Douglas-fir	0.00	0.00	0.00	0.06	0.00	0.00
Montane hardwood	53.30	25.75	120.48	45.31	13.31	1.77
Montane hardwood–conifer	48.77	0.70	99.06	97.70	78.41	7.73
Montane riparian	2.72	3.23	20.57	6.12	1.00	1.19
Ponderosa pine	152.04	21.54	123.71	114.78	35.08	40.92
Total	263.88	51.21	363.82	263.97	130.26	58.53

Source: Data compiled by North State Resources, Inc., in 2011 based on habitat assessments and mapping
Note:
*Acreages are approximate and will be revised based on habitat containing suitable tree diameters.

Impact Wild-6 (CP2): Take and Loss of Nesting and Foraging Habitat for the Northern Spotted Owl Construction activities and vegetation removal associated with the construction of raising the dam, construction activities in the relocation areas, and removal of various amounts of vegetation in the impoundment areas during the nesting season could result in the incidental loss of fertile eggs or nestlings or otherwise lead to the abandonment of nests of the northern spotted owl, a Federally listed as threatened species and MSCS-covered species. In addition, inundation caused by the raising of Shasta Dam would result in the loss of habitat, including critical habitat for this species. This impact would be potentially significant.

Impacts caused by construction and vegetation clearing for the dam and relocation areas would be similar to CP1. However, inundation caused by a 12.5-foot raise of Shasta Dam would result in a greater loss of suitable habitat for the northern spotted owl. This impact would be potentially significant.

Inundation resulting from a 12.5-foot dam raise would result in a loss of 1,080 acres (29 acres of critical habitat) of nesting and foraging habitat for the northern spotted owl. Impacts on suitable habitat for the spotted owl by CWHR type in the impoundment area are summarized in Table 13-23.

Additional analysis of impacts will be conducted in relation to suitable habitats available in the Shasta Lake watershed. An analysis of indirect impacts and temporary impacts will be completed in subsequent documents. Mitigation for this impact is proposed in Section 13.3.5.

Table 13-23. Impacts on Suitable Habitat for the Northern Spotted Owl in the Impoundment Area (12.5-Foot Dam Raise)

Habitat	Area (acres*)					
	Main Body	Big Backbone Arm	Sacramento Arm	McCloud Arm	Squaw Creek Arm	Pit Arm
Douglas-fir	0.00	0.00	0.00	0.06	0.00	0.00
Montane hardwood	53.30	25.75	120.48	45.31	13.31	1.77
Montane hardwood–conifer	48.77	0.70	99.06	97.70	78.41	7.73
Ponderosa pine	152.04	21.54	123.71	114.78	35.08	40.92
Total	254.11	47.99	343.25	257.85	126.80	50.42

Source: Data compiled by North State Resources, Inc., in 2011 based on habitat assessments and mapping

Note:

*Acres are approximate.

Impact Wild-7 (CP2): Impact on the Purple Martin and Its Nesting Habitat
Construction activities and vegetation removal associated with the construction of raising the dam, construction activities in the relocation areas, and removal of various amounts of vegetation in the impoundment areas during the nesting season could result in the incidental loss of fertile eggs or nestlings or otherwise lead to the abandonment of nests of purple martins, a California species of special concern. In addition, inundation caused by the raising of Shasta Dam would result in the loss of nest trees. This impact would be significant.

Impacts caused by construction and vegetation clearing for the dam and relocation areas would be similar to CP1. Similar to CP1, nest trees occurring in the lake could be adversely affected by inundation and related vegetation removal. These impacts would be potentially significant.

Additional analysis of impacts will be conducted in relation to suitable habitats available in the Shasta Lake watershed. An analysis of indirect impacts and temporary impacts will be completed in subsequent documents. Mitigation for this impact is proposed in Section 13.3.5.

Impact Wild-8 (CP2): Impacts on the Willow Flycatcher, Vaux's Swift, Yellow Warbler, and Yellow-Breasted Chat and Their Foraging and Nesting Habitat
Construction activities and vegetation removal associated with the construction of raising the dam, construction activities in the relocation areas, and removal of various amounts of vegetation in the impoundment areas during the nesting season could result in the incidental loss of fertile eggs or nestlings or otherwise lead to the abandonment of nests of the willow flycatcher, a State-listed as endangered species, USFS sensitive species, and MSCS-covered species; the Vaux's swift, a California species of special concern; and the yellow warbler and yellow-breasted chat, both California species of special concern and MSCS-covered species. In addition, the raising of Shasta Dam would result in the loss of habitat, including nesting habitat, for these species. This impact would be potentially significant.

Impacts caused by construction and vegetation clearing for the dam and relocation areas would be similar to CP1. However, inundation caused by a 12.5-foot raise of Shasta Dam would result in a greater loss of suitable habitat for these species. This impact would be potentially significant.

Inundation resulting from a 12.5-foot dam raise would result in a loss of 1,115 acres of nesting and foraging habitat for the Vaux's swift (Douglas-fir, montane hardwood, montane hardwood-conifer, montane riparian, and ponderosa pine) and 35 acres for the willow flycatcher, yellow warbler, and yellow-breasted chat (montane riparian).

Impacts on suitable habitats for the willow flycatcher, Vaux's swifts, yellow warbler, and yellow-breasted chat habitat by CWHR type in the impoundment area is summarized in Table 13-24.

Table 13-24. Impacts on Suitable Habitat for the Willow Flycatcher, Vaux's Swift, Yellow Warbler, and Yellow-Breasted Chat in the Impoundment Area (12.5-Foot Dam Raise)

Habitat	Area (acres*)					
	Main Body	Big Backbone Arm	Sacramento Arm	McCloud Arm	Squaw Creek Arm	Pit Arm
Vaux's Swift						
Douglas-fir	0.00	0.00	0.00	0.06	0.00	0.00
Montane hardwood	53.30	25.75	120.48	45.31	13.31	1.77
Montane hardwood–conifer	48.77	0.70	99.06	97.70	78.41	7.73
Montane riparian	2.72	3.23	20.57	6.12	1.00	1.19
Ponderosa pine	152.04	21.54	123.71	114.78	35.08	40.92
Total Vaux's Swift Habitat	256.83	51.22	363.82	263.97	127.80	51.61
Willow Flycatcher, Yellow Warbler, and Yellow-Breasted Chat						
Montane riparian	2.72	3.23	20.57	6.12	1.00	1.19
Total Habitat	2.72	3.23	20.57	6.12	1.00	1.19

Source: Data compiled by North State Resources, Inc., in 2011 based on habitat assessments and mapping
Note:
**Acres are approximate.*

Additional analysis of impacts will be conducted in relation to suitable habitats available in the Shasta Lake watershed. An analysis of indirect impacts and temporary impacts will be completed in subsequent documents. Mitigation for this impact is proposed in Section 13.3.5.

Impact Wild-9 (CP2): Impacts on the Long-Eared Owl, Northern Goshawk, Cooper's Hawk, Great Blue Heron, and Osprey and Their Foraging and Nesting Habitat Construction activities and vegetation removal associated with the construction of raising the dam, construction activities in the relocation areas, and removal of various amounts of vegetation in the impoundment areas during the nesting season could result in the incidental loss of fertile eggs or nestlings or otherwise lead to the abandonment of nests of the long-eared owl, a California species of special concern and an MSCS-covered species; the northern goshawk, a California species of special concern, a USFS sensitive

species, and a BLM sensitive species; the Cooper's hawk, an MSCS-covered species; the great blue heron, an MSCS-covered species; and the osprey, an MSCS-covered species. In addition, the raising of Shasta Dam would result in the loss of foraging and nesting habitat for these species. This impact would be potentially significant.

Impacts caused by construction and vegetation clearing for the dam and relocation areas would be similar to CP1. However, inundation caused by a 12.5-foot raise of Shasta Dam would result in a greater loss of suitable habitat for these species. This impact would be potentially significant.

Inundation resulting from a 12.5-foot dam raise would result in a loss of 1,080 acres of nesting and foraging habitat (Douglas-fir, montane hardwood–conifer, and ponderosa pine) for the long-eared owl and northern goshawk, and 1,473 acres of nesting and foraging habitat for the Cooper's hawk and great blue heron (blue oak–foothill pine, closed-cone pine-cypress, Douglas-fir, montane hardwood, montane hardwood–conifer, montane riparian, and ponderosa pine).

Impacts on suitable habitat by CWHR type in the impoundment area are summarized in Table 13-25.

Table 13-25. Impacts on Suitable Habitat for the Long-Eared Owl, Northern Goshawk, Cooper's Hawk, and Great Blue Heron in the Impoundment Area (12.5-Foot Dam Raise)

Habitat	Area (acres*)					
	Main Body	Big Backbone Arm	Sacramento Arm	McCloud Arm	Squaw Creek Arm	Pit Arm
Long-Eared Owl and Northern Goshawk						
Douglas-fir	0.00	0.00	0.00	0.06	0.00	0.00
Montane hardwood	53.30	25.75	120.48	45.31	13.31	1.77
Montane hardwood–conifer	48.77	0.70	99.06	97.70	78.41	7.73
Ponderosa pine	152.04	21.54	123.71	114.78	35.08	40.92
Total Habitat	254.11	47.99	343.25	257.85	126.80	50.42
Cooper's Hawk and Great Blue Heron						
Blue oak–foothill pine	7.05	0.00	0.00	0.00	2.46	5.27
Closed-cone pine-cypress	24.40	0.00	8.95	14.89	32.72	262.31
Douglas-fir	0.00	0.00	0.00	0.06	0.00	0.00
Montane hardwood	53.30	25.75	120.48	45.31	13.31	1.77
Montane hardwood–conifer	48.77	0.70	99.06	97.70	78.41	7.73
Montane riparian	2.72	3.23	20.57	6.12	1.00	1.19
Ponderosa pine	152.04	21.54	123.71	114.78	35.08	40.92
Total Habitat	288.28	51.22	372.77	278.86	162.98	319.19

Source: Data compiled by North State Resources, Inc., in 2011 based on habitat assessments and mapping

Note:
*Acres are approximate.

Impacts on the osprey would be similar to those described for CP1. There are 54 osprey nests within the perimeter of Shasta Lake. There are six nest trees that would be affected by a 12.5-foot dam raise. Eleven osprey nests are located in relocation areas. Removal of nest trees would be a potentially significant impact. Because osprey generally use the same nest for multiple years, the loss of 17 nest trees (31 percent) collectively between the impoundment area and relocation areas would be a potentially significant impact.

Additional analysis of impacts will be conducted in relation to suitable habitats available in the Shasta Lake watershed. Osprey nesting activity changes from year to year. The number of osprey nests is subject to change based on current eagle activity at the time of construction and the subsequent inundation. An analysis of indirect impacts and temporary impacts will be completed in subsequent documents. Mitigation for this impact is proposed in Section 13.3.5.

Impact Wild-10 (CP2): Take and Loss of Habitat for the Pacific Fisher
Construction activities and vegetation removal associated with the construction of raising the dam, construction activities in the relocation areas, and removal of various amounts of vegetation in the impoundment areas would result in a loss of habitat for the Pacific fisher, a Federal candidate for listing, a California species of special concern, a USFS sensitive species, and a BLM sensitive species. Furthermore, take (including mortality of individuals because of destruction or disturbance of active roost sites or dens) could result from construction activities and vegetation clearing. This impact would be potentially significant.

Impacts caused by construction and vegetation clearing for the dam and relocation areas would be identical to CP1. However, inundation caused by a 12.5-foot raise of Shasta Dam would result in a greater loss of suitable habitat for these species. This impact would be potentially significant.

Inundation resulting from a 12.5-foot dam raise would result in a loss of 855 acres of habitat (Douglas-fir, montane hardwood–conifer, montane riparian, and ponderosa pine) for the Pacific fisher.

Impacts on suitable habitat by CWHR type in the impoundment area are summarized in Table 13-26.

Additional analysis of impacts will be conducted in relation to suitable habitats available in the Shasta Lake watershed. An analysis of indirect impacts and temporary impacts will be completed in subsequent documents. Mitigation for this impact is proposed in Section 13.3.5.

Table 13-26. Impacts on Suitable Habitat for the Pacific Fisher in the Impoundment Area (12.5-Foot Dam Raise)

Habitat	Area (acres*)					
	Main Body	Big Backbone Arm	Sacramento Arm	McCloud Arm	Squaw Creek Arm	Pit Arm
Impoundment Area						
Douglas-fir	0.00	0.00	0.00	0.06	0.00	0.00
Montane hardwood–conifer	48.77	0.70	99.06	97.70	78.41	7.73
Montane riparian	2.72	3.23	20.57	6.12	1.00	1.19
Ponderosa pine	152.04	21.54	123.71	114.78	35.08	40.92
Total Habitat	203.53	25.47	243.34	218.66	114.49	49.84

Source: Data compiled by North State Resources, Inc., in 2011 based on habitat assessments and mapping

Note:
**Acres are approximate.*

Impact Wild-11 (CP2): Impacts on Special-Status Bats (Pallid Bat, Spotted Bat, Western Red Bat, Western Mastiff Bat, Townsend's Big-Eared Bat, Long-Eared Myotis, and Yuma Myotis), the American Marten, and Ringtail and Their Habitat Construction activities and vegetation removal associated with the construction of raising the dam, construction activities in the relocation areas, and removal of various amounts of vegetation in the impoundment areas would result in a loss of habitat for the pallid bat, a California species of special concern, a USFS sensitive species, and a BLM sensitive species; the western red bat, a USFS sensitive species; the western mastiff bat, a California species of special concern, an MSCS-covered species, and a BLM sensitive species; the Townsend's big-eared bat, a California species of special concern, a USFS sensitive species, and a BLM sensitive species; the long-eared Myotis, a BLM sensitive species; the Yuma Myotis, a BLM sensitive species; the American marten, a USFS sensitive species; and the ringtail, a State fully protected and MSCS-covered species. Furthermore, take (including mortality of individuals because of destruction or disturbance of active roost sites or dens) could result from construction activities and vegetation clearing. This impact would be potentially significant.

Impacts caused by construction and vegetation clearing for the dam and relocation areas would be similar to CP1. However, inundation caused by a 12.5-foot raise of Shasta Dam would result in a greater loss of suitable habitat for these species. This impact would be potentially significant.

Inundation resulting from a 12.5-foot dam raise would result in the loss of 18 acres of habitat for the pallid bat, spotted bat, western mastiff bat, Townsend's big-eared bat and Yuma myotis (barren, blue oak woodland, and blue oak–foothill pine); the loss of 1,677 acres of habitat for the western red bat long-eared myotis, and ringtail (barren, blue oak woodland, blue oak–foothill pine, closed-cone pine-cypress, Douglas-fir, mixed chaparral, montane hardwood, montane hardwood–conifer, montane riparian, and ponderosa pine); and the loss of 855 acres of habitat for the American marten (Douglas-fir,

montane hardwood–conifer, montane riparian, and ponderosa pine). This impact would be potentially significant.

Impacts on suitable habitat by CWHR type in the impoundment area are summarized in Table 13-27.

Additional analysis of impacts will be conducted in relation to suitable habitats available in the Shasta Lake watershed. An analysis of indirect impacts and temporary impacts will be completed in subsequent documents. Mitigation for this impact is proposed in Section 13.3.5.

Impact Wild-12 (CP2): Impacts on Special-Status Terrestrial Mollusks (Shasta Sideband, Wintu Sideband, Shasta Chaparral, and Shasta Hesperian) andTtheir Habitat All of these species are designated USFS sensitive and survey and manage species and are proposed for Federal listing. The Shasta sideband is also an MSCS-covered species. Ground-disturbing activities and vegetation removal associated with the construction of raising the dam, construction activities in the relocation areas, and removal of various amounts of vegetation in the impoundment areas could result in direct take and/or loss of suitable habitat for special-status terrestrial mollusks. In addition, the raising of Shasta Dam would result in the inundation of suitable habitat and direct take of this species. This would be a significant impact.

Impacts caused by construction and vegetation clearing for the dam and relocation areas would be similar to CP1. However, inundation caused by a 12.5-foot raise of Shasta Dam would result in a greater loss of suitable habitat for these species. This impact would be potentially significant.

Inundation resulting from a 12.5-foot dam raise would result in the loss of 1,680 acres of habitat for the Shasta chaparral (annual grassland, barren, blue oak woodland, blue oak–foothill pine, closed-cone pine-cypress, Douglas-fir, mixed chaparral, montane hardwood, montane hardwood–conifer, montane riparian, and ponderosa pine), 367 acres in the impoundment area for Shasta hesperian (Douglas-fir, montane hardwood conifer, and montane riparian), 7 acres of limestone habitat for the Shasta sideband, and 2 acres of limestone habitat for the Wintu sideband. This impact would be potentially significant.

Table 13-27. Impacts on Suitable Habitat for Special-Status Bats, American Marten, and Ringtail in the Impoundment Area (12.5-Foot Dam Raise)

Habitat	Area (acres*)					
	Main Body	Big Backbone Arm	Sacramento Arm	McCloud Arm	Squaw Creek Arm	Pit Arm
Impoundment Area						
Pallid Bat, Spotted Bat, Western Mastiff Bat, Townsend's Big-Eared Bat and, Yuma Myotis						
Barren	0.77	0.00	0.36	0.00	0.00	0.00
Blue oak woodland	0.00	0.00	0.00	0.00	0.00	1.65
Blue oak–foothill pine	7.05	0.00	0.00	0.00	2.46	5.27
Total	7.82	0.00	0.36	0.00	2.46	6.92
Western Red Bat, Long-Eared Myotis, and Ringtail						
Barren	0.77	0.00	0.36	0.00	0.00	0.00
Blue oak woodland	0.00	0.00	0.00	0.00	0.00	1.65
Blue oak–foothill pine	7.05	0.00	0.00	0.00	2.46	5.27
Closed-cone pine-cypress	24.40	0.00	8.95	14.89	32.72	262.31
Douglas-fir	0.00	0.00	0.00	0.06	0.00	0.00
Mixed chaparral	20.58	9.56	112.76	10.97	7.35	40.11
Montane hardwood	53.30	25.75	120.48	45.31	13.31	1.77
Montane hardwood–conifer	48.77	0.70	99.06	97.70	78.41	7.73
Montane riparian	2.72	3.23	20.57	6.12	1.00	1.19
Ponderosa pine	152.04	21.54	123.71	114.78	35.08	40.92
Total Habitat	309.64	60.78	485.90	289.83	170.34	360.96
American Marten						
Douglas-fir	0.00	0.00	0.00	0.06	0.00	0.00
Montane hardwood–conifer	48.77	0.70	99.06	97.70	78.41	7.73
Montane riparian	2.72	3.23	20.57	6.12	1.00	1.19
Ponderosa pine	152.04	21.54	123.71	114.78	35.08	40.92
Total Habitat	203.53	25.47	243.34	218.66	114.49	49.84

Source: Data compiled by North State Resources, Inc., in 2011 based on habitat assessments and mapping

Note:
*Acreages are approximate.

Impacts on suitable habitat by CWHR type in the impoundment area are summarized in Table 13-28.

Additional analysis of impacts will be conducted in relation to suitable habitats available in the Shasta Lake watershed. An analysis of indirect impacts and temporary impacts will be completed in subsequent documents. Mitigation for this impact is proposed in Section 13.3.5.

Table 13-28. Impacts on Suitable Habitat for Special-Status Terrestrial Mollusks in the Impoundment Area (12.5-Foot Dam Raise)

Habitat	Area (acres*)					
	Main Body	Big Backbone Arm	Sacramento Arm	McCloud Arm	Squaw Creek Arm	Pit Arm
Impoundment Area: Shasta Sideband						
Limestone	0.00	0.00	0.00	7.29	0.00	0.00
Impoundment Area: Wintu Sideband						
Limestone	0.00	0.00	0.00	0.00	0.00	2.06
Impoundment Area: Shasta Chaparral						
Annual grassland	0.36	0.00	1.53	0.53	0.00	0.00
Barren	0.77	0.00	0.36	0.00	0.00	0.00
Blue oak woodland	0.00	0.00	0.00	0.00	0.00	1.65
Blue oak–foothill pine	7.05	0.00	0.00	0.00	2.46	5.27
Closed-cone pine–cypress	24.40	0.00	8.95	14.89	32.72	262.31
Douglas-fir	0.00	0.00	0.00	0.06	0.00	0.00
Mixed chaparral	20.58	9.56	112.76	10.97	7.35	40.11
Montane hardwood	53.30	25.75	120.48	45.31	13.31	1.77
Montane hardwood–conifer	48.77	0.70	99.06	97.70	78.41	7.73
Montane riparian	2.72	3.23	20.57	6.12	1.00	1.19
Ponderosa pine	152.04	21.54	123.71	114.78	35.08	40.92
Total Habitat	310.00	60.78	487.42	290.36	170.34	360.96
Impoundment Area: Shasta Hesperian						
Douglas-fir	0.00	0.00	0.00	0.06	0.00	0.00
Montane hardwood–conifer	48.77	0.70	99.06	97.70	78.41	7.73
Montane riparian	2.72	3.23	20.57	6.12	1.00	1.19
Total Habitat	51.49	3.93	119.63	103.82	79.41	8.92

Source: Data compiled by North State Resources, Inc., in 2011 based on habitat assessments and mapping
Note:
*Acres are approximate.

Impact Wild-13 (CP2): Permanent Loss of General Wildlife Habitat
Construction activities and vegetation removal associated with the construction of raising the dam, construction activities in the relocation areas, and removal of various amounts of vegetation in the impoundment areas would result in a permanent loss of habitat. In addition, inundation caused by the raising of Shasta Dam would result in a permanent loss of habitat. This would be a potentially significant impact.

Impacts caused by construction and vegetation clearing for the dam and relocation areas would be similar to CP1. However, inundation caused by a 12.5-foot raise of Shasta Dam would result in a greater loss of general wildlife habitat. This impact would be potentially significant.

Inundation resulting from a 12.5-foot dam raise would result in a loss of 1,715 acres of general wildlife habitat in the impoundment area. Impacts on general wildlife habitat by CWHR type in the impoundment area are summarized in Table 13-29.

Table 13-29. Impacts on CWHR Habitats in the Impoundment Area (12.5-Foot Dam Raise)

Habitat	Area (acres*)					
	Main Body	Big Backbone Arm	Sacramento Arm	McCloud Arm	Squaw Creek Arm	Pit Arm
Annual grassland	0.36	0	1.53	0.53	0	0
Barren	0.77	0	0.36	0.00	0	0.00
Blue oak–foothill pine	7.05	0	0	0	2.46	5.27
Blue oak woodland	0	0	0	0	0	1.65
Closed-cone pine–cypress	24.40	0	8.95	14.89	32.72	262.31
Douglas-fir	0	0	0	0.06	0	0
Mixed chaparral	20.58	9.56	112.76	10.97	7.35	40.11
Montane hardwood	53.30	25.75	120.48	45.31	13.31	1.77
Montane hardwood–conifer	48.77	0.70	99.06	97.70	78.41	7.73
Montane riparian	2.72	3.23	20.57	6.12	1.00	1.19
Ponderosa pine	152.04	21.54	123.71	114.78	35.08	40.92
Riverine	0	0.42	4.02	4.51	0.84	0
Urban	16.65	0	1.63	6.42	0	1.24
Total	326.64	61.20	492.71	301.28	171.18	362.19

Source: Data compiled by North State Resources, Inc., in 2011 based on habitat assessments and mapping
Note:
**Acres are approximate.*

Additional analysis of impacts will be conducted in relation to suitable habitats available in the Shasta Lake watershed. An analysis of indirect impacts and temporary impacts will be completed in subsequent documents. Mitigation for this impact is proposed in Section 13.3.5.

Impact Wild-14 (CP2): Impacts on Other Birds of Prey (i.e., red-tailed hawk and red-shouldered hawk) and Migratory Bird Species(i.e., American robin, Anna's hummingbird) and their Foraging and Nesting Habitat Construction activities and vegetation removal associated with the construction of raising the dam, construction activities in the relocation areas, and removal of various amounts of vegetation in the impoundment areas during the nesting season could result in the incidental loss of fertile eggs or nestlings or otherwise lead to the abandonment of nests of other birds of prey and migratory bird species. In addition, inundation caused by the raising of Shasta Dam would result in the loss of active nests and habitat for these species. This impact would be potentially significant.

Impacts caused by construction and vegetation clearing for the dam and relocation areas would be similar to CP1. However, inundation caused by a 12.5-foot raise of Shasta Dam would result in greater impacts on nesting migratory birds and raptors. This impact would be potentially significant.

Additional analysis of impacts will be conducted in relation to suitable habitats available in the Shasta Lake watershed. An analysis of indirect impacts and temporary impacts will be completed in subsequent documents. Mitigation for this impact is proposed in Section 13.3.5.

Impact Wild-15 (CP2): Loss of Critical Deer Winter and Fawning Range
Construction activities and vegetation removal associated with the construction of raising the dam, construction activities in the relocation areas, and removal of various amounts of vegetation in the impoundment areas would result in a loss of critical deer winter and fawning range. In addition, inundation caused by the raising of Shasta Dam would result in the loss of critical deer range. This would be a potentially significant impact.

Impacts caused by construction and vegetation clearing for the dam and relocation areas would be similar to CP1. However, inundation caused by a 12.5-foot raise of Shasta Dam would result in the loss of 1,679 acres of suitable deer habitat. This impact would be potentially significant.

Additional analysis of impacts will be conducted in relation to suitable habitats available in the Shasta Lake watershed. An analysis of indirect impacts and temporary impacts will be completed in subsequent documents. Mitigation for this impact is proposed in Section 13.3.5.

Impact Wild-16 (CP2): Take and Loss of the California Red-Legged Frog
Reclamation is concurrently completing an assessment of California red-legged frog habitat, which will be submitted to USFWS for review. Based on this assessment, USFWS will determine whether surveys are needed. Impacts on the California red-legged frog will be assessed if surveys are conducted and California red-legged frog is found. Impacts for each alternative will not be assessed until USFWS has determined whether suitable habitat is present and whether surveys would be required. Mitigation for this impact is proposed in Section 13.3.5.

Upper Sacramento River (Shasta Dam to Red Bluff)
Impact Wild-17 (CP2): Impacts on Riparian-Associated Special-Status Wildlife Resulting from Modifications to the Existing Flow Regime in the Primary Study Area Implementation of CP2 would result in a modified flow regime that would reduce the frequency, duration, and magnitude of intermediate to large flows below Shasta Dam during winter and spring in some years, and would increase the volume of flows from spring through fall of most years. This change in surface and subsurface hydrology could affect habitats adjacent to the river channel and the formation of off-channel habitats. Reduced formation of off-channel habitat would be a substantial long-term effect on the habitat of western pond turtle. Also, although the total amount of riparian vegetation would not be substantially altered, the portion of riparian vegetation in early successional stages would be reduced. These early successional stages provide habitat for some special-status wildlife species. In particular, these changes could result in substantial effects on the distribution or abundance of riparian-nesting special-status bird species. Therefore, this impact would be potentially significant.

This impact would be similar to Impact Wild-17 (CP1). The extent of the impact would be potentially greater under CP2 than under CP1 but less than under CP3. The differences in flow regime among the alternatives are described in detail in Chapter 6, "Hydrology, Hydraulics, and Water Management." This impact would be potentially significant. Mitigation for this impact is proposed in Section 13.3.5.

Impact Wild-18 (CP2): Impacts on Bank Swallow in the Primary Study Area Resulting from Modifications of Geomorphic Processes CP2 would cause a small reduction in the magnitude, duration, and frequency of intermediate to large flows, which also would alter the geomorphic processes along the Sacramento River, including the rate of bank erosion in the primary study area. However, the length of eroding banks would not be substantially altered, and thus, nesting habitat for bank swallows would not be substantially reduced. High flows during the nesting season that may cause localized nest failure would not be increased. The impact on habitat for bank swallow nesting colonies would be less than significant.

This impact would be similar to Impact Wild-18 (CP1). The extent of the impact would be potentially greater under CP2 than under CP1 but less than under CP3. Nonetheless, for the same reasons as CP1, this impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact Wild-19 (CP2): Disturbance or Removal of Vernal Pool Habitat for Special-Status Wildlife from Changes in Flow Regime Construction-related disturbances at Shasta Dam are not anticipated to disturb or permanently remove vernal pool habitat for special-status wildlife species along the upper Sacramento River. Altered flow regimes resulting from project-related dam operation are also not anticipated to temporarily disturb or permanently remove vernal pool habitat for special-status wildlife species. This impact would be less than significant.

This impact would be similar to Impact Wild-19 (CP1). The extent of the impact would be potentially greater under CP2 than under CP1 but less than under CP3. This impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact Wild-20 (CP2): Consistency with Local and Regional Plans with Goals of Promoting Riparian Habitat in the Primary Study Area Several conservation and management plans have been adopted in the primary and extended study areas with goals of promoting riparian habitat along the Sacramento River. Because flow regimes and riverine geomorphic processes could be altered with project implementation, riparian habitat could be affected in such a manner that the goals of the local and regional plans would be less likely to be attained. This potential conflict between the project and local and regional plans to promote riparian habitat would be a potentially significant impact.

This impact would be similar to Impact Wild-20 (CP1). The extent of the impact would be potentially greater under CP2 than under CP1 but less than under CP3. This impact would be potentially significant. Mitigation for this impact is proposed in Section 13.3.5.

Impact Wild-21 (CP2): Impacts on Riparian-Associated Special-Status Wildlife Resulting from the Gravel Augmentation Program CP2 would not include the gravel augmentation program. There would be no impact. Mitigation for this impact is not needed, and thus not proposed.

Impact Wild-22 (CP2): Impacts on Riparian-Associated Special-Status Wildlife Species Resulting from Restoration of Reading Island CP2 would not include Reading Island restoration. There would be no impact. Mitigation for this impact is not needed, and thus not proposed.

Lower Sacramento River and Delta

Impact Wild-23 (CP2): Impacts on Riparian-Associated and Aquatic Special-Status Wildlife Resulting from Modifications to Existing Flow Regimes in the Lower Sacramento River and Delta Implementation of CP2 would modify the flow regime and would reduce the frequency, duration, and magnitude of intermediate to large flows in the lower Sacramento River during winter and spring in some years, and would increase the volume of flows from spring through fall of most years. Although this change in surface and subsurface hydrology would be less than in the upper Sacramento River, it could affect habitats adjacent to the river channel and the formation of off-channel habitats along the middle Sacramento River. Reduced formation of off-channel habitat would be a substantial long-term effect on the habitat of western pond turtle. Also, although the total amount of riparian vegetation would not be substantially altered, the portion of riparian vegetation in early successional stages would be reduced. These early successional stages provide habitat for some special-status wildlife species. In particular, these changes could result in substantial effects on the distribution or abundance of riparian-nesting special-status bird species. Therefore, this impact would be potentially significant.

This impact would be similar to Impact Wild-23 (CP1). The extent of the impact would be potentially greater under CP2 than under CP1 but less than under CP3. This impact would be potentially significant. Mitigation for this impact is proposed in Section 13.3.5.

Impact Wild-24 (CP2): Impacts on Bank Swallow Along the Lower Sacramento River Resulting from Modifications of Geomorphic Processes The effect of CP2 on bank swallow habitat along the lower Sacramento River would be similar to the effect along the upper Sacramento River, but smaller because the effect of CP2 on river flows would attenuate with distance downstream. The rate of bank erosion would be reduced, but the length of eroding banks would not be substantially altered, and thus, nesting habitat for bank swallows would not be substantially reduced. High flows during the nesting season that may

cause localized bank and nest failure would not be increased. The impact on habitat for bank swallow nesting colonies would be less than significant.

This impact would be similar to Impact Wild-24 (CP1). The extent of the impact would be potentially greater under CP2 than under CP1 but less than under CP3. Nonetheless, for the same reasons described for CP1, this impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact Wild-25 (CP2): Disturbance or Removal of Vernal Pool Habitat for Special-Status Wildlife Along the Lower Sacramento River and in the Delta from Changes in Flow Regime of the Sacramento River and Affected Tributaries, and Changes in Seasonal Water Availability Altered flow regimes as a result of dam operation associated with the project are not anticipated to temporarily disturb or permanently remove vernal pool habitat for special-status wildlife species in the lower Sacramento River and Delta portion of the extended study area. This impact would be less than significant.

This impact would be similar to Impact Wild-25 (CP1). The extent of the impact would be potentially greater under CP2 than under CP1 but less than under CP3. This impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact Wild-26 (CP2): Consistency with Local and Regional Plans with Goals of Promoting Riparian Habitat Along the Lower Sacramento River and in the Delta Several conservation and management plans have been adopted in the primary and extended study areas with goals of promoting riparian habitat along the Sacramento River. Because flow regimes and riverine geomorphic processes could be altered with project implementation, riparian habitat could be affected in such a manner that the goals of the local and regional plans would be less likely to be attained. This potential conflict between the project and local and regional plans to promote riparian habitat would be a potentially significant impact.

This impact would be similar to Impact Wild-26 (CP1). The extent of the impact would be potentially greater under CP2 than under CP1 but less than under CP3. This impact would be potentially significant. Mitigation for this impact is proposed in Section 13.3.5.

CVP/SWP Service Areas

Impact Wild-27 (CP2): Impacts on Riparian-Associated or Aquatic Special-Status Wildlife in the CVP/SWP Service Areas Resulting from Modifications to Existing Flow Regimes By altering storage and operations at several reservoirs associated with the CVP and SWP service areas, CP2 would change flow regimes in several downstream waterways. Modified flow regimes would reduce the frequency, duration, and magnitude of intermediate to large flows along the Sacramento River. However, based on the CalSim-II modeling results,

the hydrologic effects on tributaries with CVP and SWP dams are expected to be less than effects on the Sacramento River. Most potential noticeable changes in flows and stages would diminish downstream from Red Bluff. The change in surface and subsurface hydrology could affect habitats adjacent to the river channel that provide habitat for special-status wildlife species. These changes are unlikely to result in substantial effects on the distribution or abundance of riparian-associated or aquatic special-status wildlife species in the CVP and SWP service areas outside of the primary study area. Therefore, this impact would be less than significant.

This impact would be similar to Impact Wild-27 (CP1). The extent of the impact would be potentially greater under CP2 than under CP1 but less than under CP3. This impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

CP3 – 18.5-Foot Dam Raise, Anadromous Fish Survival and Water Supply

CP3 is similar to CP1 and CP2. It focuses on the greatest practical enlargement of Shasta Dam and Shasta Lake consistent with the goals of the 2000 CALFED ROD, and was formulated for the primary purposes of increased water supply reliability and increased survival of anadromous fish. In addition to the common features above, CP3 involves raising Shasta Dam 18.5 feet, an elevation change that would increase the full pool by 20.5 feet and enlarge the total storage space in the reservoir by 634,000 acre-feet to 5.19 million acre-feet.

With respect to wildlife impacts, dam construction activities for CP1 through CP5 would be so similar that they are considered to be identical for purposes of this analysis. Because CP3 would result in higher lake levels than CP1, CP3 would also require more relocation of utilities, public service facilities, and recreational facilities than CP1. However, the wildlife impact analysis for CP1 assumes maximum impacts related to mechanized vegetation clearing and construction within the relocation areas. Therefore, vegetation clearing and construction impacts within the relocation areas would be identical for CP1 through CP5. Because CP3 would result in higher lake levels than CP1, CP3 would result in a larger (and deeper) area of inundation than CP1, in turn requiring more vegetation clearing within the inundation area than CP1.

Shasta Lake and Vicinity

Impact Wild-1 (CP3): Take and Loss of Habitat for the Shasta Salamander

Ground-disturbing activities associated with construction could result in direct take of the Shasta salamander, a State-listed species, USFS sensitive species, survey and manage species, MSCS-covered species, and BLM sensitive species. In addition, the raising of Shasta Dam would result in the inundation of habitat for this species. This impact would be significant.

Impacts caused by construction and vegetation clearing for the dam and relocation areas would be similar to CP1. However, inundation caused by an

18.5-foot raise of Shasta Dam would result in a greater loss of suitable habitat for the Shasta salamander. This impact would be significant.

Inundation resulting from an 18.5-foot dam raise would result in a loss of 15 acres of limestone habitat and 2,429 acres of nonlimestone habitat. Impacts on limestone and nonlimestone by CWHR type providing suitable habitat in the impoundment area are summarized in Table 13-30.

Table 13-30. Impacts on Suitable Habitat for the Shasta Salamander in the Impoundment Area (18.5-Foot Dam Raise)

Habitat	Area (acres*)					
	Main Body	Big Backbone Arm	Sacramento Arm	McCloud Arm	Squaw Creek Arm	Pit Arm
Limestone	0.00	1.63	0.00	10.51	0.00	2.85
Nonlimestone	437.60	90.04	723.57	424.44	242.77	510.99
Total	437.60	91.67	723.57	434.95	242.77	513.84

Source: Data compiled by North State Resources, Inc., in 2011 based on habitat assessments and mapping
Note:
*Acres are approximate.

Additional analysis of impacts will be conducted in relation to suitable habitats available in the Shasta Lake watershed or in the species range (if appropriate). Surveys of the Shasta salamander are ongoing and it is anticipated that protocol-level surveys will be conducted within the dam construction footprint and all relocation area footprints. Protocol-level surveys would provide specific information about the presence or absence of Shasta salamanders within individual construction footprints. Mitigation for acres affected would then be refined based on these results. Direct and indirect impacts based on those results will be reported in the FEIS. Additionally, other indirect and temporary impacts will be analyzed in the FEIS. Mitigation for this impact is proposed in Section 13.3.5.

Impact Wild-2 (CP3): Impact on the Foothill Yellow-Legged Frog and Tailed Frog and Their Habitat Ground-disturbing activities associated with construction could result in direct take (e.g., because of operation of equipment in or adjacent to riverine or riparian habitat) of the foothill yellow-legged frog, a California species of special concern, a USFS sensitive species, an MSCS-covered species, and a BLM sensitive species, and of the tailed frog, a California species of special concern. In addition, the raising of Shasta Dam would result in the conversion of suitable riverine and riparian habitat to unsuitable lacustrine habitat. This impact would be potentially significant.

Impacts caused by construction and vegetation clearing for the dam and relocation areas would be similar to CP1. However, inundation caused by an 18.5-foot raise of Shasta Dam would result in a greater loss of suitable habitat for the foothill yellow-legged and tailed frogs. This impact would be potentially significant.

Implementation of an 18.5-foot raise of the dam would result in inundation of 77 acres of habitat for the foothill yellow-legged frog and tailed frog. A summary of suitable habitat loss by arm is presented in Table 13-31.

Table 13-31. Impacts on Suitable Habitat for the Foothill Yellow-Legged and Tailed Frog in the Impoundment Area (18.5-Foot Dam Raise)

Habitat	Area (acres*)					
	Main Body	Big Backbone Arm	Sacramento Arm	McCloud Arm	Squaw Creek Arm	Pit Arm
Montane riparian	4.16	6.67	26.16	13.91	1.53	1.57
Riverine	0.00	0.88	5.24	15.43	1.41	0.00
Total	4.16	7.55	31.40	29.34	2.94	1.57

Source: Data compiled by North State Resources, Inc., in 2011 based on habitat assessments and mapping
Note:
*Acres are approximate.

Additional analysis of impacts will be conducted in relation to suitable habitats available in the Shasta Lake watershed. An analysis of indirect impacts and temporary impacts will be completed in subsequent documents. Mitigation for this impact is proposed in Section 13.3.5.

Impact Wild-3 (CP3): Impact on the Northwestern Pond Turtle and Its Habitat
Ground-disturbing activities associated with construction could result in direct take (e.g., because of operation of equipment in or adjacent to riverine or riparian habitat) of the northwestern pond turtle, an MSCS-covered species, a California species of special concern, and a USFS sensitive species. In addition, project implementation could result in the degradation of suitable aquatic habitat because of increased erosion and sedimentation. This impact would be potentially significant.

Impacts caused by construction and vegetation clearing for the dam and relocation areas would be similar to CP1. However, inundation caused by an 18.5-foot raise of Shasta Dam would result in a greater loss of suitable habitat for the northwestern pond turtle. This impact would be potentially significant.

Implementation of an 18.5-foot raise of the dam would result in the conversion of 54 acres of montane riparian and 23 acres of riverine habitat to lacustrine habitat. Because equally valuable components are lost or gained in either habitat, the quality of the habitat would not be compromised. However, maximum lake inundation would be infrequent (at most 1 month per year) and would not benefit the species throughout the remainder of the year. Thus, the conversion to lacustrine habitat would remain an impact on northwestern pond turtle habitat. A summary of suitable habitat loss by arm is presented in Table 13-32.

Table 13-32. Impacts on Suitable Habitat for the Northwestern Pond Turtle in the Impoundment Area (18.5-Foot Dam Raise)

Habitat	Area (acres*)					
	Main Body	Big Backbone Arm	Sacramento Arm	McCloud Arm	Squaw Creek Arm	Pit Arm
Montane riparian	4.16	6.67	26.16	13.91	1.53	1.57
Riverine	0.00	0.88	5.24	15.43	1.41	0.00
Total	4.16	7.55	31.40	29.34	2.94	1.57

Source: Data compiled by North State Resources, Inc., in 2011 based on habitat assessments and mapping
Note:
*Acres are approximate.

Additional analysis of impacts will be conducted in relation to suitable habitats available in the Shasta Lake watershed or in the species range (if appropriate). Analysis impacts on upland habitats will be quantified. An analysis of indirect impacts and temporary impacts will be completed in subsequent documents. Mitigation for this impact is proposed in Section 13.3.5.

Impact Wild-4 (CP3): Impact on the American Peregrine Falcon Construction activities and vegetation removal associated with the construction of raising the dam, construction activities in the relocation areas, and removal of various amounts of vegetation in the impoundment areas during the nesting season could result in the incidental loss of fertile eggs or nestlings or otherwise lead to the abandonment of nests of American peregrine falcons, a State fully protected species and MSCS-covered species. This impact would be potentially significant.

Impacts caused by construction and vegetation clearing for the dam and relocation areas would be similar to CP1. However, inundation caused by an 18.5-foot raise of Shasta Dam would result in a greater loss of suitable habitat for the American peregrine falcon.

Similar to CP1, overstory and complete vegetation removal is expected to occur within the impoundment area in suitable cliff habitat. Thus, overstory vegetation removal occurring in or near suitable cliff habitat during the nesting season could result in the incidental loss of fertile eggs or nestlings or otherwise lead to the abandonment of nests. Additionally, because of the steep terrain, trees would be yarded by helicopter. Noise generated by chainsaws and helicopter yarding could cause the abandonment of nests, resulting in the incidental loss of fertile eggs or nestlings. This impact would be potentially significant.

No known eyries would be inundated with a 18.5-foot raise in lake elevation; however, 20.5 (full pool) vertical feet of cliff habitat would be inundated. Based on the large area required for suitable nesting habitat for peregrine falcons, impacts on suitable cliff habitat for nesting would be less than significant. The conversion of uplands to lacustrine habitat would not adversely affect foraging habitat for the species because they frequently forage over water. Mitigation for this impact is proposed in Section 13.3.5.

Impact Wild-5 (CP3): Take and Loss of Habitat for the Bald Eagle
Construction activities and vegetation removal associated with the construction of raising the dam, construction activities in the relocation areas, and removal of various amounts of vegetation in the impoundment areas in addition to inundation caused by the raising of Shasta Dam during the nesting season would result in the loss of nest and perch trees used by the bald eagle, a State-listed species, fully protected species, and USFS sensitive species, an MSCS-covered species, and a BLM sensitive species. This impact would be significant.

Impacts caused by construction and vegetation clearing for the dam and relocation areas would be similar to CP1. However, inundation caused by an 18.5-foot raise of Shasta Dam would result in a greater loss of suitable habitat for the bald eagle. This impact would be potentially significant.

Any raise in elevation would inundate between 8 and 14 nest trees. If inundation were to occur, nest trees within the impoundment area would die. Because peak inundation generally occurs in late April or early June, nest trees would be flooded toward the end of the nesting season. If eagles were nesting in these trees, it would be likely that young would fledge before the nest tree died from the effects of inundation. Because of inundation timing, it is not likely that individuals would be affected. Because bald eagles generally use the same nest for multiple years, the loss of nest trees would be a significant impact.

Inundation could also affect erosion and bank stability, which could affect nest trees that are in close proximity to the impoundment area. This would be a potentially significant impact.

Inundation resulting from an 18.5-foot dam raise would result in a loss 1,637 acres of nesting and roosting habitat for the bald eagle. Potential nest and roost trees occur in blue oak woodland, blue oak–foothill pine, Douglas-fir, montane hardwood, montane hardwood–conifer, montane riparian, and ponderosa pine habitats with tree diameters greater than 24 inches. Impacts on suitable spotted owl habitat by CWHR type in the impoundment area are summarized in Table 13-33.

Additional analysis of impacts will be conducted in relation to suitable habitats available in the Shasta Lake watershed. Bald eagle nesting activity changes from year to year. The number of bald eagle nests is subject to change based on eagle activity at the time of construction and the subsequent inundation. Reclamation is currently working with the USFS to determine the current eagle activity to revise the number of nest trees that may be impacted. Indirect and temporary impacts will be analyzed in the FEIS. Mitigation for this impact is proposed in Section 13.3.5.

Table 13-33. Impacts on Suitable Habitat for the Bald Eagle in the Impoundment Area (18.5-Foot Dam Raise)

Habitat	Area (acres*)					
	Main Body	Big Backbone Arm	Sacramento Arm	McCloud Arm	Squaw Creek Arm	Pit Arm
Blue oak woodland	0.00	0.00	0.00	0.00	0.00	1.94
Blue oak–foothill pine	10.36	0.00	0.00	0.00	4.29	6.81
Douglas-fir	0.00	0.00	0.00	0.36	0.00	0.00
Montane hardwood	73.49	38.76	171.01	66.06	19.43	2.49
Montane hardwood–conifer	70.68	0.99	150.42	140.93	111.63	10.55
Montane riparian	4.16	6.67	26.16	13.91	1.53	1.57
Ponderosa pine	215.11	30.72	188.19	161.74	49.56	57.50
Total	373.80	77.15	535.78	383.00	186.44	80.87

Source: Data compiled by North State Resources, Inc., in 2011 based on habitat assessments and mapping
Note:
**Acreages are approximate and will be revised based on habitat containing suitable tree diameters.*

Impact Wild-6 (CP3): Take and Loss of Nesting and Foraging Habitat for the Northern Spotted Owl Construction activities and vegetation removal associated with the construction of raising the dam, construction activities in the relocation areas, and removal of various amounts of vegetation in the impoundment areas during the nesting season could result in the incidental loss of fertile eggs or nestlings or otherwise lead to the abandonment of nests of the northern spotted owl, a Federally listed as threatened species and MSCS-covered species. In addition, inundation caused by the raising of Shasta Dam would result in the loss of habitat, including critical habitat for this species. This impact would be potentially significant.

Impacts caused by construction and vegetation clearing for the dam and relocation areas would be similar to CP1. However, inundation caused by an 18.5-foot raise of Shasta Dam would result in a greater loss of suitable habitat for the northern spotted owl. This impact would be potentially significant.

Inundation resulting from an 18.5-foot dam raise would result in a loss of 1,560 acres (42 acres of critical habitat) of nesting and foraging habitat for the northern spotted owl. Impacts on suitable spotted owl habitat by CWHR type in the impoundment area are summarized in Table 13-34.

Additional analysis of impacts will be conducted in relation to suitable habitats available in the Shasta Lake watershed. An analysis of indirect impacts and temporary impacts will be completed in subsequent documents. Mitigation for this impact is proposed in Section 13.3.5.

Table 13-34. Impacts on Suitable Habitat for the Northern Spotted Owl in the Impoundment Area (18.5-Foot Dam Raise)

Habitat	Area (acres*)					
	Main Body	Big Backbone Arm	Sacramento Arm	McCloud Arm	Squaw Creek Arm	Pit Arm
Douglas-fir	0.00	0.00	0.00	0.36	0.00	0.00
Montane hardwood	73.49	38.76	171.01	66.06	19.43	2.49
Montane hardwood–conifer	70.68	0.99	150.42	140.93	111.63	10.55
Ponderosa pine	215.11	30.72	188.19	161.74	49.56	57.50
Total	359.28	70.47	509.62	369.09	180.62	70.54

Source: Data compiled by North State Resources, Inc., in 2011 based on habitat assessments and mapping

Note:

*Acres are approximate.

Impact Wild-7 (CP3): Impact on the Purple Martin and Its Nesting Habitat
Construction activities and vegetation removal associated with the construction of raising the dam, construction activities in the relocation areas, and removal of various amounts of vegetation in the impoundment areas during the nesting season could result in the incidental loss of fertile eggs or nestlings or otherwise lead to the abandonment of nests of purple martins, a California species of special concern. In addition, inundation caused by the raising of Shasta Dam would result in the loss of nest trees. This impact would be significant.

Impacts caused by construction and vegetation clearing for the dam and relocation areas would be similar to CP1. Similar to CP1, nest trees occurring in the lake could be adversely affected by inundation and related vegetation removal. These impacts would be potentially significant.

Additional analysis of impacts will be conducted in relation to suitable habitats available in the Shasta Lake watershed. An analysis of indirect impacts and temporary impacts will be completed in subsequent documents. Mitigation for this impact is proposed in Section 13.3.5.

Impact Wild-8 (CP3): Impacts on the Willow Flycatcher, Vaux's Swift, Yellow Warbler, and Yellow-Breasted Chat and Their Foraging and Nesting Habitat
Construction activities and vegetation removal associated with the construction of raising the dam, construction activities in the relocation areas, and removal of various amounts of vegetation in the impoundment areas during the nesting season could result in the incidental loss of fertile eggs or nestlings or otherwise lead to the abandonment of nests of the willow flycatcher, a State-listed as endangered species, USFS sensitive species, and MSCS-covered species; the Vaux's swift, a California species of special concern; and the yellow warbler and yellow-breasted chat, both California species of special concern and MSCS-covered species. In addition, the raising of Shasta Dam would result in the loss of habitat, including nesting habitat, for these species. This impact would be potentially significant.

Impacts caused by construction and vegetation clearing for the dam and relocation areas would be similar to CP1. However, inundation caused by an 18.5-foot raise of Shasta Dam would result in a greater loss of suitable habitat for these species. This impact would be potentially significant.

Inundation resulting from an 18.5-foot dam raise would result in a loss of 1,614 acres of nesting and foraging habitat for the Vaux's swift (Douglas-fir, montane hardwood, montane hardwood–conifer, montane riparian, and ponderosa pine) and 54 acres for the willow flycatcher, yellow warbler, and yellow-breasted chat (montane riparian).

Impacts on suitable habitats for the willow flycatcher, Vaux's swift, yellow warbler, and yellow-breasted chat by CWHR type in the impoundment area are summarized in Table 13-35.

Additional analysis of impacts will be conducted in relation to suitable habitats available in the Shasta Lake watershed. An analysis of indirect impacts and temporary impacts will be completed in subsequent documents. Mitigation for this impact is proposed in Section 13.3.5.

Table 13-35. Impacts on Suitable Habitat for the Vaux's Swift, Yellow Warbler, and Yellow-Breasted Chat in the Impoundment Area (18.5-Foot Dam Raise)

Habitat	Area (acres*)					
	Main Body	Big Backbone Arm	Sacramento Arm	McCloud Arm	Squaw Creek Arm	Pit Arm
Impoundment Area						
Vaux's Swift						
Douglas-fir	0.00	0.00	0.00	0.36	0.00	0.00
Montane hardwood	73.49	38.76	171.01	66.06	19.43	2.49
Montane hardwood–conifer	70.68	0.99	150.42	140.93	111.63	10.55
Montane riparian	4.16	6.67	26.16	13.91	1.53	1.57
Ponderosa pine	215.11	30.72	188.19	161.74	49.56	57.50
Total Vaux's Swift Habitat	363.44	77.14	535.78	383.00	182.15	72.11
Willow Flycatcher, Yellow Warbler, and Yellow-Breasted Chat						
Montane riparian	4.16	6.67	26.16	13.91	1.53	1.57
Total Habitat	4.16	6.67	26.16	13.91	1.53	1.57

Source: Data compiled by North State Resources, Inc., in 2011 based on habitat assessments and mapping
Note:
**Acres are approximate.*

Impact Wild-9 (CP3): Impacts on the Long-Eared Owl, Northern Goshawk, Cooper's Hawk, Great Blue Heron, and Osprey and Their Foraging and Nesting Habitat Construction activities and vegetation removal associated with the construction of raising the dam, construction activities in the relocation areas, and removal of various amounts of vegetation in the impoundment areas during the nesting season could result in the incidental loss of fertile eggs or nestlings or otherwise lead to the abandonment of nests of the long-eared owl, a

California species of special concern and an MSCS-covered species; the northern goshawk, a California species of special concern, a USFS sensitive species, and a BLM sensitive species; the Cooper's hawk, an MSCS-covered species; the great blue heron, an MSCS-covered species; and the osprey, an MSCS-covered species. In addition, the raising of Shasta Dam would result in the loss of foraging and habitat for these species. This impact would be potentially significant.

Impacts caused by construction and vegetation clearing for the dam and relocation areas would be similar to CP1. However, inundation caused by an 18.5-foot raise of Shasta Dam would result in a greater loss of suitable habitat for these species. This impact would be potentially significant.

Inundation resulting from an 18.5-foot dam raise would result in a loss 1,560 acres of nesting and foraging habitat (Douglas-fir, montane hardwood-conifer, and ponderosa pine) for the long-eared owl and northern goshawk, and 2,120 acres of nesting and foraging habitat for the Cooper's hawk and great blue heron (blue oak-foothill pine, closed-cone pine-cypress, Douglas-fir, montane hardwood, montane hardwood-conifer, montane riparian, and ponderosa pine).

Impacts on suitable habitat by CWHR type in the impoundment area are summarized in Table 13-36.

Table 13-36. Impacts on Suitable Habitat for the Long-Eared Owl, Northern Goshawk, Cooper's Hawk, and Great Blue Heron in the Impoundment Area (18.5-Foot Dam Raise)

Habitat	Area (acres*)					
	Main Body	Big Backbone Arm	Sacramento Arm	McCloud Arm	Squaw Creek Arm	Pit Arm
Long-Eared Owl and Northern Goshawk						
Douglas-fir	0.00	0.00	0.00	0.36	0.00	0.00
Montane hardwood	73.49	38.76	171.01	66.06	19.43	2.49
Montane hardwood–conifer	70.68	0.99	150.42	140.93	111.63	10.55
Ponderosa pine	215.11	30.72	188.19	161.74	49.56	57.50
Total Habitat	359.28	70.47	509.62	369.09	180.62	70.54
Cooper's Hawk and Great Blue Heron						
Blue oak–foothill pine	10.36	0.00	0.00	0.00	4.29	1.94
Closed-cone pine-cypress	32.68	0.00	12.95	20.79	44.72	373.48
Douglas-fir	0.00	0.00	0.00	0.36	0.00	0.00
Montane hardwood	73.49	38.76	171.01	66.06	19.43	2.49
Montane hardwood–conifer	70.68	0.99	150.42	140.93	111.63	10.55
Montane riparian	4.16	6.67	26.16	13.91	1.53	1.57
Ponderosa pine	215.11	30.72	188.19	161.74	49.56	57.50
Total Habitat	406.48	77.14	548.73	403.79	231.16	447.53

Source: Data compiled by North State Resources, Inc., in 2011 based on habitat assessments and mapping
Note:
*Acres are approximate.

Impacts on the osprey are similar to those described for CP1. There are 54 osprey nests within the perimeter of Shasta Lake. Seven nest trees would be affected by an 18.5-foot dam raise. Eleven osprey nests are located in relocation areas. Removal of nest trees would be a potentially significant impact. Because ospreys generally use the same nest for multiple years, the loss of 18 nest trees (33 percent) collectively between the impoundment area and the relocation areas would be a potentially significant impact.

Additional analysis of impacts will be conducted in relation to suitable habitats available in the Shasta Lake watershed. Osprey nesting activity changes from year to year. The number of osprey nests is subject to change based on current osprey activity at the time of construction and the subsequent inundation. An analysis of indirect impacts and temporary impacts will be completed in subsequent documents. Mitigation for this impact is proposed in Section 13.3.5.

Impact Wild-10 (CP3): Take and Loss of Habitat for the Pacific Fisher
Construction activities and vegetation removal associated with the construction of raising the dam, construction activities in the relocation areas, and removal of various amounts of vegetation in the impoundment areas would result in a loss of habitat for the Pacific fisher, a Federal candidate for listing, a California species of special concern, a USFS sensitive species, and a BLM sensitive species. Furthermore, take (including mortality of individuals because of destruction or disturbance of active roost sites or dens) could result from construction activities and vegetation clearing. This impact would be potentially significant.

Impacts caused by construction and vegetation clearing for the dam and relocation areas would be similar to CP1. However, inundation caused by an 18.5-foot raise of Shasta Dam would result in a greater loss of suitable habitat for these species. This impact would be potentially significant.

Inundation resulting from an 18.5-foot dam raise would result in a loss of 1,242 acres of habitat (Douglas-fir, montane hardwood–conifer, montane riparian, and ponderosa pine) for the Pacific fisher.

Impacts on suitable habitat by CWHR type in the impoundment area are summarized in Table 13-37.

Additional analysis of impacts will be conducted in relation to suitable habitats available in the Shasta Lake watershed. An analysis of indirect impacts and temporary impacts will be completed in subsequent documents. Mitigation for this impact is proposed in Section 13.3.5.

Table 13-37. Impacts on Suitable Habitat for the Pacific Fisher in the Impoundment Area (18.5-Foot Dam Raise)

Habitat	Area (acres*)					
	Main Body	Big Backbone Arm	Sacramento Arm	McCloud Arm	Squaw Creek Arm	Pit Arm
Douglas-fir	0.00	0.00	0.00	0.36	0.00	0.00
Montane hardwood–conifer	70.68	0.99	150.42	140.93	111.63	10.55
Montane riparian	4.16	6.67	26.16	13.91	1.53	1.57
Ponderosa pine	215.11	30.72	188.19	161.74	49.56	57.50
Total Habitat	289.95	38.38	364.77	316.94	162.72	69.62

Source: Data compiled by North State Resources, Inc., in 2011 based on habitat assessments and mapping
Note:
*Acres are approximate

Impact Wild-11 (CP3): Impacts on Special-Status Bats (Pallid Bat, Spotted Bat, Western Red Bat, Western Mastiff Bat, Townsend's Big-Eared Bat, Long-Eared Myotis, and Yuma Myotis), the American Marten, and Ringtail and Their Habitat Construction activities and vegetation removal associated with the construction of raising the dam, construction activities in the relocation areas, and removal of various amounts of vegetation in the impoundment areas would result in a loss of habitat for the pallid bat, a California species of special concern, a USFS sensitive species, and a BLM sensitive species; the western red bat, a USFS sensitive species; the western mastiff bat, a California species of special concern, an MSCS-covered species, and a BLM sensitive species; the Townsend's big-eared bat, a California species of special concern, a USFS sensitive species, and a BLM sensitive species; the long-eared Myotis, a BLM sensitive species; the Yuma Myotis, a BLM sensitive species; the American marten, a USFS sensitive species; and the ringtail, a State fully protected and MSCS-covered species. Furthermore, take (including mortality of individuals because of destruction or disturbance of active roost sites or dens) could result from construction activities and vegetation clearing. This impact would be potentially significant.

Impacts caused by construction and vegetation clearing for the dam and relocation areas would be similar to CP1. However, inundation caused by an 18.5-foot raise of Shasta Dam would result in a greater loss of suitable habitat for these species. This impact would be potentially significant.

Inundation resulting from an 18.5-foot dam raise would result in the loss of 25 acres of habitat for the pallid bat, spotted bat, western mastiff bat, Townsend's big-eared bat, and Yuma myotis (barren, blue oak woodland, and blue oak–foothill pine); the loss of 2,412 acres of habitat for the western red bat, long-eared myotis and ringtail (barren, blue oak woodland, blue oak–foothill pine, closed-cone pine-cypress, Douglas-fir, mixed chaparral, montane hardwood, montane hardwood–conifer, montane riparian, and ponderosa pine); and the loss of 855 acres of habitat for the American marten (Douglas-fir, montane hardwood–conifer, montane riparian, and ponderosa pine). This impact would be potentially significant.

Impacts on suitable habitat by CWHR type in the impoundment area are summarized in Table 13-38.

Additional analysis of impacts will be conducted in relation to suitable habitats available in the Shasta Lake watershed. An analysis of indirect impacts and temporary impacts will be completed in subsequent documents. Mitigation for this impact is proposed in Section 13.3.5.

Table 13-38. Impacts on Suitable Habitat for Special-Status Bats, American Marten, and Ringtail in the Impoundment Area (18.5-Foot Dam Raise)

Habitat	Area (acres*)					
	Main Body	Big Backbone Arm	Sacramento Arm	McCloud Arm	Squaw Creek Arm	Pit Arm
Pallid Bat, Spotted Bat, Western Mastiff Bat, Townsend's Big-Eared Bat, and Yuma Myotis						
Barren	1.06	0.00	0.55	0.00	0.00	0.00
Blue oak woodland	0.00	0.00	0.00	0.00	0.00	6.81
Blue oak–foothill pine	10.36	0.00	0.00	0.00	4.29	1.94
Total	11.42	0.00	0.55	0.00	4.29	8.76
Western Red Bat, Long-Eared Bat, and Ringtail						
Barren	1.06	0.00	0.55	0.00	0.00	0.00
Blue oak woodland	0.00	0.00	0.00	0.00	0.00	6.81
Blue oak–foothill pine	10.36	0.00	0.00	0.00	4.29	1.94
Closed-cone pine-cypress	32.68	0.00	12.95	20.79	44.72	373.48
Douglas-fir	0.00	0.00	0.00	0.36	0.00	0.00
Mixed chaparral	29.19	13.64	161.04	15.06	10.35	59.50
Montane hardwood	73.49	38.76	171.01	66.06	19.43	2.49
Montane hardwood–conifer	70.68	0.99	150.42	140.93	111.63	10.55
Montane riparian	4.16	6.67	26.16	13.91	1.53	1.57
Ponderosa pine	215.11	30.72	188.19	161.74	49.56	57.50
Total Habitat	436.74	90.78	710.32	418.85	241.51	513.85
American Marten						
Douglas-fir	0.00	0.00	0.00	0.36	0.00	0.00
Montane hardwood–conifer	70.68	0.99	150.42	140.93	111.63	10.55
Montane riparian	4.16	6.67	26.16	13.91	1.53	1.57
Ponderosa pine	215.11	30.72	188.19	161.74	49.56	57.50
Total Habitat	289.95	38.38	364.77	316.94	162.72	69.62

Source: Data compiled by North State Resources, Inc., in 2011 based on habitat assessments and mapping
Note:
*Acreages are approximate.

Impact Wild-12 (CP3): Impacts on Special-Status Terrestrial Mollusks (Shasta Sideband, Wintu Sideband, Shasta Chaparral, and Shasta Hesperian) and Their Habitat All of these species are designated USFS sensitive and survey and manage species and are proposed for Federal listing. The Shasta sideband is also an MSCS-covered species. Ground-disturbing activities and vegetation removal associated with the construction of raising the dam, construction activities in the relocation areas, and removal of various amounts of vegetation in the impoundment areas could result in direct take and/or loss of suitable habitat for special-status terrestrial mollusks. In addition, the raising of Shasta

Dam would result in the inundation of suitable habitat and direct take of this species. This would be a significant impact.

Impacts caused by construction and vegetation clearing for the dam and relocation areas would be similar to CP1. However, inundation caused by an 18.5-foot raise of Shasta Dam would result in a greater loss of suitable habitat for these species. This impact would be potentially significant.

Inundation resulting from an 18.5-foot dam raise would result in the loss of 2,416 acres of habitat for the Shasta chaparral and Shasta hesperian (annual grassland, barren, blue oak woodland, blue oak-foothill pine, closed-cone pine-cypress, Douglas-fir, mixed chaparral, montane hardwood, montane hardwood-conifer, montane riparian, and ponderosa pine), 539 acres in the impoundment area for Shasta hesperian (Douglas-fir, montane hardwood conifer, and montane riparian), 11 acres of limestone habitat for the Shasta sideband and 3 acres of limestone habitat for the Wintu sideband. This impact would be potentially significant.

Impacts on suitable habitat by CWHR type in the impoundment area are summarized in Table 13-39.

Additional analysis of impacts will be conducted in relation to suitable habitats available in the Shasta Lake watershed. An analysis of indirect impacts and temporary impacts will be completed in subsequent documents. Mitigation for this impact is proposed in Section 13.3.5.

Table 13-39. Impacts on Suitable Habitat for Special-Status Terrestrial Mollusks in the Impoundment Area (18.5-Foot Dam Raise)

Habitat	Area (acres*)					
	Main Body	Big Backbone Arm	Sacramento Arm	McCloud Arm	Squaw Creek Arm	Pit Arm
Impoundment Area: Shasta Sideband						
Limestone	0.00	0.00	0.00	10.5	0.00	0.00
Impoundment Area: Wintu Sideband						
Limestone	0.00	0.00	0.00	0.00	0.00	2.85
Impoundment Area: Shasta Chaparral						
Annual grassland	0.44	0.00	3.10	0.70	0.00	0.00
Barren	1.06	0.00	0.55	0.00	0.00	0.00
Blue oak woodland	0.00	0.00	0.00	0.00	0.00	6.81
Blue oak–foothill pine	10.36	0.00	0.00	0.00	4.29	1.94
Closed-cone pine-cypress	32.68	0.00	12.95	20.79	44.72	373.48
Douglas-fir	0.00	0.00	0.00	0.36	0.00	0.00
Mixed chaparral	29.19	13.64	161.04	15.06	10.35	59.50
Montane hardwood	73.49	38.76	171.01	66.06	19.43	2.49
Montane hardwood–conifer	70.68	0.99	150.42	140.93	111.63	10.55
Montane riparian	4.16	6.67	26.16	13.91	1.53	1.57
Ponderosa pine	215.11	30.72	188.19	161.74	49.56	57.50
Total Habitat	437.18	90.78	713.42	419.55	241.51	513.85
Impoundment Area: Shasta Hesperian						
Douglas-fir	0.00	0.00	0.00	0.36	0.00	0.00
Montane hardwood–conifer	70.68	0.99	150.42	140.93	111.63	10.55
Montane riparian	4.16	6.67	26.16	13.91	1.53	1.57
Total Habitat	74.84	7.66	176.58	154.84	113.16	12.12

Source: Data compiled by North State Resources, Inc., in 2011 based on habitat assessments and mapping
Note:
*Acres are approximate

Impact Wild-13 (CP3): Permanent Loss of General Wildlife Habitat
Construction activities and vegetation removal associated with the construction of raising the dam, construction activities in the relocation areas, and removal of various amounts of vegetation in the impoundment areas would result in a permanent loss of habitat. In addition, inundation caused by the raising of Shasta Dam would result in a permanent loss of habitat. This would be a potentially significant impact.

Impacts caused by construction and vegetation clearing for the dam and relocation areas would be similar to CP1. However, inundation caused by an 18.5-foot raise of Shasta Dam would result in a greater loss of general wildlife habitat. This impact would be potentially significant.

Inundation resulting from an 18.5-foot dam raise would result in a loss of 2,472 acres of general wildlife habitat in the impoundment area. Impacts on general wildlife habitat by CWHR type in the impoundment area are summarized in Table 13-40.

Table 13-40. Impacts on CWHR Habitats in the Impoundment Area (18.5-Foot Dam Raise)

Habitat	Area (acres*)					
	Main Body	Big Backbone Arm	Sacramento Arm	McCloud Arm	Squaw Creek Arm	Pit Arm
Annual grassland	0.44	0.00	3.10	0.70	0.00	0.00
Barren	1.05	0.00	0.55	0.00	0.00	0.00
Blue oak–foothill pine	10.36	0.00	0.00	0.00	4.29	1.94
Blue oak woodland	0.00	0.00	0.00	0.00	0.00	6.81
Closed-cone pine–cypress	32.68	0.00	12.95	20.79	44.72	373.48
Douglas-fir	0.00	0.00	0.00	0.36	0.00	0.00
Mixed chaparral	29.19	13.64	161.04	15.06	10.35	59.50
Montane hardwood	73.49	38.76	171.01	66.06	19.43	2.49
Montane hardwood–conifer	70.68	0.99	150.42	140.93	111.63	10.55
Montane riparian	4.16	6.67	26.16	13.91	1.53	1.57
Ponderosa pine	215.11	30.72	188.19	161.74	49.56	57.50
Riverine	0.00	0.88	5.24	15.43	1.41	0.00
Urban	21.95	00.00	1.95	7.96	0.00	1.92
Total	459.11	91.67	720.06	442.93	242.92	515.77

Source: Data compiled by North State Resources, Inc., in 2011 based on habitat assessments and mapping
Note:
*Acreage values are approximate.

Additional analysis of impacts will be conducted in relation to suitable habitats available in the Shasta Lake watershed. An analysis of indirect impacts and temporary impacts will be completed in subsequent documents. Mitigation for this impact is proposed in Section 13.3.5.

Impact Wild-14 (CP3): Impacts on Other Birds of Prey (i.e., red-tailed hawk and red-shouldered hawk) and Migratory Bird Species(i.e., American robin, Anna's hummingbird) and their Foraging and Nesting Habitat Construction activities and vegetation removal associated with the construction of raising the dam, construction activities in the relocation areas, and removal of various amounts of vegetation in the impoundment areas during the nesting season could result in the incidental loss of fertile eggs or nestlings or otherwise lead to the abandonment of nests of other birds of prey and migratory bird species. In addition, inundation caused by the raising of Shasta Dam would result in the loss of active nests and habitat for these species. This impact would be potentially significant.

Impacts caused by construction and vegetation clearing for the dam and relocation areas would be similar to CP1. However, inundation caused by an 18.5-foot raise of Shasta Dam would result in greater impacts on nesting migratory birds and raptors. This impact would be potentially significant.

Additional analysis of impacts will be conducted in relation to suitable habitats available in the Shasta Lake watershed. An analysis of indirect impacts and temporary impacts will be completed in subsequent documents. Mitigation for this impact is proposed in Section 13.3.5.

Impact Wild-15 (CP3): Loss of Critical Deer Winter and Fawning Range
Construction activities and vegetation removal associated with the construction of raising the dam, construction activities in the relocation areas, and removal of various amounts of vegetation in the impoundment areas would result in a loss of critical deer winter and fawning range. In addition, inundation caused by the raising of Shasta Dam would result in the loss of critical deer range. This would be a potentially significant impact.

Impacts caused by construction and vegetation clearing for the dam and relocation areas would be similar to CP1. However, inundation caused by an 18.5-foot raise of Shasta Dam would result the loss of 2,415 acres of suitable deer habitat. This impact would be potentially significant.

Additional analysis of impacts will be conducted in relation to suitable habitats available in the Shasta Lake watershed. An analysis of indirect impacts and temporary impacts will be completed in subsequent documents. Mitigation for this impact is proposed in Section 13.3.5.

Impact Wild-16 (CP3): Take and Loss of the California Red-Legged Frog
Reclamation is concurrently completing an assessment of California red-legged frog habitat, which will be submitted to USFWS for review. Based on this assessment, USFWS will determine whether surveys are needed. Impacts on the California red-legged frog will be assessed if surveys are conducted and California red-legged frog is found. Impacts for each alternative will not be assessed until USFWS has determined whether suitable habitat is present and whether surveys would be required. Mitigation for this impact is proposed in Section 13.3.5.

Upper Sacramento River (Shasta Dam to Red Bluff)
Impact Wild-17 (CP3): Impacts on Riparian-Associated Special-Status Wildlife Resulting from Modifications to the Existing Flow Regime in the Primary Study Area Implementation of CP3 would result in a modified flow regime that would reduce the frequency, duration, and magnitude of intermediate to large flows below Shasta Dam during winter and spring in some years, and would increase the volume of flows from spring through fall of most years. This change in surface and subsurface hydrology could affect habitats adjacent to the river channel and the formation of off-channel habitats. Reduced formation of off-channel habitat would be a substantial long-term effect on the habitat of western pond turtle. Also, although the total amount of riparian vegetation would not be substantially altered, the portion of riparian vegetation in early successional stages would be reduced. These early successional stages provide habitat for some special-status wildlife species. In particular, these changes could result in substantial effects on the distribution or abundance of riparian-nesting special-status bird species. Therefore, this impact would be potentially significant.

This impact would be similar to Impact Wild-17 (CP1). Altered flow regimes as a result of dam operation associated with the project could be greatest under CP3 because the alterations of flow regimes would be more substantial than under CP1 and CP2. The differences in flow regime among the alternatives are described in detail in Chapter 6, "Hydrology, Hydraulics, and Water Management." This impact would be potentially significant. Mitigation for this impact is proposed in Section 13.3.5.

Impact Wild-18 (CP3): Impacts on Bank Swallow in the Primary Study Area Resulting from Modifications of Geomorphic Processes CP3 would cause a small reduction in the magnitude, duration, and frequency of intermediate to large flows, which also would alter the geomorphic processes along the Sacramento River, including the rate of bank erosion in the primary study area. However, the length of eroding banks would not be substantially altered, and thus, nesting habitat for bank swallows would not be substantially reduced. High flows during the nesting season that may cause localized nest failure would not be increased. The impact on habitat for bank swallow nesting colonies would be less than significant.

This impact would be similar to Impact Wild-18 (CP1). The extent of the impact would be potentially greater under CP1 or CP2. Nonetheless, for the same reasons as CP1, this impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact Wild-19 (CP3): Disturbance or Removal of Vernal Pool Habitat for Special-Status Wildlife from Changes in Flow Regime Construction-related disturbances at Shasta Dam are not anticipated to disturb or permanently remove vernal pool habitat for special-status wildlife species along the upper Sacramento River. Altered flow regimes resulting from project-related dam operation are also not anticipated to temporarily disturb or permanently remove vernal pool habitat for special-status wildlife species. This impact would be less than significant.

This impact would be similar to Impact Wild-19 (CP1). The extent of the impact could be greatest under CP3 because the alterations of flow regimes would be more substantial than under CP1 and CP2; however, vernal pool habitats are not expected to be affected by the flows. Therefore, this impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact Wild-20 (CP3): Consistency with Local and Regional Plans with Goals of Promoting Riparian Habitat in the Primary Study Area Several conservation and management plans have been adopted in the primary and extended study areas with goals of promoting riparian habitat along the Sacramento River. Because flow regimes and riverine geomorphic processes could be altered with project implementation, riparian habitat could be affected in such a manner that the goals of the local and regional plans would be less

likely to be attained. This potential conflict between the project and local and regional plans to promote riparian habitat would be a potentially significant impact.

This impact would be similar to Impact Wild-20 (CP1). These effects associated with the project could be greatest under CP3 because the alterations of flow regimes would be more substantial than under CP1 and CP2. This impact would be potentially significant. Mitigation for this impact is proposed in Section 13.3.5.

Impact Wild-21 (CP3): Impacts on Riparian-Associated Special-Status Wildlife Resulting from the Gravel Augmentation Program CP3 would not include the gravel augmentation program. There would be no impact. Mitigation for this impact is not needed, and thus not proposed.

Impact Wild-22 (CP3): Impacts on Riparian-Associated Special-Status Wildlife Species Resulting from Restoration of Reading Island CP3 would not include Reading Island restoration. There would be no impact. Mitigation for this impact is not needed, and thus not proposed.

Lower Sacramento River and Delta

Impact Wild-23 (CP3): Impacts on Riparian-Associated and Aquatic Special-Status Wildlife Resulting from Modifications to Existing Flow Regimes in the Lower Sacramento River and Delta Implementation of CP3 would modify the flow regime and would reduce the frequency, duration, and magnitude of intermediate to large flows in the lower Sacramento River during winter and spring in some years, and would increase the volume of flows from spring through fall of most years. Although this change in surface and subsurface hydrology would be less than in the upper Sacramento River, it could affect habitats adjacent to the river channel and the formation of off-channel habitats. Reduced formation of off-channel habitat would be a substantial long-term effect on the habitat of western pond turtle. Also, although the total amount of riparian vegetation would not be substantially altered, the portion of riparian vegetation in early successional stages would be reduced. These early successional stages provide habitat for some special-status wildlife species. In particular, these changes could result in substantial effects on the distribution or abundance of riparian-nesting special-status bird species. Therefore, this impact would be potentially significant.

This impact would be similar to Impact Wild-23 (CP1). These effects associated with the project could be greatest under CP3 because the alterations of flow regimes would be more substantial than under CP1 and CP2. This impact would be potentially significant. Mitigation for this impact is proposed in Section 13.3.5.

Impact Wild-24 (CP3): Impacts on Bank Swallow along the Lower Sacramento River Resulting from Modifications of Geomorphic Processes The effect of

CP3on bank swallow habitat Along the lower Sacramento River would be similar to the effect along the upper Sacramento River, but smaller because the effect of CP3 on river flows would attenuate with distance downstream. The rate of bank erosion would be reduced, but the length of eroding banks would not be substantially altered, and thus, nesting habitat for bank swallows would not be substantially reduced. High flows during the nesting season that may cause localized bank and nest failure would not be increased. The impact on habitat for bank swallow nesting colonies would be less than significant.

This impact would be similar to Impact Wild-24 (CP1). The extent of the impact would be potentially greater under CP3 than under CP1 or CP2. Nonetheless, for the same reasons described for CP1, this impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact Wild-25 (CP3): Disturbance or Removal of Vernal Pool Habitat for Special-Status Wildlife Along the Lower Sacramento River and in the Delta from Changes in Flow Regime of the Sacramento River and Affected Tributaries, and Changes in Seasonal Water Availability Altered flow regimes as a result of dam operation associated with the project are not anticipated to temporarily disturb or permanently remove vernal pool habitat for special-status wildlife species in the lower Sacramento River and Delta portion of the extended study area. This impact would be less than significant.

This impact would be similar to Impact Wild-25 (CP1). These effects associated with the project could be greatest under CP3 because the alterations of flow regimes would be more substantial than under CP1 and CP2. This impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact Wild-26 (CP3): Consistency with Local and Regional Plans with Goals of Promoting Riparian Habitat along the Lower Sacramento River and in the Delta Several conservation and management plans have been adopted in the primary and extended study areas with goals of promoting riparian habitat along the Sacramento River. Because flow regimes and riverine geomorphic processes could be altered with project implementation, riparian habitat could be affected in such a manner that the goals of the local and regional plans would be less likely to be attained. This potential conflict between the project and local and regional plans to promote riparian habitat would be a potentially significant impact.

This impact would be similar to Impact Wild-26 (CP1). These effects associated with CP3 could be greatest under CP3 because the alterations of flow regimes would be more substantial than under CP1 and CP2. This impact would be potentially significant. Mitigation for this impact is proposed in Section 13.3.5.

CVP/SWP Service Areas

Impact Wild-27 (CP3): Impacts on Riparian-Associated or Aquatic Special-Status Wildlife in the CVP/SWP Service Areas Resulting from Modifications to Existing Flow Regimes By altering storage and operations at several reservoirs associated with the CVP and SWP service areas, CP3 would change flow regimes in several downstream waterways. Modified flow regimes would reduce the frequency, duration, and magnitude of intermediate to large flows along the Sacramento River. However, based on the CalSim-II modeling results, the hydrologic effects in tributaries with CVP and SWP dams, outside of the primary study area, are expected to be less than effects on the Sacramento River. Most potential noticeable changes in flows and stages would diminish downstream from Red Bluff. The change in surface and subsurface hydrology could affect habitats adjacent to the river channel that provide habitat for special-status wildlife species. These changes are unlikely to result in substantial effects on the distribution or abundance of riparian-associated or aquatic special-status wildlife species in the CVP and SWP service areas outside of the primary study area. Therefore, this impact would be less than significant.

This impact would be similar to Impact Wild-27 (CP1). These effects associated with the project could be greatest under CP3 because the alterations of flow regimes would be more substantial than under CP1 and CP2. This impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

CP4 – 18.5-Foot Dam Raise, Anadromous Fish Focus with Water Supply Reliability

The primary function of CP4 is to address survival of anadromous fish, while still improving water supply reliability. CP4 focuses on increasing the volume of cold water available to the temperature control device through reservoir reoperations and on raising Shasta Dam by 18.5 feet. As with CP3 and the common features above, this raise would increase the full pool by 20.5 feet and enlarge total reservoir storage space by 634,000 acre-feet.

In addition to the activities common to CP1–CP3, CP4 includes augmenting locations along the Upper Sacramento River segment of the study area with gravel to increase spawning habitat for anadromous fish. Gravel placement would occur at one or more sites per year over a 10-year period and would be accomplished by one of three methods; lateral berms, talus cone, direct placement in river; as appropriate depending on specific conditions, including geomorphology, of the augmentation site. To the extent available, existing river access points would be used to deliver gravel to the river; however, temporary new access roads would be needed in some cases, mostly adjacent to the river, and would be extended from existing dirt roads. Furthermore, under CP4, riparian, floodplain, and side channel habitat restoration would be constructed at Reading Island to restore habitat for anadromous salmonids in the Anderson

Creek Slough. This Reading Island project could involve some vegetation clearing.

With respect to wildlife impacts, dam construction activities for CP1–CP5 would be so similar that they are considered to be identical for purposes of this analysis. Because CP4 would result in higher lake levels than CP1, CP4 would also require more relocation of utilities, public service facilities, and recreational facilities than CP1. However, the wildlife impact analysis for CP1 assumes maximum impacts related to mechanized vegetation clearing and construction within the relocation areas. Therefore, vegetation clearing and construction impacts within the relocation areas would be identical for CP1–CP5. Because CP4 would result in higher lake levels than CP1, CP4 would result in a larger (and deeper) area of inundation than CP1, in turn requiring more vegetation clearing within the inundation area than CP1. CP4 would also involve some vegetation clearing in the Upper Sacramento River portion of the study area to provide access for gravel augmentation.

Shasta Lake and Vicinity

Impact Wild-1 (CP4): Take and Loss of Habitat for the Shasta Salamander
Ground-disturbing activities associated with construction could result in direct take of the Shasta salamander, a State-listed species, USFS sensitive species, survey and manage species, MSCS-covered species, and BLM sensitive species. In addition, the raising of Shasta Dam would result in the inundation of habitat for this species. This impact would be significant.

This impact would be similar to Impact Wild-1 (CP3) and would be significant. Mitigation for this impact is proposed in Section 13.3.5.

Impact Wild-2 (CP4): Impact on the Foothill Yellow-Legged Frog and Tailed Frog and Their Habitat Ground-disturbing activities associated with construction could result in direct take (e.g., because of operation of equipment in or adjacent to riverine or riparian habitat) of the foothill yellow-legged frog, a California species of special concern, a USFS sensitive species, an MSCS-covered species, and a BLM sensitive species, and of the tailed frog, a California species of special concern. In addition, the raising of Shasta Dam would result in the conversion of suitable riverine and riparian habitat to unsuitable lacustrine habitat. This impact would be potentially significant.

This impact would be similar to Impact Wild-2 (CP3) and would be potentially significant. Mitigation for this impact is proposed in Section 13.3.5.

Impact Wild-3 (CP4): Impact on the Northwestern Pond Turtle and Its Habitat
Ground-disturbing activities associated with construction could result in direct take (e.g., because of operation of equipment in or adjacent to riverine or riparian habitat) of the northwestern pond turtle, an MSCS-covered species, a California species of special concern, and a USFS sensitive species. In addition, project implementation could result in the degradation of suitable aquatic

habitat because of increased erosion and sedimentation. This impact would be potentially significant.

This impact would be similar to Impact Wild-3 (CP3) and would be potentially significant. Mitigation for this impact is proposed in Section 13.3.5.

Impact Wild-4 (CP4): Impact on the American Peregrine Falcon Construction activities and vegetation removal associated with the construction of raising the dam, construction activities in the relocation areas, and removal of various amounts of vegetation in the impoundment areas during the nesting season could result in the incidental loss of fertile eggs or nestlings or otherwise lead to the abandonment of nests of American peregrine falcons, a State fully protected species and MSCS-covered species. This impact would be potentially significant.

This impact would be similar to Impact Wild-4 (CP3) and would be potentially significant. Mitigation for this impact is proposed in Section 13.3.5.

Impact Wild-5 (CP4): Take and Loss of Habitat for the Bald Eagle Construction activities and vegetation removal associated with the construction of raising the dam, construction activities in the relocation areas, and removal of various amounts of vegetation in the impoundment areas in addition to inundation caused by the raising of Shasta Dam during the nesting season would result in the loss of nest and perch trees used by the bald eagle, a State-listed species, fully protected species, and USFS sensitive species, an MSCS-covered species, and a BLM sensitive species. This impact would be significant.

This impact would be similar to Impact Wild-5 (CP3) and would be potentially significant. Mitigation for this impact is proposed in Section 13.3.5.

Impact Wild-6 (CP4): Take and Loss of Nesting and Foraging Habitat for the Northern Spotted Owl Construction activities and vegetation removal associated with the construction of raising the dam, construction activities in the relocation areas, and removal of various amounts of vegetation in the impoundment areas during the nesting season could result in the incidental loss of fertile eggs or nestlings or otherwise lead to the abandonment of nests of the northern spotted owl, a Federally listed as threatened species and MSCS-covered species. In addition, inundation caused by the raising of Shasta Dam would result in the loss of habitat, including critical habitat for this species. This impact would be potentially significant.

This impact would be similar to Impact Wild-6 (CP3) and would be potentially significant. Mitigation for this impact is proposed in Section 13.3.5.

Impact Wild-7 (CP4): Impact on the Purple Martin and Its Nesting Habitat Construction activities and vegetation removal associated with the construction of raising the dam, construction activities in the relocation areas, and removal of various amounts of vegetation in the impoundment areas during the nesting

season could result in the incidental loss of fertile eggs or nestlings or otherwise lead to the abandonment of nests of purple martins, a California species of special concern. In addition, inundation caused by the raising of Shasta Dam would result in the loss of nest trees. This impact would be significant.

This impact would be similar to Impact Wild-7 (CP3) and would be significant. Mitigation for this impact is proposed in Section 13.3.5.

Impact Wild-8 (CP4): Impacts on the Willow Flycatcher, Vaux's Swift, Yellow Warbler, and Yellow-Breasted Chat and Their Foraging and Nesting Habitat Construction activities and vegetation removal associated with the construction of raising the dam, construction activities in the relocation areas, and removal of various amounts of vegetation in the impoundment areas during the nesting season could result in the incidental loss of fertile eggs or nestlings or otherwise lead to the abandonment of nests of the willow flycatcher, a State-listed as endangered species, USFS sensitive species, and MSCS-covered species; the Vaux's swift, a California species of special concern; and the yellow warbler and yellow-breasted chat, both California species of special concern and MSCS-covered species. In addition, the raising of Shasta Dam would result in the loss of habitat, including nesting habitat, for these species. This impact would be potentially significant.

This impact would be similar to Impact Wild-8 (CP3) and would be potentially significant. Mitigation for this impact is proposed in Section 13.3.5.

Impact Wild-9 (CP4): Impacts on the Long-Eared Owl, Northern Goshawk, Cooper's Hawk, Great Blue Heron, and Osprey and Their Foraging and Nesting Habitat Construction activities and vegetation removal associated with the construction of raising the dam, construction activities in the relocation areas, and removal of various amounts of vegetation in the impoundment areas during the nesting season could result in the incidental loss of fertile eggs or nestlings or otherwise lead to the abandonment of nests of the long-eared owl, a California species of special concern and an MSCS-covered species; the northern goshawk, a California species of special concern, a USFS sensitive species, and a BLM sensitive species; the Cooper's hawk, an MSCS-covered species; the great blue heron, an MSCS-covered species; and the osprey, an MSCS-covered species. In addition, the raising of Shasta Dam would result in the loss of foraging and nesting habitat for these species. This impact would be potentially significant.

This impact would be similar to Impact Wild-9 (CP3) and would be potentially significant. Mitigation for this impact is proposed in Section 13.3.5.

Impact Wild-10 (CP4): Take and Loss of Habitat for the Pacific Fisher Construction activities and vegetation removal associated with the construction of raising the dam, construction activities in the relocation areas, and removal of various amounts of vegetation in the impoundment areas would result in a loss

of habitat for the Pacific fisher, a Federal candidate for listing, a California species of special concern, a USFS sensitive species, and a BLM sensitive species. Furthermore, take (including mortality of individuals because of destruction or disturbance of active roost sites or dens) could result from construction activities and vegetation clearing. This impact would be potentially significant.

This impact would be similar to Impact Wild-10 (CP3) and would be potentially significant. Mitigation for this impact is proposed in Section 13.3.5.

Impact Wild-11 (CP4): Impacts on Special-Status Bats (Pallid Bat, Spotted Bat, Western Red Bat, Western Mastiff Bat, Townsend's Big-Eared Bat, Long-Eared Myotis, and Yuma Myotis), the American Marten, and Ringtail and Their Habitat Construction activities and vegetation removal associated with the construction of raising the dam, construction activities in the relocation areas, and removal of various amounts of vegetation in the impoundment areas would result in a loss of habitat for the pallid bat, a California species of special concern, a USFS sensitive species, and a BLM sensitive species; the western red bat, a USFS sensitive species; the western mastiff bat, a California species of special concern, an MSCS-covered species, and a BLM sensitive species; the Townsend's big-eared bat, a California species of special concern, a USFS sensitive species, and a BLM sensitive species; the long-eared Myotis, a BLM sensitive species; the Yuma Myotis, a BLM sensitive species; the American marten, a USFS sensitive species; and the ringtail, a State fully protected and MSCS-covered species. Furthermore, take (including mortality of individuals because of destruction or disturbance of active roost sites or dens) could result from construction activities and vegetation clearing. This impact would be potentially significant.

This impact would be similar to Impact Wild-11 (CP3) and would be potentially significant. Mitigation for this impact is proposed in Section 13.3.5.

Impact Wild-12 (CP4): Impacts on Special-Status Terrestrial Mollusks (Shasta Sideband, Wintu Sideband, Shasta Chaparral, and Shasta Hesperian) and Their Habitat All of these species are designated USFS sensitive and survey and manage species and are proposed for Federal listing. The Shasta sideband is also an MSCS-covered species. Ground-disturbing activities and vegetation removal associated with the construction of raising the dam, construction activities in the relocation areas, and removal of various amounts of vegetation in the impoundment areas could result in direct take and/or loss of suitable habitat for special-status terrestrial mollusks. In addition, the raising of Shasta Dam would result in the inundation of suitable habitat and direct take of this species. This would be a significant impact.

This impact would be similar to Impact Wild-12 (CP3) and would be significant. Mitigation for this impact is proposed in Section 13.3.5.

Impact Wild-13 (CP4): Permanent Loss of General Wildlife Habitat
Construction activities and vegetation removal associated with the construction of raising the dam, construction activities in the relocation areas, and removal of various amounts of vegetation in the impoundment areas would result in a permanent loss of habitat. In addition, inundation caused by the raising of Shasta Dam would result in a permanent loss of habitat. This would be a potentially significant impact.

This impact would be similar to Impact Wild-13 (CP3) and would be potentially significant. Mitigation for this impact is proposed in Section 13.3.5.

Impact Wild-14 (CP4): Impacts on Other Birds of Prey (i.e., red-tailed hawk and red-shouldered hawk) and Migratory Bird Species(i.e., American robin, Anna's hummingbird) and their Foraging and Nesting Habitat Construction activities and vegetation removal associated with the construction of raising the dam, construction activities in the relocation areas, and removal of various amounts of vegetation in the impoundment areas during the nesting season could result in the incidental loss of fertile eggs or nestlings or otherwise lead to the abandonment of nests of other birds of prey and migratory bird species. In addition, inundation caused by the raising of Shasta Dam would result in the loss of active nests and habitat for these species. This impact would be potentially significant.

This impact would be similar to Impact Wild-14 (CP3) and would be potentially significant. Mitigation for this impact is proposed in Section 13.3.5.

Impact Wild-15 (CP4): Loss of Critical Deer Winter and Fawning Range
Construction activities and vegetation removal associated with the construction of raising the dam, construction activities in the relocation areas, and removal of various amounts of vegetation in the impoundment areas would result in a loss of critical deer winter and fawning range. In addition, inundation caused by the raising of Shasta Dam would result in the loss of critical deer range. This would be a potentially significant impact.

This impact would be identical to Impact Wild-15 (CP3) and would be potentially significant. Mitigation for this impact is proposed in Section 13.3.5.

Impact Wild-16 (CP4): Take and Loss of the California Red-Legged Frog
Reclamation is concurrently completing an assessment of California red-legged frog habitat, which will be submitted to USFWS for review. Based on this assessment, USFWS will determine whether surveys are needed. Impacts on the California red-legged frog will be assessed if surveys are conducted and California red-legged frog is found. Impacts for each alternative will not be assessed until USFWS has determined whether suitable habitat is present and whether surveys would be required. Mitigation for this impact is proposed in Section 13.3.5.

Upper Sacramento River (Shasta Dam to Red Bluff)

Impact Wild-17 (CP4): Impacts on Riparian-Associated Special-Status Wildlife Resulting from Modifications to the Existing Flow Regime in the Primary Study Area Implementation of CP4 would result in a modified flow regime that would reduce the frequency, duration, and magnitude of intermediate to large flows below Shasta Dam during winter and spring in some years, and would increase the volume of flows from spring through fall of most years. This change in surface and subsurface hydrology could affect habitats adjacent to the river channel and the formation of off-channel habitats. Reduced formation of off-channel habitat would be a substantial long-term effect on the habitat of western pond turtle. Also, although the total amount of riparian vegetation would not be substantially altered, the portion of riparian vegetation in early successional stages would be reduced. These early successional stages provide habitat for some special-status wildlife species. In particular, these changes could result in substantial effects on the distribution or abundance of riparian-nesting special-status bird species. Therefore, this impact would be potentially significant.

This impact would be the same as Impact Wild-17 (CP1) and would be potentially significant. Mitigation for this impact is proposed in Section 13.3.5.

Impact Wild-18 (CP4): Impacts on Bank Swallow in the Primary Study Area Resulting from Modifications of Geomorphic Processes CP4 would cause a small reduction in the magnitude, duration, and frequency of intermediate to large flows, which also would alter the geomorphic processes along the Sacramento River, including the rate of bank erosion in the primary study area. However, the length of eroding banks would not be substantially altered, and thus, nesting habitat for bank swallows would not be substantially reduced. High flows during the nesting season that may cause localized nest failure would not be increased. The impact on habitat for bank swallow nesting colonies would be less than significant.

This impact would be the same as Impact Wild-18 (CP1) and would be less than significant. Mitigation for this impact is proposed in Section 13.3.5.

Impact Wild-19 (CP4): Disturbance or Removal of Vernal Pool Habitat for Special-Status Wildlife from Dam Construction and from Changes in Flow Regime Construction-related disturbances at Shasta Dam are not anticipated to disturb or permanently remove vernal pool habitat for special-status wildlife species in the primary study area. Altered flow regimes resulting from project-related dam operation are also not anticipated to temporarily disturb or permanently remove vernal pool habitat for special-status wildlife species. This impact would be less than significant.

This impact would be the same as Impact Wild-19 (CP1) and would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact Wild-20 (CP4): Consistency with Local and Regional Plans with Goals of Promoting Riparian Habitat in the Primary Study Area Several conservation and management plans have been adopted in the primary and extended study areas with goals of promoting riparian habitat along the Sacramento River. Because flow regimes and riverine geomorphic processes could be altered with project implementation, riparian habitat could be affected in such a manner that the goals of the local and regional plans would be less likely to be attained. This potential conflict between the project and local and regional plans to promote riparian habitat would be a potentially significant impact.

This impact would be the same as Impact Wild-20 (CP1) and would be potentially significant. Mitigation for this impact is proposed in Section 13.3.5.

Impact Wild-21 (CP4): Impacts on Riparian-Associated Special-Status Wildlife Resulting from the Gravel Augmentation Program CP4 would include the gravel augmentation program. Implementing the gravel augmentation program could result in temporary or short-term disturbance of riparian vegetation that has the potential to support special-status wildlife and there are no vernal pools or other seasonal wetland habitats at the augmentation sites. However, riparian-associated special-status wildlife species could be killed during riparian vegetation removal. Direct loss of individuals of riparian-associated special-status species during vegetation removal would be a potentially significant impact.

CP4 would include the gravel augmentation program. Implementing the gravel augmentation program could result in temporary disturbance of habitat or removal of riparian vegetation that has the potential to support special-status wildlife. Gravel augmentation would occur at one to a few sites per year over a 10-year period so the area of impact in a given year would be very small. A total of 15 potential augmentation sites have been identified between Keswick Dam and RBDD. Gravel placement itself is not expected to result in substantial adverse effects on any wildlife species, and there are no vernal pools or other seasonal wetland habitats at the augmentation sites. Short-term habitat loss also would not be sufficient to substantially affect any wildlife species. However, riparian-associated special-status wildlife species could be killed during riparian vegetation removal. Direct loss of riparian-associated special-status species during vegetation removal would be a potentially significant impact. Potential effects on special-status wildlife species are as follows:

- **Invertebrates** – Blue elderberry shrubs, the host plant for the valley elderberry longhorn beetle, are found throughout much of the Sacramento River's riparian corridor. Gravel augmentation activities have the potential to directly and indirectly affect blue elderberry shrubs, and valley elderberry longhorn beetles potentially present in the shrubs. Eleven individual elderberry shrubs and/or clumps are present within 100 feet of areas that would be disturbed during gravel

augmentation; these shrubs are located 20 feet or more from the access trail. No elderberry shrub removal is required; the nearest project activity is restricted to use of the access trail. Disturbance of elderberry shrubs would be a potentially significant impact.

- **Reptiles and Amphibians** – The northwestern pond turtle has been documented within the Sacramento River, and suitable habitat for the species is provided within the primary study area. Riparian vegetation that would be removed along the river corridor provides potential cover and foraging habitat for northwestern pond turtle. Augmentation activities would take place during the northwestern pond turtle breeding season so there is also potential to effect nests, eggs, or nesting females during vegetation clearing, grading, and gravel placement. Therefore, loss of habitat for the northwestern pond turtle would be a potentially significant impact.

- **Birds** – The riparian and wetland habitats along the Sacramento River floodway provide potential nesting and foraging habitat for western yellow-billed cuckoo, California yellow warbler, and yellow-breasted chat, all of which are special-status birds that nest in riparian vegetation. In addition, northern harrier and short-eared owl may nest in marshes in or adjacent to the stream channel. Other raptors – Cooper's hawk, Swainson's hawk, white-tailed kite, bald eagle, and osprey – may nest in trees in the riparian habitat in the study area. Gravel augmentation activities would be limited to a one-month window from late August to September each year. Therefore, gravel augmentation would generally be conducted outside of the nesting season of most of these species. However, there would still be some potential for active nests to be present in gravel augmentation and vegetation removal areas until mid September. For example, the nesting season for Swainson's hawk, white-tailed kite, and other raptors is from March 1 to September 15 and the nesting season of many other species extends through August 31. Therefore, vegetation removal or disturbance of active nests could result in direct mortality or loss or abandonment of active nests. This would be a potentially significant impact.

- **Mammals** – Special-status mammals potentially occurring in the project area include pallid bat, western red bat, and ringtail. Riparian habitat can provide important foraging and roosting habitat for bats, but these species are not typically dependent on riparian habitats. The amount of potential foraging habitat would not decrease appreciably, and available riparian habitats would still be sufficient for roosting habitat such that impacts on special-status bats would be less than significant. Removal of small amounts of riparian vegetation along the river channel in the study area would not substantially reduce habitat

for ringtail. Therefore, impacts on special-status mammals would be less than significant.

Because of the potential to affect valley elderberry longhorn beetle, northwestern pond turtle, and riparian-associated special-status birds, this impact would be potentially significant. Mitigation for this impact is proposed in Section 13.3.5.

Impact Wild-22 (CP4): Impacts on Riparian-Associated Special-Status Wildlife Species Resulting from Restoration of Reading Island Restoring connectivity between Anderson Creek Slough and the Sacramento River, rehabilitating the existing boat ramp, and constructing a handicap fishing access area could result in disturbance and short-term removal of riparian vegetation that support riparian-associated special-status wildlife species that could be killed during riparian vegetation removal. Direct loss of riparian-associated special-status species during vegetation removal would be a potentially significant impact.

CP4 would include restoration actions at Reading Island. Potential effects of these actions on special-status wildlife species are as follows:

- **Invertebrates** – Blue elderberry shrubs, the host plant for the valley elderberry longhorn beetle, are found throughout much of the Sacramento River's riparian corridor and may be present on the levee separating Anderson Slough and the Sacramento River. Elderberry shrubs may be present throughout Reading Island, including near the boat ramp and areas under consideration for constructing handicap fishing access. Construction activities on Reading Island have the potential to directly and indirectly affect blue elderberry shrubs, and valley elderberry longhorn beetles potentially present in the shrubs. Disturbance of elderberry shrubs would be a potentially significant impact.

- **Reptiles and Amphibians** – The northwestern pond turtle has been documented within the Sacramento River, and suitable habitat for the species is provided within the primary study area. Riparian vegetation that would be removed along the river corridor provides potential cover and foraging habitat for northwestern pond turtle. Boat ramp rehabilitation, construction of fishing access, and habitat restoration activities would take place during the northwestern pond turtle breeding season so there is also potential to effect nests, eggs, or nesting females during vegetation clearing, grading, and gravel placement. Therefore, loss of habitat for the northwestern pond turtle would be a potentially significant impact.

- **Birds** – The riparian habitat along the Sacramento River and Anderson Slough provide potential nesting and foraging habitat for western yellow-billed cuckoo, California yellow warbler, and yellow-breasted

chat, all of which are special-status birds that nest in riparian vegetation. In addition, northern harrier and short-eared owl may nest in marshes in or adjacent to the stream channel. Other raptors—Cooper's hawk, Swainson's hawk, white-tailed kite, bald eagle, and osprey—may nest in trees in the riparian habitat along these waterways and throughout Reading Island. Vegetation removal or disturbance of active nests could result in direct mortality or loss or abandonment of active nests. This would be a potentially significant impact.

- **Mammals** – Special-status mammals potentially occurring in the project area include pallid bat, western red bat, and ringtail. Riparian habitat can provide important foraging and roosting habitat for bats, but these species are not typically dependent on riparian habitats. The amount of potential foraging habitat would not decrease appreciably, and available riparian habitats would still be sufficient for roosting habitat such that impacts on special-status bats would be less than significant. Rehabilitating the existing boat ramp and constructing handicap fishing access would result in minimal vegetation removal. Restoring connectivity of the side channel between Anderson Slough and the river could result in greater amounts of vegetation removal, but this would still be a relatively small amount of riparian vegetation. Removal of small amounts of riparian vegetation along the river corridor, Anderson Slough, or Reading Island would not substantially reduce habitat for ringtail. Therefore, impacts on special-status mammals would be less than significant.

Because of the potential to affect valley elderberry longhorn beetle, northwestern pond turtle, and riparian-associated special-status birds, this impact would be potentially significant. Mitigation for this impact is proposed in Section 13.3.5.

Lower Sacramento River and Delta

Impact Wild-23 (CP4): Impacts on Riparian-Associated and Aquatic Special-Status Wildlife Resulting from Modifications to Existing Flow Regimes in the Lower Sacramento River and Delta Implementation of CP4 would modify the flow regime and would reduce the frequency, duration, and magnitude of intermediate to large flows in the lower Sacramento River during winter and spring in some years, and would increase the volume of flows from spring through fall of most years. Although this change in surface and subsurface hydrology would be less than in the upper Sacramento River, it could affect habitats adjacent to the river channel and the formation of off-channel habitats along the middle Sacramento River. Reduced formation of off-channel habitat would be a substantial long-term effect on the habitat of western pond turtle. Also, although the total amount of riparian vegetation would not be substantially altered, the portion of riparian vegetation in early successional stages would be reduced. These early successional stages provide habitat for

some special-status wildlife species. In particular, these changes could result in substantial effects on the distribution or abundance of riparian-nesting special-status bird species. Therefore, this impact would be potentially significant.

This impact would be the same as Impact Wild-23 (CP1) and would be potentially significant. Mitigation for this impact is proposed in Section 13.3.5.

Impact Wild-24 (CP4): Impacts on Bank Swallow Along the Lower Sacramento River Resulting from Modifications of Geomorphic Processes The effect of CP4 on bank swallow habitat along the lower Sacramento River would be similar to the effect along the upper Sacramento River, but smaller because the effect of CP4 on river flows would attenuate with distance downstream. The rate of bank erosion would be reduced, but the length of eroding banks would not be substantially altered, and thus, nesting habitat for bank swallows would not be substantially reduced. High flows during the nesting season that may cause localized bank and nest failure would not be increased. The impact on habitat for bank swallow nesting colonies would be less than significant.

This impact would be the same as Impact Wild-24 (CP1), and would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact Wild-25 (CP4): Disturbance or Removal of Vernal Pool Habitat for Special-Status Wildlife Along the Lower Sacramento River and in the Delta from Changes in Flow Regime of the Sacramento River and Affected Tributaries, and Changes in Seasonal Water Availability Altered flow regimes as a result of dam operation associated with the project are not anticipated to temporarily disturb or permanently remove vernal pool habitat for special-status wildlife species in the lower Sacramento River and Delta portion of the extended study area. This impact would be less than significant.

This impact would be the same as Impact Wild-25 (CP1) and would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact Wild-26 (CP4): Consistency with Local and Regional Plans with Goals of Promoting Riparian Habitat along the Lower Sacramento River and in the Delta Several conservation and management plans have been adopted in the primary and extended study areas with goals of promoting riparian habitat along the Sacramento River. Because flow regimes and riverine geomorphic processes could be altered with project implementation, riparian habitat could be affected in such a manner that the goals of the local and regional plans would be less likely to be attained. This potential conflict between the project and local and regional plans to promote riparian habitat would be a potentially significant impact.

This impact would be the same as Impact Wild-26 (CP1) and would be potentially significant. Mitigation for this impact is proposed in Section 13.3.5.

CVP/SWP Service Areas

Impact Wild-27 (CP4): Impacts on Riparian-Associated or Aquatic Special-Status Wildlife in the CVP/SWP Service Areas Resulting from Modifications to Existing Flow Regimes By altering storage and operations at several reservoirs associated with the CVP and SWP service areas, CP4 would change flow regimes in several downstream waterways. Modified flow regimes would reduce the frequency, duration, and magnitude of intermediate to large flows along the Sacramento River. However, based on the CalSim-II modeling results, the hydrologic effects on tributaries with CVP and SWP dams are expected to be less than effects on the Sacramento River. The change in surface and subsurface hydrology could affect habitats adjacent to the river channel that provide habitat for special-status wildlife species. These changes are unlikely to result in substantial effects on the distribution or abundance of riparian-associated or aquatic special-status wildlife species in the CVP and SWP service areas outside of the primary study area. Therefore, this impact would be less than significant.

This impact would be the same as Impact Wild-27 (CP1) and would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

CP5 – 18.5-Foot Dam Raise, Combination Plan

CP5 would address both the primary and secondary planning objectives. It involves enlarging Shasta Dam by 18.5 feet, which is consistent with the objectives of the 2000 CALFED ROD, and also includes the common features described above. In addition, CP5 involves (1) implementing environmental restoration features along the lower reaches of major tributaries to Shasta Lake, (2) constructing shoreline fish habitat around Shasta Lake, and (3) constructing either additional or improved recreation features at various locations around Shasta Lake to increase the value of the recreational experience. Formulation of specific environmental restoration features and increased recreation components is included in the Draft Feasibility Report.

CP5 would also include implementing the same gravel augmentation program and the same riparian, floodplain, and side channel habitat restoration at Reading Island as described for CP4.

Shasta Lake and Vicinity

Impact Wild-1 (CP5): Take and Loss of Habitat for the Shasta Salamander
Ground-disturbing activities associated with construction could result in direct take of the Shasta salamander, a State-listed species, USFS sensitive species, survey and manage species, MSCS-covered species, and BLM sensitive species. In addition, the raising of Shasta Dam would result in the inundation of habitat for this species. This impact would be significant.

This impact would be similar to Impact Wild-1 (CP3) and would be significant. Mitigation for this impact is proposed in Section 13.3.5.

Additional impacts may occur depending on specific restoration and recreation enhancement details. These impacts will be quantified when the details of the proposed actions are developed.

Impact Wild-2 (CP5): Impact on the Foothill Yellow-Legged Frog and Tailed Frog and Their Habitat Ground-disturbing activities associated with construction could result in direct take (e.g., because of operation of equipment in or adjacent to riverine or riparian habitat) of the foothill yellow-legged frog, a California species of special concern, a USFS sensitive species, an MSCS-covered species, and a BLM sensitive species, and of the tailed frog, a California species of special concern. In addition, the raising of Shasta Dam would result in the conversion of suitable riverine and riparian habitat to unsuitable lacustrine habitat. This impact would be potentially significant.

This impact would be similar to Impact Wild-2 (CP3) and would be potentially significant. Mitigation for this impact is proposed in Section 13.3.5.

Additional impacts may occur depending on specific restoration and recreation enhancement details. These impacts will be quantified when the details of the proposed actions are developed.

Impact Wild-3 (CP5): Impact on the Northwestern Pond Turtle and Its Habitat Ground-disturbing activities associated with construction could result in direct take (e.g., because of operation of equipment in or adjacent to riverine or riparian habitat) of the northwestern pond turtle, an MSCS-covered species, a California species of special concern, and a USFS sensitive species. In addition, project implementation could result in the degradation of suitable aquatic habitat because of increased erosion and sedimentation. This impact would be potentially significant.

This impact would be similar to Impact Wild-3 (CP3) and would be potentially significant. Mitigation for this impact is proposed in Section 13.3.5.

Additional impacts may occur depending on specific restoration and recreation enhancement details. These impacts will be quantified when the details of the proposed actions are developed.

Impact Wild-4 (CP5): Impact on the American Peregrine Falcon Construction activities and vegetation removal associated with the construction of raising the dam, construction activities in the relocation areas, and removal of various amounts of vegetation in the impoundment areas during the nesting season could result in the incidental loss of fertile eggs or nestlings or otherwise lead to the abandonment of nests of American peregrine falcons, a State fully protected species and MSCS-covered species. This impact would be potentially significant.

This impact would be similar to Impact Wild-4 (CP3) and would be potentially significant. Mitigation for this impact is proposed in Section 13.3.5.

Additional impacts may occur depending on specific restoration and recreation enhancement details. These impacts will be quantified when the details of the proposed actions are developed.

Impact Wild-5 (CP5): Take and Loss of Habitat for the Bald Eagle
Construction activities and vegetation removal associated with the construction of raising the dam, construction activities in the relocation areas, and removal of various amounts of vegetation in the impoundment areas in addition to inundation caused by the raising of Shasta Dam during the nesting season would result in the loss of nest and perch trees used by the bald eagle, a State-listed species, fully protected species, and USFS sensitive species, an MSCS-covered species, and a BLM sensitive species. This impact would be significant.

This impact would be similar to Impact Wild-5 (CP3) and would be significant. Mitigation for this impact is proposed in Section 13.3.5.

Additional impacts may occur depending on specific restoration and recreation enhancement details. These impacts will be quantified when the details of the proposed actions are developed.

Impact Wild-6 (CP5): Take and Loss of Nesting and Foraging Habitat for the Northern Spotted Owl Construction activities and vegetation removal associated with the construction of raising the dam, construction activities in the relocation areas, and removal of various amounts of vegetation in the impoundment areas during the nesting season could result in the incidental loss of fertile eggs or nestlings or otherwise lead to the abandonment of nests of the northern spotted owl, a Federally listed as threatened species and MSCS-covered species. In addition, inundation caused by the raising of Shasta Dam would result in the loss of habitat, including critical habitat for this species. This impact would be potentially significant.

This impact would be similar to Impact Wild-6 (CP3) and would be potentially significant. Mitigation for this impact is proposed in Section 13.3.5.

Additional impacts may occur depending on specific restoration and recreation enhancement details. These impacts will be quantified when the details of the proposed actions are developed.

Impact Wild-7 (CP5): Impact on the Purple Martin and Its Nesting Habitat
Construction activities and vegetation removal associated with the construction of raising the dam, construction activities in the relocation areas, and removal of various amounts of vegetation in the impoundment areas during the nesting season could result in the incidental loss of fertile eggs or nestlings or otherwise lead to the abandonment of nests of purple martins, a California species of special concern. In addition, inundation caused by the raising of Shasta Dam would result in the loss of nest trees. This impact would be significant.

This impact would be similar to Impact Wild-7 (CP3) and would be significant. Mitigation for this impact is proposed in Section 13.3.5.

Additional impacts may occur depending on specific restoration and recreation enhancement details. These impacts will be quantified when the details of the proposed actions are developed.

Impact Wild-8 (CP5): Impacts on the Willow Flycatcher, Vaux's Swift, Yellow Warbler, and Yellow-Breasted Chat and Their Foraging and Nesting Habitat
Construction activities and vegetation removal associated with the construction of raising the dam, construction activities in the relocation areas, and removal of various amounts of vegetation in the impoundment areas during the nesting season could result in the incidental loss of fertile eggs or nestlings or otherwise lead to the abandonment of nests of the willow flycatcher, a State-listed as endangered species, USFS sensitive species, and MSCS-covered species; the Vaux's swift, a California species of special concern; and the yellow warbler and yellow-breasted chat, both California species of special concern and MSCS-covered species. In addition, the raising of Shasta Dam would result in the loss of habitat, including nesting habitat, for these species. This impact would be potentially significant.

This impact would be similar to Impact Wild-8 (CP3) and would be potentially significant. Mitigation for this impact is proposed in Section 13.3.5.

Additional impacts may occur depending on specific restoration and recreation enhancement details. These impacts will be quantified when the details of the proposed actions are developed.

Impact Wild-9 (CP5): Impacts on the Long-Eared Owl, Northern Goshawk, Cooper's Hawk, Great Blue Heron, and Osprey and Their Foraging and Nesting Habitat Construction activities and vegetation removal associated with the construction of raising the dam, construction activities in the relocation areas, and removal of various amounts of vegetation in the impoundment areas during the nesting season could result in the incidental loss of fertile eggs or nestlings or otherwise lead to the abandonment of nests of the long-eared owl, a California species of special concern and an MSCS-covered species; the northern goshawk, a California species of special concern, a USFS sensitive species, and a BLM sensitive species; the Cooper's hawk, an MSCS-covered species; the great blue heron, an MSCS-covered species; and the osprey, an MSCS-covered species. In addition, the raising of Shasta Dam would result in the loss of foraging and nesting habitat for these species. This impact would be potentially significant.

This impact would be similar to Impact Wild-9 (CP3) and would be potentially significant. Mitigation for this impact is proposed in Section 13.3.5.

Additional impacts may occur depending on specific restoration and recreation enhancement details. These impacts will be quantified when the details of the proposed actions are developed.

Impact Wild-10 (CP5): Take and Loss of Habitat for the Pacific Fisher
Construction activities and vegetation removal associated with the construction of raising the dam, construction activities in the relocation areas, and removal of various amounts of vegetation in the impoundment areas would result in a loss of habitat for the Pacific fisher, a Federal candidate for listing, a California species of special concern, a USFS sensitive species, and a BLM sensitive species. Furthermore, take (including mortality of individuals because of destruction or disturbance of active roost sites or dens) could result from construction activities and vegetation clearing. This impact would be potentially significant.

This impact would be similar to Impact Wild-10 (CP3) and would be potentially significant. Mitigation for this impact is proposed in Section 13.3.5.

Additional impacts may occur depending on specific restoration and recreation enhancement details. These impacts will be quantified when the details of the proposed actions are developed.

Impact Wild-11 (CP5): Impacts on Special-Status Bats (Pallid Bat, Spotted Bat, Western Red Bat, Western Mastiff Bat, Townsend's Big-Eared Bat, Long-Eared Myotis, and Yuma Myotis), the American Marten, and Ringtail and Their Habitat Construction activities and vegetation removal associated with the construction of raising the dam, construction activities in the relocation areas, and removal of various amounts of vegetation in the impoundment areas would result in a loss of habitat for the pallid bat, a California species of special concern, a USFS sensitive species, and a BLM sensitive species; the western red bat, a USFS sensitive species; the western mastiff bat, a California species of special concern, an MSCS-covered species, and a BLM sensitive species; the Townsend's big-eared bat, a California species of special concern, a USFS sensitive species, and a BLM sensitive species; the long-eared Myotis, a BLM sensitive species; the Yuma Myotis, a BLM sensitive species; the American marten, a USFS sensitive species; and the ringtail, a State fully protected and MSCS-covered species. Furthermore, take (including mortality of individuals because of destruction or disturbance of active roost sites or dens) could result from construction activities and vegetation clearing. This impact would be potentially significant.

This impact would be similar to Impact Wild-11 (CP3) and would be potentially significant. Mitigation for this impact is proposed in Section 13.3.5.

Additional impacts may occur depending on specific restoration and recreation enhancement details. These impacts will be quantified when the details of the proposed actions are developed.

Impact Wild-12 (CP5): Impacts on Special-Status Terrestrial Mollusks (Shasta Sideband, Wintu Sideband, Shasta Chaparral, and Shasta Hesperian) and Their Habitat All of these species are designated USFS sensitive and survey and manage species and are proposed for Federal listing. The Shasta sideband is also an MSCS-covered species. Ground-disturbing activities and vegetation removal associated with the construction of raising the dam, construction activities in the relocation areas, and removal of various amounts of vegetation in the impoundment areas could result in direct take and/or loss of suitable habitat for special-status terrestrial mollusks. In addition, the raising of Shasta Dam would result in the inundation of suitable habitat and direct take of this species. This would be a significant impact.

This impact would be similar to Impact Wild-12 (CP3) and would be a significant impact. Mitigation for this impact is proposed in Section 13.3.5.

Additional impacts may occur depending on specific restoration and recreation enhancement details. These impacts will be quantified when the details of the proposed actions are developed.

Impact Wild-13 (CP5): Permanent Loss of General Wildlife Habitat
Construction activities and vegetation removal associated with the construction of raising the dam, construction activities in the relocation areas, and removal of various amounts of vegetation in the impoundment areas would result in a permanent loss of habitat. In addition, inundation caused by the raising of Shasta Dam would result in a permanent loss of habitat. This would be a potentially significant impact.

This impact would be similar to Impact Wild-13 (CP3) and would be potentially significant. Mitigation for this impact is proposed in Section 13.3.5.

Additional impacts may occur depending on specific restoration and recreation enhancement details. These impacts will be quantified when the details of the proposed actions are developed.

Impact Wild-14 (CP5): Impacts on Other Birds of Prey (i.e., red-tailed hawk and red-shouldered hawk) and Migratory Bird Species(i.e., American robin, Anna's hummingbird) and their Foraging and Nesting Habitat Construction activities and vegetation removal associated with the construction of raising the dam, construction activities in the relocation areas, and removal of various amounts of vegetation in the impoundment areas during the nesting season could result in the incidental loss of fertile eggs or nestlings or otherwise lead to the abandonment of nests of other birds of prey and migratory bird species. In addition, inundation caused by the raising of Shasta Dam would result in the loss of active nests and habitat for these species. This impact would be potentially significant.

This impact would be similar to Impact Wild-14 (CP3) and would be potentially significant. Mitigation for this impact is proposed in Section 13.3.5.

Additional impacts may occur depending on specific restoration and recreation enhancement details. These impacts will be quantified when the details of the proposed actions are developed.

Impact Wild-15 (CP5): Loss of Critical Deer Winter and Fawning Range
Construction activities and vegetation removal associated with the construction of raising the dam, construction activities in the relocation areas, and removal of various amounts of vegetation in the impoundment areas would result in a loss of critical deer winter and fawning range. In addition, inundation caused by the raising of Shasta Dam would result in the loss of critical deer range. This would be a potentially significant impact.

This impact would be similar to Impact Wild-15 (CP3) and would be potentially significant. Mitigation for this impact is proposed in Section 13.3.5.

Additional impacts may occur depending on specific restoration and recreation enhancement details. These impacts will be quantified when the details of the proposed actions are developed.

Impact Wild-16 (CP5): Take and Loss of the California Red-Legged Frog
Reclamation is concurrently completing an assessment of California red-legged frog habitat, which will be submitted to USFWS for review. Based on this assessment, USFWS will determine whether surveys are needed. Impacts on the California red-legged frog will be assessed if surveys are conducted and California red-legged frog is found. Impacts for each alternative will not be assessed until USFWS has determined whether suitable habitat is present and whether surveys would be required. Mitigation for this impact is proposed in Section 13.3.5.

Upper Sacramento River (Shasta Dam to Red Bluff)
Impact Wild-17 (CP5): Impacts on Riparian-Associated Special-Status Wildlife Resulting from Modifications to the Existing Flow Regime in the Primary Study Area Implementation of CP5 would result in a modified flow regime that would reduce the frequency, duration, and magnitude of intermediate to large flows below Shasta Dam during winter and spring in some years, and would increase the volume of flows from spring through fall of most years. This change in surface and subsurface hydrology could affect habitats adjacent to the river channel and the formation of off-channel habitats. Reduced formation of off-channel habitat would be a substantial long-term effect on the habitat of western pond turtle. Also, although the total amount of riparian vegetation would not be substantially altered, the portion of riparian vegetation in early successional stages would be reduced. These early successional stages provide habitat for some special-status wildlife species. In particular, these changes could result in

substantial effects on the distribution or abundance of riparian-nesting special-status bird species. Therefore, this impact would be potentially significant.

This impact would be the same as Impact Wild-17 (CP3) and would be potentially significant. Mitigation for this impact is proposed in Section 13.3.5.

Impact Wild-18 (CP5): Impacts on Bank Swallow in the Primary Study Area Resulting from Modifications of Geomorphic Processes CP5 would cause a small reduction in the magnitude, duration, and frequency of intermediate to large flows, which also would alter the geomorphic processes along the Sacramento River, including the rate of bank erosion in the primary study area. However, the length of eroding banks would not be substantially altered, and thus, nesting habitat for bank swallows would not be substantially reduced. High flows during the nesting season that may cause localized nest failure would not be increased. The impact on habitat for bank swallow nesting colonies would be less than significant.

This impact would be the same as Impact Wild-18 (CP3) and would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact Wild-19 (CP5): Disturbance or Removal of Vernal Pool Habitat for Special-Status Wildlife from Dam Construction and from Changes in Flow Regime Construction-related disturbances at Shasta Dam are not anticipated to disturb or permanently remove vernal pool habitat for special-status wildlife species in the primary study area. Altered flow regimes resulting from project-related dam operations are also not anticipated to temporarily disturb or permanently remove vernal pool habitat for special-status wildlife species. This impact would be less than significant.

This impact would the same as Impact Wild-19 (CP3) and would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact Wild-20 (CP5): Consistency with Local and Regional Plans with Goals of Promoting Riparian Habitat in the Primary Study Area Several conservation and management plans have been adopted in the primary and extended study areas with goals of promoting riparian habitat along the Sacramento River. Because flow regimes and riverine geomorphic processes could be altered with project implementation, riparian habitat could be affected in such a manner that the goals of the local and regional plans would be less likely to be attained. This potential conflict between the project and local and regional plans to promote riparian habitat would be a potentially significant impact.

This impact would be the same as Impact Wild-20 (CP3) and would be potentially significant. Mitigation for this impact is proposed in Section 13.3.5.

Impact Wild-21 (CP5): Impacts on Riparian-Associated Special-Status Wildlife Resulting from the Gravel Augmentation Program CP5 includes the gravel augmentation program. Implementing the gravel augmentation program could

result in disturbance or removal of riparian vegetation that has the potential to support special-status wildlife. Gravel augmentation would occur at one to a few sites per year over a 10-year period so the area of impact in a given year would be very small. Thus, gravel placement is not expected to result in any substantial short- or long-term adverse effects on any wildlife species. However, riparian-associated special-status wildlife species could be killed during riparian vegetation disturbance or removal. Direct loss of individuals of riparian-associated special-status species during vegetation removal would be a potentially significant impact.

This impact would be the same as Impact Wild-21 (CP4) and would be potentially significant. Mitigation for this impact is proposed in Section 13.3.5.

Impact Wild-22 (CP5): Impacts on Riparian-Associated Special-Status Wildlife Species Resulting from Restoration of Reading Island Restoring connectivity between Anderson Creek Slough and the Sacramento River, rehabilitating the existing boat ramp, and constructing a handicap fishing access area could result in disturbance and short-term removal of riparian vegetation that support riparian-associated special-status wildlife species that could be killed during riparian vegetation removal. Direct loss of riparian-associated special-status species during vegetation removal would be a potentially significant impact.

This impact would be the same as Impact Wild-22 (CP4) and would be potentially significant. Mitigation for this impact is proposed in Section 13.3.5.

Lower Sacramento River and Delta

Impact Wild-23 (CP5): Impacts on Riparian-Associated and Aquatic Special-Status Wildlife Resulting from Modifications to Existing Flow Regimes in the Lower Sacramento River and Delta Implementation of CP5 would modify the flow regime and would reduce the frequency, duration, and magnitude of intermediate to large flows in the lower Sacramento River during winter and spring in some years, and would increase the volume of flows from spring through fall of most years. Although this change in surface and subsurface hydrology would be less than in the upper Sacramento River, it could affect habitats adjacent to the river channel and the formation of off-channel habitats along the middle Sacramento River. Reduced formation of off-channel habitat would be a substantial long-term effect on the habitat of western pond turtle. Also, although the total amount of riparian vegetation would not be substantially altered, the portion of riparian vegetation in early successional stages would be reduced. These early successional stages provide habitat for some special-status wildlife species. In particular, these changes could result in substantial effects on the distribution or abundance of riparian-nesting special-status bird species. Therefore, this impact would be potentially significant.

This impact would be the same as Impact Wild-23 (CP3) and would be potentially significant. Mitigation for this impact is proposed in Section 13.3.5.

Impact Wild-24 (CP5): Impacts on Bank Swallow Along the Lower Sacramento River Resulting from Modifications of Geomorphic Processes The effect of CP5 on bank swallow habitat along the lower Sacramento River would be similar to the effect along the upper Sacramento River, but smaller because the effect of CP5 on river flows would attenuate with distance downstream. The rate of bank erosion would be reduced, but the length of eroding banks would not be substantially altered, and thus, nesting habitat for bank swallows would not be substantially reduced. High flows during the nesting season that may cause localized bank and nest failure would not be increased. The impact on habitat for bank swallow nesting colonies would be less than significant.

This impact would be the same as Impact Wild-24 (CP3), and would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact Wild-25 (CP5): Disturbance or Removal of Vernal Pool Habitat for Special-Status Wildlife Along the Lower Sacramento River and in the Delta from Changes in Flow Regime of the Sacramento River and Affected Tributaries, and Changes in Seasonal Water Availability Altered flow regimes as a result of dam operation associated with the project are not anticipated to temporarily disturb or permanently remove vernal pool habitat for special-status wildlife species in the lower Sacramento River and Delta portion of the extended study area. This impact would be less than significant.

This impact would be the same as Impact Wild-25 (CP3) and would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact Wild-26 (CP5): Consistency with Local and Regional Plans with Goals of Promoting Riparian Habitat along the Lower Sacramento River and in the Delta Several conservation and management plans have been adopted in the primary and extended study areas with goals of promoting riparian habitat along the Sacramento River. Because flow regimes and riverine geomorphic processes could be altered with project implementation, riparian habitat could be affected in such a manner that the goals of the local and regional plans would be less likely to be attained. This potential conflict between the project and local and regional plans to promote riparian habitat would be a potentially significant impact.

This impact would be the same as Impact Wild-26 (CP3) and would be potentially significant. Mitigation for this impact is proposed in Section 13.3.5.

CVP/SWP Service Areas

Impact Wild-27 (CP5): Impacts on Riparian-Associated or Aquatic Special-Status Wildlife in the CVP/SWP Service Areas Resulting from Modifications to Existing Flow Regimes By altering storage and operations at several reservoirs associated with the CVP and SWP service areas, CP5 would change flow regimes in several downstream waterways. Modified flow regimes would reduce the frequency, duration, and magnitude of intermediate to large flows along the Sacramento River. However, based on the CalSim-II modeling results,

the hydrologic effects on tributaries with CVP and SWP dams are expected to be less than effects on the Sacramento River. Most potential noticeable changes in flows and stages would diminish downstream from Red Bluff. The change in surface and subsurface hydrology could affect habitats adjacent to the river channel that provide habitat for special-status wildlife species. These changes are unlikely to result in substantial effects on the distribution or abundance of riparian-associated or aquatic special-status wildlife species in the CVP and SWP service areas outside of the primary study area. Therefore, this impact would be less than significant.

This impact would be the same as Impact Wild-27 (CP3) and would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

13.3.5 Mitigation Measures

Table 13-41 presents a summary of mitigation measures for wildlife resources.

Table 13-41. Summary of Mitigation Measures for Wildlife Resources

Impact		No-Action Alternative	CP1	CP2	CP3	CP4	CP5
Impact Wild-1: Take and Loss of Habitat for the Shasta Salamander	LOS before Mitigation	NI	S	S	S	S	S
	Mitigation Measure	None required.	Mitigation Measure Wild-1: Avoid, Relocate, and Acquire Mitigation Lands for Shasta Salamander.				
	LOS after Mitigation	NI	SU	SU	SU	SU	SU
Impact Wild-2: Impact on the Foothill Yellow-Legged Frog and Tailed Frog and Their Habitat	LOS before Mitigation	NI	PS	PS	PS	PS	PS
	Mitigation Measure	None required.	Mitigation Measure Wild-2: Avoid, Relocate, and Acquire Mitigation Lands for Foothill Yellow-Legged Frog and Tailed Frog.				
	LOS after Mitigation	NI	SU	SU	SU	SU	SU
Impact Wild-3: Impact on the Northwestern Pond Turtle and Its Habitat	LOS before Mitigation	NI	PS	PS	PS	PS	PS
	Mitigation Measure	None required.	Mitigation Measure Wild-3: Avoid, Relocate, and Acquire Mitigation Lands for Northwestern Pond Turtle.				
	LOS after Mitigation	NI	SU	SU	SU	SU	SU
Impact Wild-4: Impact on the American Peregrine Falcon	LOS before Mitigation	NI	PS	PS	PS	PS	PS
	Mitigation Measure	None required.	Mitigation Measure Wild-4: Conduct Preconstruction Surveys for the American Peregrine Falcon and Establish Buffers.				
	LOS after Mitigation	NI	LTS	LTS	LTS	LTS	LTS
Impact Wild-5: Take and Loss of Habitat for the Bald Eagle	LOS before Mitigation	NI	S	S	S	S	S
	Mitigation Measure	None required.	Mitigation Measure Wild-5: Acquire and Preserve Mitigation Lands; Conduct Protocol-Level Surveys for the Bald Eagle and Establish Buffers.				
	LOS after Mitigation	NI	SU	SU	SU	SU	SU

Table 13-41. Summary of Mitigation Measures for Wildlife Resources (contd.)

Impact		No-Action Alternative	CP1	CP2	CP3	CP4	CP5
Impact Wild-6: Take and Loss of Nesting and Foraging Habitat for the Northern Spotted Owl	LOS before Mitigation	NI	PS	PS	PS	PS	PS
	Mitigation Measure	None required.	Mitigation Measure Wild-6: Acquire and Preserve Mitigation Lands; Conduct Protocol-Level Surveys for the Northern Spotted Owl and Establish Buffers.				
	LOS after Mitigation	NI	SU	SU	SU	SU	SU
Impact Wild-7: Impact on the Purple Martin and Its Habitat	LOS before Mitigation	NI	S	S	S	S	S
	Mitigation Measure	None required.	Mitigation Measure Wild-7: Conduct a Preconstruction Survey for the Purple Martin and Establish Buffers.				
	LOS after Mitigation	NI	SU	SU	SU	SU	SU
Impact Wild-8: Impacts on the Willow Flycatcher, Vaux's Swift, Yellow Warbler, and Yellow-Breasted Chat and Their Foraging and Nesting Habitat	LOS before Mitigation	NI	PS	PS	PS	PS	PS
	Mitigation Measure	None required.	Mitigation Measure Wild-8: Acquire and Preserve Mitigation Lands; Conduct a Preconstruction Survey for the Willow Flycatcher, Vaux's Swift, Yellow Warbler, and Yellow-Breasted Chat and Establish Buffers.				
	LOS after Mitigation	NI	SU	SU	SU	SU	SU
Impact Wild-9: Impacts on the Long-Eared Owl, Northern Goshawk, Cooper's Hawk, Great Blue Heron, and Osprey and Their Foraging and Nesting Habitat	LOS before Mitigation	NI	PS	PS	PS	PS	PS
	Mitigation Measure	None required.	Mitigation Measure Wild-9: Acquire and Preserve Mitigation Lands; Conduct a Preconstruction Survey for the Long-Eared Owl, Northern Goshawk, Cooper's Hawk, and Great Blue Heron and Establish Buffers.				
	LOS after Mitigation	NI	SU	SU	SU	SU	SU

Table 13-41. Summary of Mitigation Measures for Wildlife Resources (contd.)

Impact		No-Action Alternative	CP1	CP2	CP3	CP4	CP5
Impact Wild-10: Take and Loss of Habitat for the Pacific Fisher	LOS before Mitigation	NI	PS	PS	PS	PS	PS
	Mitigation Measure	None required.	Mitigation Measure Wild-10: Acquire and Preserve Mitigation Lands; Conduct Preconstruction Surveys for the Pacific Fisher and Establish Buffers.				
	LOS after Mitigation	NI	SU	SU	SU	SU	SU
Impact Wild-11: Impacts on Special-Status Bats (Pallid Bat, Spotted Bat, Western Red Bat, Western Mastiff Bat, Townsend's Big-Eared Bat, Long-Eared Myotis, and Yuma Myotis), the American Marten, and Ringtails and Their Habitat	LOS before Mitigation	NI	PS	PS	PS	PS	PS
	Mitigation Measure	None required.	Mitigation Measure Wild-11: Acquire and Preserve Mitigation Lands; Conduct a Preconstruction Survey for Special-Status Bats, American Marten, and Ringtails and Establish Buffers.				
	LOS after Mitigation	NI	SU	SU	SU	SU	SU
Impact Wild-12: Impacts on Special-Status Terrestrial Mollusks (Shasta Sideband, Wintu Sideband, Shasta Chaparral, and Shasta Hesperian) and Their Habitat	LOS before Mitigation	NI	S	S	S	S	S
	Mitigation Measure	None required.	Mitigation Measure Wild-12: Avoid Suitable Habitat; Acquire and Preserve Mitigation Lands for Special-Status Terrestrial Mollusks.				
	LOS after Mitigation	NI	SU	SU	SU	SU	SU
Impact Wild-13: Permanent Loss of General Wildlife Habitat	LOS before Mitigation	NI	PS	PS	PS	PS	PS
	Mitigation Measure	None required.	Mitigation Measure Wild-13: Acquire and Preserve Mitigation Lands for Permanent Loss of General Wildlife Habitat.				
	LOS after Mitigation	NI	SU	SU	SU	SU	SU

Table 13-41. Summary of Mitigation Measures for Wildlife Resources (contd.)

Impact		No-Action Alternative	CP1	CP2	CP3	CP4	CP5
Impact Wild-14: Impacts on Other Birds of Prey (i.e., Red-Tailed Hawk and Red-Shouldered Hawk) and Migratory Bird Species (i.e., American Robin, Anna's Hummingbird) and Their Foraging and Nesting Habitat	LOS before Mitigation	NI	PS	PS	PS	PS	PS
	Mitigation Measure	None required.	Mitigation Measure Wild-14: Conduct Preconstruction Surveys for Other Nesting Raptors and Migratory Birds and Establish Buffers.				
	LOS after Mitigation	NI	SU	SU	SU	SU	SU
Impact Wild-15: Loss of Critical Deer Winter and Fawning Range	LOS before Mitigation	NI	PS	PS	PS	PS	PS
	Mitigation Measure	None required.	Mitigation Measure Wild-15: Acquire and Preserve Mitigation Lands for Permanent Loss of Critical Deer Wintering and Fawning Range.				
	LOS after Mitigation	NI	SU	SU	SU	SU	SU
Impact Wild-16: Take and Loss of the California Red-Legged Frog	LOS before Mitigation	NI	TBD	TBD	TBD	TBD	TBD
	Mitigation Measure	None required.	TBD				
	LOS after Mitigation	NI	TBD	TBD	TBD	TBD	TBD
Impact Wild-17: Impacts on Riparian-Associated Special-Status Wildlife Resulting from Modifications to the Existing Flow Regime in the Primary Study Area	LOS before Mitigation	LTS	PS	PS	PS	PS	PS
	Mitigation Measure	None required.	Mitigation Measure Wild-17: Implement Mitigation Measure Bot-7: Develop and Implement a Rivierine Ecosystem Mitigation and Adaptive Management Plan to Avoid and Compensate for the Impact of Altered Flow Regimes on Riparian and Wetland Communities.				
	LOS after Mitigation	LTS	LTS	LTS	LTS	LTS	LTS

Table 13-41. Summary of Mitigation Measures for Wildlife Resources (contd.)

Impact		No-Action Alternative	CP1	CP2	CP3	CP4	CP5
Impact Wild-18: Impacts on Bank Swallow in the Primary Study Area Resulting from Modifications of Geomorphic Processes	LOS before Mitigation	LTS	LTS	LTS	LTS	LTS	LTS
	Mitigation Measure	None required.	None needed; thus, none proposed.				
	LOS after Mitigation	LTS	LTS	LTS	LTS	LTS	LTS
Impact Wild-19: Disturbance or Removal of Vernal Pool Habitat for Special-Status Wildlife from Changes in Flow Regime	LOS before Mitigation	LTS	LTS	LTS	LTS	LTS	LTS
	Mitigation Measure	None required.	None needed; thus, none proposed.				
	LOS after Mitigation	LTS	LTS	LTS	LTS	LTS	LTS
Impact Wild-20: Consistency with Local and Regional Plans with Goals of Promoting Riparian Habitat in the Primary Study Area	LOS before Mitigation	LTS	PS	PS	PS	PS	PS
	Mitigation Measure	None required.	Mitigation Measure Wild-20: Implement Mitigation Measure Bot-7: Develop and Implement a Rivierine Ecosystem Mitigation and Adaptive Management Plan to Avoid and Compensate for the Impact of Altered Flow Regimes on Riparian and Wetland Communities.				
	LOS after Mitigation	LTS	LTS	LTS	LTS	LTS	LTS
Impact Wild-21: Impacts on Riparian-Associated Special-Status Wildlife Resulting from the Gravel Augmentation Program	LOS before Mitigation	NI	NI	NI	NI	PS	PS
	Mitigation Measure	None required.	None needed; thus, none proposed.			Mitigation Measure Wild-21: Conduct Preconstruction Surveys for Elderberry Shrubs, Northwestern Pond Turtle, and Nesting Riparian Raptors and Other Nesting Birds. Avoid Removal or Degradation of Elderberry Shrubs and Avoid Vegetation Removal near Active Nest Sites.	
	LOS after Mitigation	NI	NI	NI	NI	LTS	LTS

Table 13-41. Summary of Mitigation Measures for Wildlife Resources (contd.)

Impact		No-Action Alternative	CP1	CP2	CP3	CP4	CP5
Impact Wild-22: Impacts on Riparian-Associated Special-Status Wildlife Species Resulting from Restoration of Reading Island	LOS before Mitigation	NI	NI	NI	NI	PS	PS
	Mitigation Measure	None required.	None needed; thus, none proposed.			Mitigation Measure Wild-22: Implement Mitigation Measure Wild-21: Conduct Preconstruction Surveys for Elderberry Shrubs, Northwestern Pond Turtle, and Nesting Riparian Raptors and Other Nesting Birds. Avoid Removal or Degradation of Elderberry Shrubs and Avoid Vegetation Removal near Active Nest Sites.	
	LOS after Mitigation	NI	NI	NI	NI	LTS	LTS
Impact Wild-23: Impacts on Riparian-Associated and Aquatic Special-Status Wildlife Resulting from Modifications to Existing Flow Regimes in the Lower Sacramento River and Delta	LOS before Mitigation	LTS	PS	PS	PS	PS	PS
	Mitigation Measure	None required.	Mitigation Measure Wild-23: Implement Mitigation Measure Bot-7: Develop and Implement a Rivierine Ecosystem Mitigation and Adaptive Management Plan to Avoid and Compensate for the Impact of Altered Flow Regimes on Riparian and Wetland Communities.				
	LOS after Mitigation	LTS	LTS	LTS	LTS	LTS	LTS
Impact Wild-24: Impacts on Bank Swallow Along the Lower Sacramento River Resulting from Modifications of Geomorphic Processes	LOS before Mitigation	LTS	LTS	LTS	LTS	LTS	LTS
	Mitigation Measure	None required.	None needed; thus, none proposed.				
	LOS after Mitigation	LTS	LTS	LTS	LTS	LTS	LTS

Table 13-41. Summary of Mitigation Measures for Wildlife Resources (contd.)

Impact		No-Action Alternative	CP1	CP2	CP3	CP4	CP5
Impact Wild-25: Disturbance or Removal of Vernal Pool Habitat for Special-Status Wildlife Along the Lower Sacramento River and in the Delta from Changes in Flow Regime of the Sacramento River and Affected Tributaries, and Changes in Seasonal Water Availability	LOS before Mitigation	LTS	LTS	LTS	LTS	LTS	LTS
	Mitigation Measure	None required.	None needed; thus, none proposed.				
	LOS after Mitigation	LTS	LTS	LTS	LTS	LTS	LTS
Impact Wild-26: Consistency with Local and Regional Plans with Goals of Promoting Riparian Habitat along the Lower Sacramento River and in the Delta	LOS before Mitigation	LTS	PS	PS	PS	PS	PS
	Mitigation Measure	None required.	Mitigation Measure Wild-26: Implement Mitigation Measure Bot-7: Develop and Implement a Rivierine Ecosystem Mitigation and Adaptive Management Plan to Avoid and Compensate for the Impact of Altered Flow Regimes on Riparian and Wetland Communities.				
	LOS after Mitigation	LTS	LTS	LTS	LTS	LTS	LTS
Impact Wild-27: Impacts on Riparian-Associated or Aquatic Special-Status Wildlife in the CVP/SWP Service Areas Resulting from Modifications to Existing Flow Regimes	LOS before Mitigation	LTS	LTS	LTS	LTS	LTS	LTS
	Mitigation Measure	None required.	None needed; thus, none proposed.				
	LOS after Mitigation	LTS	LTS	LTS	LTS	LTS	LTS

Key:
LOS = level of significance
LTS = less than significant
NI = no impact
PS = potentially significant
S = significant
SU = significant and unavoidable
TBD = to be determined

No-Action Alternative

No mitigation measures are needed for this alternative.

CP1 – 6.5-Foot Dam Raise, Anadromous Fish Survival and Water Supply Reliability

No mitigation is needed for Impacts Wild-18 (CP1), Wild-19 (CP1), Wild-21, Wild-22, Wild-24 (CP1), Wild-25 (CP1), and Wild-27 (CP1). Mitigation is provided below for the remaining impacts of CP1 on wildlife species.

Mitigation Measure Wild-1 (CP1): Avoid, Relocate, and Acquire Mitigation Lands for Shasta Salamander To avoid or minimize impacts on the Shasta salamander, the following measures will be implemented:

Inundation Area It is unfeasible to quantify the number of individual Shasta salamanders that would be lost in the impoundment area. Direct loss of individuals and of limestone habitat from inundation cannot be mitigated. Mitigation lands will be acquired and placed in conservation easements to mitigate for the loss of Shasta salamander habitat.

Potential mitigation lands containing comparable Shasta salamander habitat have been identified adjacent to the project. Shasta salamander has been found in both limestone and nonlimestone habitat in this site. Additional discussion of how these lands could be applied as mitigation will be presented in the FEIS.

Vegetation Removal and Construction Activities

- Protocol-level surveys will be conducted in all relocation areas to determine presence or absence of the Shasta salamander. If absent, no further mitigation is required.

- When feasible, use of heavy equipment and excavation in limestone substrates will be avoided.

- To minimize impacts on individuals, preconstruction surveys, in consultation with DFG and USFS, will be conducted by a qualified biologist prior to construction activities during the wet season. Individuals will be relocated to suitable limestone habitat in the vicinity of detection.

- In occupied relocation areas, mitigation measures developed for loss of suitable limestone and nonlimestone habitat in the impoundment area will be applied.

The avoidance and relocation measures for vegetation removal and construction activities would effectively mitigate impacts caused by those activities. However, the effectiveness of providing compensatory mitigation by acquiring and conserving habitat mitigation lands to mitigate inundation impacts cannot

be accurately determined without additional details. This impact, therefore, is considered significant and unavoidable.

Mitigation Measure Wild-2 (CP1): Avoid, Relocate, and Acquire Mitigation Lands for Foothill Yellow-Legged Frog and Tailed Frog To avoid or minimize impacts on the foothill yellow-legged frog and tailed frog, the following measures will be implemented:

Inundation Area Individual foothill yellow-legged frog and tailed frogs will not be affected by the inundation caused by the raise of the dam. Animals will be able to swim upstream to suitable habitat.

It is anticipated that mitigation lands will be acquired and placed in conservation easements to mitigate for the loss of foothill yellow-legged frog and tailed frog habitat lost to inundation. Additionally, opportunities for restoration and enhancement of habitat will be explored and defined.

Potential mitigation lands containing comparable foothill yellow-legged frog and tailed frog habitat have been identified adjacent to the project. The foothill yellow-legged frog is found in this area. Additional discussion of how these lands could be applied as mitigation will be presented in the FEIS.

Vegetation Removal and Construction Activities

- To the extent feasible, projects planned in relocation areas will be designed to avoid construction in perennial streams and their associated riparian zones.

- When instream construction activities must occur, a preconstruction survey of the foothill yellow-legged frog and tailed frog adults, larvae, and eggs will be conducted by a qualified biologist before ground-disturbing activities begin in perennial stream and riparian habitat. This survey will be conducted within the construction boundary no more than 1 week before instream or adjacent riparian construction activities begin. If foothill yellow-legged frog or tailed frog adults, larvae, or eggs are detected, the biologist in coordination with DFG and USFS will relocate them to a suitable stream habitat outside the construction boundary. If frogs are absent, no further surveys will be required.

- If adults are found to actively use the stream where construction activities are intended to take place, a qualified biologist will relocate all individuals to suitable habitat outside the construction zone daily before instream activities resume.

The avoidance and relocation measures for vegetation removal and construction activities would effectively mitigate impacts caused by those activities. However, the effectiveness of providing compensatory mitigation by acquiring

and conserving habitat mitigation lands to mitigate inundation impacts cannot be accurately determined without additional details. This impact, therefore, is considered significant and unavoidable.

Mitigation Measure Wild-3 (CP1): Avoid, Relocate, and Acquire Mitigation Lands for Northwestern Pond Turtle To avoid or minimize impacts on the northwestern pond turtle, the following measures will be implemented:

Inundation Area Individual northwestern pond turtles will not be impacted by the inundation caused by the raise of the dam. Lacustrine is suitable habitat for the northwestern pond turtle. The loss of northwestern pond turtle nests in the inundation zone if inundated while eggs are in the nest is unavoidable.

It is anticipated that mitigation lands will be acquired and placed in conservation easements to mitigate for the loss of northwestern pond turtle habitat. Additionally, opportunities for restoration and enhancement of habitat will be explored and defined.

Potential mitigation lands containing comparable northwestern pond turtle habitat have been identified adjacent to the project. Additional discussion of how these lands could be applied as mitigation will be presented in the FEIS.

Vegetation Removal and Construction Activities

- To the extent feasible, projects planned in relocation areas will be designed to avoid all suitable aquatic habitat and its associated riparian zone.

- When construction activities are to occur within suitable northwestern pond turtle habitat as defined in Impact Wild-3 (CP1), a qualified biologist will conduct a minimum of one preconstruction survey for northwestern pond turtles and their nests. The survey will be conducted no more than 1 week prior to construction. If a pond turtle nest is found, the biologist will flag the site and determine whether construction activities can avoid impacting the nest. If the nest cannot be avoided, DFG and the USFS will be contacted for further direction and construction activities in that location will be halted.

- In the event that a pond turtle is observed within the construction limits, the contractor will temporarily halt construction activities until a qualified biologist has moved the turtle to a safe location within suitable habitat outside of the construction limits.

The avoidance and relocation measures for vegetation removal and construction activities would effectively mitigate impacts caused by those activities. However, the effectiveness of providing compensatory mitigation by acquiring and conserving habitat mitigation lands to mitigate inundation impacts cannot

be accurately determined without additional details. This impact, therefore, is considered significant and unavoidable.

Mitigation Measure Wild-4 (CP1): Conduct Preconstruction Surveys for the American Peregrine Falcon and Establish Buffers To avoid or minimize impacts on nesting American peregrine falcons, the following measures will be implemented:

Inundation Area Individual American peregrine falcons will not be impacted by the inundation caused by the raise of the dam.

Vegetation Removal and Construction Activities

- To the extent feasible, projects planned in relocation areas will be designed to avoid suitable cliff habitat.

- If vegetation removal or construction occurs outside of the breeding season (February 1 through July 31), no further mitigation will be necessary. If the breeding season cannot be completely avoided, the following measure will be implemented.

- For proposed construction activities between February 1 and July 31 within 0.5 mile of a known American peregrine falcon eyrie or suitable habitat identified in Impact Wild-4 (CP1), a qualified biologist will conduct a protocol-level survey. The survey will be conducted no more than 2 weeks before construction begins. If an active nest is found, a qualified biologist, in consultation with DFG, will determine the construction-free buffer zone to be established around the nest until the young have fledged. In consultation with DFG, a plan will be developed to monitor whether construction activity is disturbing the nesting process and to determine when the young have fledged.

Implementation of this mitigation measure will reduce impacts on American peregrine falcon to a less than significant level.

Mitigation Measure Wild-5 (CP1): Acquire and Preserve Mitigation Lands; Conduct Protocol-Level Surveys for the Bald Eagle and Establish Buffers To avoid or minimize impacts on nesting bald eagles, the following measures will be implemented:

Inundation Area

- For each year of project activity, all active bald eagle nests will be located using the National Bald Eagle Management Guidelines (USFWS 2007b).

- During initial inundation of the impoundment area, active eagle nests occurring within the inundation area will be protected by the placement of floating buoys and signage prohibiting access to the

established buffer developed in consultation with DFG, USFS, and USFWS (see measures below).

- It is anticipated that mitigation lands will be acquired and placed in conservation easements to mitigate for the loss of bald eagle habitat. Additionally, opportunities for restoration and enhancement of habitat will be explored and defined. Potential mitigation lands containing comparable bald eagle habitat have been identified adjacent to the project. Additional discussion of how these lands could be applied as mitigation will be presented in the FEIS.

Vegetation Removal and Construction Activities

- For each year of vegetation removal or construction activity, all active bald eagle nests will be located and mapped using the National Bald Eagle Management Guidelines (USFWS 2007b).

- If vegetation removal or construction occurs outside of the breeding season (January 1 through August 1), no further mitigation will be necessary. If the breeding season cannot be completely avoided, the following measure will be implemented.

- If vegetation removal is to occur between January 1 and August 1, a 660-foot to 0.5-mile buffer will be established around active nests in consultation with DFG and USFS. No vegetation removal or construction activity will occur within the established buffer during the limited operating period.

The avoidance and relocation measures for vegetation removal and construction activities and the nest protection measures within the inundation area would effectively mitigate impacts caused by those activities. However, the effectiveness of providing compensatory mitigation by acquiring and conserving habitat mitigation lands to mitigate inundation impacts cannot be accurately determined without additional details. This impact, therefore, is considered significant and unavoidable.

Mitigation Measure Wild-6 (CP1): Acquire and Preserve Mitigation Lands; Conduct Protocol-Level Surveys for the Northern Spotted Owl and Establish Buffers To avoid or minimize impacts on nesting northern spotted owls, the following measures will be implemented:

Inundation Area

- All suitable habitat within 1.3 miles of the impoundment and relocation areas will be delineated by type using California Forest Practice Rules to determine suitable nesting and roosting habitat for the northern spotted owl.

- For each year of vegetation removal or construction activity, protocol-level surveys using current approved USFWS protocol will be conducted in all delineated suitable northern spotted owl habitat.

- If nests are found, during initial inundation of the impoundment area, active northern spotted owl nests located within the inundation area will be protected by the placement of floating buoys and signage prohibiting access to the established buffer developed in consultation with DFG and USFS (see measures below).

- It is anticipated that mitigation lands will be acquired and placed in conservation easements to mitigate for the loss of northern spotted owl habitat. Additionally, opportunities for restoration and enhancement of habitat will be explored and defined. Potential mitigation lands containing comparable northern spotted owl habitat have been identified adjacent to the project. Additional discussion of how these lands may be applied as mitigation will be presented in the FEIS.

Vegetation Removal and Construction Activities

- For each year of vegetation removal or construction activity, protocol-level surveys using current approved USFWS protocol will be conducted in all delineated suitable northern spotted owl habitat.

- If vegetation removal or construction occurs outside of the breeding season (February 1 through August 31), no further mitigation will be necessary. If the breeding season cannot be completely avoided, the following measure will be implemented.

- If vegetation removal is to occur between February 1 and August 31, a 660-foot to 0.5-mile buffer will be established around active nests in consultation with DFG, USFS and USFWS. No vegetation removal or construction activity will occur within the established buffer during the limited operating period.

The avoidance and relocation measures for vegetation removal and construction activities and the nest protection measures within the inundation area would effectively mitigate impacts caused by those activities. However, the effectiveness of providing compensatory mitigation by acquiring and conserving habitat mitigation lands to mitigate inundation impacts cannot be accurately determined without additional details. This impact, therefore, is considered significant and unavoidable.

Mitigation Measure Wild-7 (CP1): Conduct a Preconstruction Survey for the Purple Martin and Establish Buffers To avoid or minimize impacts on nesting purple martins, the following measures will be implemented:

Inundation Area Individual purple martins actively nesting within the impoundment area could be flooded when the lake reaches maximum inundation. These potential losses cannot be mitigated.

Vegetation Removal and Construction Activities

- To the extent feasible, all snags in the Pit Arm will be retained. Vegetation will not be removed from the Pit Arm from Painter Creek north, with exception of Arbuckle Campground, which will recruit snags from trees that will die from inundation.

- If vegetation removal or construction occurs outside of the breeding season (April 1 through August 31), no further mitigation will be necessary. If the breeding season cannot be completely avoided, the following measure will be implemented.

- If proposed vegetation removal and construction activities are to take place on the Pit Arm from April 1 through August 31, a qualified biologist will conduct a protocol-level survey to locate active nests. The survey will be conducted no more than 2 weeks before construction begins. If an active nest is found, a qualified biologist, in consultation with DFG, will determine a construction-free buffer zone to be established around the nest until the young have fledged. In consultation with DFG, a plan will be developed to monitor whether construction activity is disturbing the reproductive process and to determine when the young have fledged.

- A monitoring and adaptive management plan will be developed to explore and develop options to provide additional nesting habitat for the purple martin (e.g., artificial nesting structures, girdling trees to develop snags).

Implementation of this mitigation measure will reduce impacts on individual purple martins nesting during the implementation of the project; however, these measures would not protect purple martins actively nesting within the impoundment area when the lake reaches maximum inundation and might not fully mitigate the loss of snags used for nesting. This impact, therefore, is considered significant and unavoidable.

Mitigation Measure Wild-8 (CP1): Acquire and Preserve Mitigation Lands; Conduct a Preconstruction Survey for the Willow Flycatcher, Vaux's Swift, Yellow Warbler, and Yellow-Breasted Chat and Establish Buffers To avoid or minimize impacts on nesting willow flycatchers, Vaux's swifts, yellow warblers, and yellow-breasted chats, the following measures will be implemented:

Inundation Area Individuals actively nesting within the impoundment area could be flooded when the lake reaches maximum inundation. These potential losses cannot be mitigated.

It is anticipated that mitigation lands will be acquired and placed in conservation easements to mitigate for the loss of willow flycatcher, Vaux's swift, yellow warbler, and yellow-breasted chat habitat. Additionally, opportunities for restoration and enhancement of habitat will be explored and defined.

Potential mitigation lands containing comparable willow flycatcher, Vaux's swift, yellow warbler, and yellow-breasted chat habitat have been identified adjacent to the project. Additional discussion of how these lands could be applied as mitigation will be presented in the FEIS.

Vegetation Removal and Construction Activities

- To the extent feasible, projects planned in relocation areas will be designed to avoid riparian habitat.

- To the extent feasible, construction activities will be avoided within riparian habitat and snags suitable for Vaux's swift nesting.

- If vegetation removal or construction occurs outside of the breeding season (April 1 through August 31), no further mitigation will be necessary. If the breeding season cannot be completely avoided, the following measure will be implemented.

- If proposed vegetation removal and construction activities are to occur within 250 feet of suitable habitat for willow flycatchers, Vaux's swifts, yellow warblers, and yellow-breasted chats between April 1 and August 31, a qualified biologist will conduct a preconstruction survey no more than 2 weeks before construction activities begin. If an active nest is found, a qualified biologist, in consultation with DFG, will determine a construction-free buffer zone to be established around the nest until the young have fledged. In consultation with DFG, a plan will be developed to monitor whether construction activity is disturbing the reproductive process and to determine when the young have fledged.

- If willow flycatchers are detected during the preconstruction survey, protocol-level surveys using a current approved USFWS protocol will be conducted to locate and monitor active nests.

The avoidance and relocation measures for vegetation removal and construction activities would effectively mitigate impacts caused by those activities; however, these measures would not protect individuals actively nesting within the impoundment area when the lake reaches maximum inundation. Also, the

effectiveness of providing compensatory mitigation by acquiring and conserving habitat mitigation lands to mitigate inundation impacts cannot be accurately determined without additional details. This impact, therefore, is considered significant and unavoidable.

Mitigation Measure Wild-9 (CP1): Acquire and Preserve Mitigation Lands; Conduct a Preconstruction Survey for the Long-Eared Owl, Northern Goshawk, Cooper's Hawk, and Great Blue Heron and Establish Buffers To avoid or minimize impacts on nesting special-status raptors, the following measures will be implemented:

Inundation Area It is anticipated that mitigation lands will be acquired and placed in conservation easements to mitigate for the loss of habitat of these species. Additionally, opportunities for restoration and enhancement of habitat will be explored and defined.

Potential mitigation lands containing comparable habitat have been identified adjacent to the project. Additional discussion of how these lands could be applied as mitigation will be presented in the FEIS.

Vegetation Removal and Construction Activities

- To the extent feasible, construction activities will be avoided within riparian habitat.

- If vegetation removal or construction takes place outside of the breeding season (February 1 through August 31), no further mitigation will be necessary. If the breeding season cannot be completely avoided, the following measure will be implemented.

- If proposed vegetation removal and construction activities are to take place within 0.25 mile of suitable habitat for the long-eared owl, northern goshawk, Cooper's hawk, and great blue heron between February 1 and August 31, a qualified biologist will conduct a preconstruction survey no more than 2 weeks before construction activities begin. Protocol-level surveys will be conducted in suitable goshawk habitat.

- If vegetation removal is to occur between February 1 and August 31, a construction-free buffer will be established around active nests in consultation with DFG and USFS. No vegetation removal or construction activity will occur within the established buffer during the limited operating period.

The avoidance and relocation measures for vegetation removal and construction activities would effectively mitigate impacts caused by those activities. However, the effectiveness of providing compensatory mitigation by acquiring and conserving habitat mitigation lands to mitigate inundation impacts cannot

be accurately determined without additional details. This impact, therefore, is considered significant and unavoidable.

Mitigation Measure Wild-10 (CP1): Acquire and Preserve Mitigation Lands; Conduct a Preconstruction Surveys for the Pacific Fisher and Establish Buffers To avoid or minimize impacts on Pacific fisher natal dens, the following measures will be implemented:

Inundation Area Pacific fisher natal dens within the impoundment area could be flooded when the lake reaches maximum inundation. These potential losses cannot be mitigated. However, female fishers often move young to alternate natal dens if threatened or disturbed.

It is anticipated that mitigation lands will be acquired and placed in conservation easements to mitigate for the loss of Pacific fisher habitat. Additionally, opportunities for restoration and enhancement of habitat will be explored and defined.

Potential mitigation lands containing comparable habitat and where Pacific fishers are known to occur have been identified adjacent to the project. Additional discussion of how these lands could be applied as mitigation will be presented in the FEIS.

Vegetation Removal and Construction Activities

- If vegetation removal or construction occurs outside of the breeding season (February 1 through May 1), no further mitigation will be necessary. If the breeding season cannot be completely avoided, the following measure will be implemented.

- If proposed vegetation removal and construction activities are to occur in suitable habitat for the Pacific fisher between February 1 and May 1, a qualified biologist will conduct a preconstruction survey for potential natal or maternity den trees no more than 2 weeks before construction activities begin. If an active den is found, a qualified biologist, in consultation with USFS, BLM (if on BLM land), and USFWS, will determine a construction-free buffer zone to be established around the den until the mother and young have dispersed. In consultation with USFWS, a plan will be developed to monitor whether construction activity is disturbing the reproductive success and to determine when the young have dispersed.

The avoidance and relocation measures for vegetation removal and construction activities would effectively mitigate impacts caused by those activities. However, the effectiveness of providing compensatory mitigation by acquiring and conserving habitat mitigation lands to mitigate inundation impacts cannot be accurately determined without additional details. This impact, therefore, is considered significant and unavoidable.

Mitigation Measure Wild-11 (CP1): Acquire and Preserve Mitigation Lands; Conduct a Preconstruction Survey for Special-Status Bats, American Marten, and Ringtails and Establish Buffers To avoid or minimize impacts on bats and ringtails, the following measures will be implemented:

Inundation Area Maternity colonies or natal dens within the impoundment area could be flooded when the lake reaches maximum inundation. These potential losses cannot be mitigated. However, female western red bats, American martens, and ringtails would be expected to move young to alternate locations if threatened or disturbed.

It is anticipated that mitigation lands will be acquired and placed in conservation easements to mitigate for the loss of habitat of these species. Additionally, opportunities for restoration and enhancement of habitat will be explored and defined.

Potential mitigation lands containing comparable habitat where these species are known to be found have been identified adjacent to the project. Additional discussion of how these lands could be applied as mitigation and at what ratios will be presented in the FEIS.

Vegetation Removal and Construction Activities

- A preconstruction survey conducted by a qualified bat biologist for roosting bats will be conducted prior to the inundation or removal of any bridges, buildings, known caves or trees 12 inches or larger in diameter at breast height. If no active roosts are found, then no further action will be warranted. If a maternity roost is present, in consultation with DFG, a qualified bat biologist will determine the extent of construction-free zones around active nurseries. If either a maternity roost or a hibernacula is present, either of the following measures will be implemented.

To the extent feasible, the project will be redesigned to avoid the loss of the maternity or hibernacula roost.

- If the project cannot be redesigned, removal of the occupied tree or structure should begin before maternity colonies form (i.e., prior to March 1) or after young are volant (flying) (i.e., after July 31). The established disturbance-free buffer will be observed during the maternity roost season (March 1 through July 31).

- If a nonbreeding bat hibernacula is found in a structure or tree scheduled for removal, the individuals will be safely evicted, under the direction of a qualified bat biologist (as determined by a memorandum of understanding with DFG), by opening the roosting area to allow air flow through the cavity. Removal of the tree or structure will follow

not before the following day (i.e., there should be at least 1 night between initial disturbance for air flow and the demolition). This action will allow bats to leave during dark hours, thus increasing their chance of finding new roosts with a minimum of potential predation during daylight. Trees with roosts that need to be removed should first be disturbed at dusk, just prior to removal that same evening, to allow bats to escape at night.

- For the American marten and ringtail, if vegetation removal or construction occurs outside of the breeding season (February 1 through May 1), no further mitigation is necessary. If the breeding season cannot be completely avoided, the following measure will be implemented.

- If proposed vegetation removal and construction activities are to occur in suitable habitat for the American marten and ringtail between February 1 and May 1, a qualified biologist will conduct a preconstruction survey for potential natal or maternity den trees no more than 2 weeks before construction activities begin. If an active den is found, a qualified biologist, in consultation with DFG and USFS, will determine a construction-free buffer zone to be established around the den until the mother and young have dispersed. In consultation with DFG and USFS, a plan will be developed to monitor whether construction activity is disturbing the reproductive success and to determine when the young have dispersed.

The avoidance and relocation measures for vegetation removal and construction activities would effectively mitigate impacts caused by those activities. However, the loss of some individuals from inundation cannot be mitigated. Also, the effectiveness of providing compensatory mitigation by acquiring and conserving habitat mitigation lands to mitigate inundation impacts cannot be accurately determined without additional details. This impact, therefore, is considered significant and unavoidable.

Mitigation Measure Wild-12 (CP1): Avoid Suitable Habitat; Acquire and Preserve Mitigation Lands for Special-Status Terrestrial Mollusks To avoid or minimize impacts on special-status terrestrial mollusks, the following measures will be implemented:

Inundated Area It is infeasible to quantify the loss of individuals in the impoundment area. The loss of individuals and loss of limestone habitat (for Shasta and Wintu sideband snails) cannot be mitigated. Suitable limestone habitat will be quantified. It is anticipated that mitigation lands will be acquired and placed in conservation easements to mitigate for the loss of the habitat of these species. Additionally, opportunities for restoration and enhancement of habitat will be explored and defined.

Potential mitigation lands containing comparable special-status habitat have been identified adjacent to the project. Shasta sideband, Shasta chaparral, and Shasta hesperian snails have been found at this site. Additional discussion of how these lands could be applied as mitigation and at what ratios will be presented in the FEIS.

Vegetation Removal and Construction Activities

- When feasible, use of heavy equipment and excavation in limestone substrates and riparian or mesic habitats will be avoided.

- Guidelines provided in *Management Recommendations for Survey and Manage Terrestrial Mollusks* (Burke et al. 1999) will be applied.

The avoidance and relocation measures for vegetation removal and construction activities would effectively mitigate impacts caused by those activities. However, the loss of some individuals from inundation cannot be mitigated. Also, the effectiveness of providing compensatory mitigation by acquiring and conserving habitat mitigation lands to mitigate inundation impacts cannot be accurately determined without additional details. This impact, therefore, is considered significant and unavoidable.

Mitigation Measure Wild-13 (CP1): Acquire and Preserve Mitigation Lands for Permanent Loss of General Wildlife Habitat It is anticipated that mitigation lands will be acquired and placed in conservation easements to mitigate for the loss of wildlife habitat. Additionally, opportunities for restoration and enhancement of habitat will be explored and defined. Potential mitigation lands containing comparable habitat and where these species are known to occur have been identified adjacent to the project. Additional discussion of how these lands could be applied as mitigation will be presented in the FEIS. However, the effectiveness of providing compensatory mitigation by acquiring and conserving habitat mitigation lands to mitigate inundation impacts cannot be accurately determined without additional details. This impact, therefore, is considered significant and unavoidable.

Mitigation Measure Wild-14 (CP1): Conduct Preconstruction Surveys for Other Nesting Raptors and Migratory Birds and Establish Buffers To avoid or minimize impacts on nesting raptors and migratory birds, the following measures will be implemented:

Inundation Area Individuals actively nesting within the impoundment area could be flooded when the lake reaches maximum inundation. These potential losses cannot be mitigated. However, tree-nesting species might fledge prior to loss of the nest, because it is anticipated that the structure will remain through the duration of the breeding season.

It is anticipated that mitigation lands will be acquired and placed in conservation easements to mitigate for the loss of the habitat of these species.

Additionally, opportunities for restoration and enhancement of habitat will be explored and defined.

Potential mitigation lands containing comparable habitat have been identified adjacent to the project. Additional discussion of how these lands could be applied as mitigation and at what ratios will be presented in the FEIS.

Vegetation Removal and Construction Activities

- To the extent feasible, construction activities will be avoided within riparian habitat.

- If vegetation removal or construction occurs outside of the breeding season (February 1 through August 31), no further mitigation will be necessary. If the breeding season cannot be completely avoided, the following measure will be implemented.

- For raptors, if proposed vegetation removal and construction activities are to occur within 0.25 mile of suitable habitat for nesting raptors between February 1 and August 31, a qualified biologist will conduct a preconstruction survey no more than 2 weeks before construction activities begin. If an active nest is found, a qualified biologist, in consultation with DFG, will determine a construction-free buffer zone to be established around the nest until the young have fledged. In consultation with DFG, a plan will be developed to monitor whether construction activity is disturbing the reproductive process and to determine when the young have fledged.

The avoidance and relocation measures for vegetation removal and construction activities would effectively mitigate impacts caused by those activities. However, the loss of some individuals from inundation cannot be mitigated. Also, the effectiveness of providing compensatory mitigation by acquiring and conserving habitat mitigation lands to mitigate inundation impacts cannot be accurately determined without additional details. This impact, therefore, is considered significant and unavoidable.

Mitigation Measure Wild-15 (CP1): Acquire and Preserve Mitigation Lands for Permanent Loss of Critical Deer Wintering and Fawning Range Implement Mitigation Measure Wild-13 for loss of critical deer wintering and fawning range. Similar to Mitigation Measure Wild-13 (CP1), this impact is considered significant and unavoidable.

Mitigation Measure Wild-16 (CP1) Mitigation has yet to be determined for potential impacts to the California red-legged frog. At this time, no feasible mitigation has been determined. This impact is considered significant and unavoidable.

Mitigation Measure Wild-17 (CP1): Implement Mitigation Measure Bot-7 (CP1): Develop and Implement a Riverine Ecosystem Mitigation and Adaptive Management Plan to Reduce Impacts on Riparian-Associated and Aquatic Special-Status Wildlife in the Primary Study Area Reclamation will implement Mitigation Measure Bot-7 (CP1), "Develop and Implement a Riverine Ecosystem Mitigation and Adaptive Management Plan to Avoid and Compensate for the Impact of Altered Flow Regimes on Riparian and Wetland Communities," described in Chapter 12, "Botanical Resources and Wetlands." Implementation of this mitigation measure would reduce Impact Wild-17 (CP1) to a less than significant level.

Mitigation Measure Wild-20 (CP1): Implement Mitigation Measure Bot-7 (CP1): Develop and Implement a Riverine Ecosystem Mitigation and Adaptive Management Plan to Promote Consistency with Local and Regional Plans with Goals of Promoting Riparian Habitat in the Primary Study Area Reclamation will implement Mitigation Measure Bot-7 (CP1), "Develop and Implement a Riverine Ecosystem Mitigation and Adaptive Management Plan to Avoid and Compensate for the Impact of Altered Flow Regimes on Riparian and Wetland Communities," described in Chapter 12, "Botanical Resources and Wetlands." Implementation of this mitigation measure would reduce Impact Wild-20 (CP1) to a less than significant level.

Mitigation Measure Wild-23 (CP1): Implement Mitigation Measure Bot-7 (CP1): Develop and Implement a Riverine Ecosystem Mitigation and Adaptive Management Plan to Reduce Impacts on Riparian-Associated and Aquatic Special-Status Wildlife along the Lower Sacramento River Resulting from Modifications of Geomorphic Processes Reclamation will implement Mitigation Measure Bot-7 (CP1), "Develop and Implement a Riverine Ecosystem Mitigation and Adaptive Management Plan to Avoid and Compensate for the Impact of Altered Flow Regimes on Riparian and Wetland Communities," described in Chapter 12, "Botanical Resources and Wetlands." Implementation of this mitigation measure would reduce Impact Wild-23 (CP1) to a less than significant level.

Mitigation Measure Wild-26 (CP1): Implement Mitigation Measure Bot-7 (CP1): Develop and Implement a Riverine Ecosystem Mitigation and Adaptive Management Plan to Promote Consistency with Local and Regional Plans with Goals of Promoting Riparian Habitat along the Lower Sacramento River and in the Delta Reclamation will implement Mitigation Measure Bot-7 (CP1), "Develop and Implement a Riverine Ecosystem Mitigation and Adaptive Management Plan to Avoid and Compensate for the Impact of Altered Flow Regimes on Riparian and Wetland Communities," described in Chapter 12, "Botanical Resources and Wetlands." Implementation of this mitigation measure would reduce Impact Wild-26 (CP1) to a less than significant level.

CP2 – 12.5-Foot Dam Raise, Anadromous Fish Survival and Water Supply Reliability

No mitigation is needed for Impacts Wild-18 (CP2), Wild-19 (CP2), Wild-21 (CP2), Wild-22 (CP2), Wild-24 (CP2), Wild-25 (CP2), and Wild-27 (CP2). Mitigation is provided below for the remaining impacts of CP2 on wildlife species.

Mitigation Measure Wild-1 (CP2): Avoid, Relocate, and Acquire Mitigation Lands for Shasta Salamander This mitigation measure is identical to Mitigation Measure Wild-1 (CP1). Implementation of this mitigation measure will reduce impacts on the Shasta salamander; however, because impacts cannot be fully mitigated, Impact Wild-1 (CP2) is considered significant and unavoidable.

Mitigation Measure Wild-2 (CP2): Avoid, Relocate, and Acquire Mitigation Lands for Foothill Yellow-Legged Frog and Tailed Frog This mitigation measure is identical to Mitigation Measure Wild-2 (CP1). Implementation of this mitigation measure will reduce impacts to these species; however, because impacts cannot be fully mitigated, Impact Wild-2 (CP2) is considered significant and unavoidable.

Mitigation Measure Wild-3 (CP2): Avoid, Relocate, and Acquire Mitigation Lands for Northwestern Pond Turtle This mitigation measure is identical to Mitigation Measure Wild-3 (CP1). Implementation of this mitigation measure will reduce impacts to these species; however, because impacts cannot be fully mitigated, Impact Wild-3 (CP2) is considered significant and unavoidable.

Mitigation Measure Wild-4 (CP2): Conduct Preconstruction Surveys for the American Peregrine Falcon and Establish Buffers This mitigation measure is identical to Mitigation Measure Wild-4 (CP1). Implementation of this mitigation measure will reduce Impact Wild-4 (CP2) to a less than significant level.

Mitigation Measure Wild-5 (CP2): Acquire and Preserve Mitigation Lands; Conduct Protocol-Level Surveys for the Bald Eagle and Establish Buffers This mitigation measure is identical to Mitigation Measure Wild-5 (CP1). Implementation of this mitigation measure will reduce impacts on individual bald eagles nesting during the implementation of the project; however, all nest trees in the inundation zone will be lost; therefore, Impact Wild-5 (CP2) is considered significant and unavoidable.

Mitigation Measure Wild-6 (CP2): Acquire and Preserve Mitigation Lands; Conduct Protocol-Level Surveys for the Northern Spotted Owl and Establish Buffers This mitigation measure is identical to Mitigation Measure Wild-6 (CP1). Implementation of this mitigation measure will reduce impacts on individual northern spotted owls nesting during the implementation of the

project; however, nest trees located within the inundation zone will be lost; therefore, Impact Wild-6 (CP2) is considered significant and unavoidable.

Mitigation Measure Wild-7 (CP2): Conduct a Preconstruction Survey for the Purple Martin and Establish Buffers This mitigation measure is identical to Mitigation Measure Wild-7 (CP1). Implementation of this mitigation measure will reduce impacts on individual purple martins nesting during the implementation of the project; however, these measures might not fully mitigate the loss of snags used for nesting; therefore, Impact Wild-7 (CP2) is considered significant and unavoidable.

Mitigation Measure Wild-8 (CP2): Acquire and Preserve Mitigation Lands; Conduct a Preconstruction Survey for the Willow Flycatcher, Vaux's Swift, Yellow Warbler, and Yellow-Breasted Chat and Establish Buffers This mitigation measure is identical to Mitigation Measure Wild-8 (CP1). Implementation of this mitigation measure will reduce impacts to these species; however, because impacts cannot be fully mitigated, Impact Wild-8 (CP2) is considered significant and unavoidable.

Mitigation Measure Wild-9 (CP2): Acquire and Preserve Mitigation Lands; Conduct Preconstruction Surveys for the Long-Eared Owl, Northern Goshawk, Cooper's Hawk, and Great Blue Heron and Establish Buffers This mitigation measure is identical to Mitigation Measure Wild-9 (CP1). Implementation of this mitigation measure will reduce impacts to these species; however, because impacts cannot be fully mitigated, Impact Wild-9 (CP2) is considered significant and unavoidable.

Mitigation Measure Wild-10 (CP2): Acquire and Preserve Mitigation Lands; Conduct Preconstruction Surveys for the Pacific Fisher and Establish Buffers This mitigation measure is identical to Mitigation Measure Wild-10 (CP1). Implementation of this mitigation measure will reduce impacts to these species; however, because impacts cannot be fully mitigated, Impact Wild-10 (CP2) is considered significant and unavoidable.

Mitigation Measure Wild-11 (CP2): Acquire and Preserve Mitigation Lands; Conduct Preconstruction Surveys for Special-Status Bats, American Marten, and Ringtails and Establish Buffers This mitigation measure is identical to Mitigation Measure Wild-11 (CP1). Implementation of this mitigation measure will reduce impacts to these species; however, because impacts cannot be fully mitigated, Impact Wild-11 (CP2) is considered significant and unavoidable.

Mitigation Measure Wild-12 (CP2): Avoid Suitable Habitat; Acquire and Preserve Mitigation Lands for Special-Status Terrestrial Mollusks This mitigation measure is identical to Mitigation Measure Wild-12 (CP1). Implementation of this mitigation measure will reduce impacts on special-status

terrestrial mollusks; however, because impacts cannot be fully mitigated, Impact Wild-12 (CP2) is considered significant and unavoidable.

Mitigation Measure Wild-13 (CP2): Acquire and Preserve Mitigation Lands for Permanent Loss of General Wildlife Habitat This mitigation measure is identical to Mitigation Measure Wild-13 (CP1). Implementation of this mitigation measure will reduce impacts to these species; however, because impacts cannot be fully mitigated, Impact Wild-13 (CP2) is considered significant and unavoidable.

Mitigation Measure Wild-14 (CP2): Conduct Preconstruction Survey for Other Nesting Raptors and Migratory Birds and Establish Buffers This mitigation measure is identical to Mitigation Measure Wild-14 (CP1). Implementation of this mitigation measure will reduce impacts to these species; however, because impacts cannot be fully mitigated, Impact Wild-14 (CP2) is considered significant and unavoidable.

Mitigation Measure Wild-15 (CP2): Acquire and Preserve Mitigation Lands for Permanent Loss of Critical Deer Wintering and Fawning Range This mitigation measure is identical to Mitigation Measure Wild-15 (CP1). Implementation of this mitigation measure will reduce impacts to these species; however, because impacts cannot be fully mitigated, Impact Wild-15 (CP2) is considered significant and unavoidable.

Mitigation Measure Wild-16 (CP2) Mitigation has yet to be determined for potential impacts to the California red-legged frog. At this time, no feasible mitigation has been determined. This impact is considered significant and unavoidable.

Mitigation Measure Wild-17 (CP2): Implement Mitigation Measure Bot-7 (CP2): Develop and Implement a Riverine Ecosystem Mitigation and Adaptive Management Plan to Reduce Impacts on Riparian-Associated and Aquatic Special-Status Wildlife in the Primary Study Area This mitigation measure is identical to Mitigation Measure Bot-7 (CP2). Implementation of this mitigation measure would reduce Impact Wild-17 (CP2) to a less than significant level.

Mitigation Measure Wild-20 (CP2): Implement Mitigation Measure Bot-7 (CP2): Develop and Implement a Riverine Ecosystem Mitigation and Adaptive Management Plan to Promote Consistency with Local and Regional Plans with Goals of Promoting Riparian Habitat in the Primary Study Area This mitigation measure is identical to Mitigation Measure Bot-7 (CP2). Implementation of this mitigation measure would reduce Impact Wild-20 (CP2) to a less than significant level.

Mitigation Measure Wild-23 (CP2): Implement Mitigation Measure Bot-7 (CP2): Develop and Implement a Riverine Ecosystem Mitigation and Adaptive Management Plan to Reduce Impacts on Riparian-Associated and Aquatic Special-Status Wildlife along the Lower Sacramento River Resulting from Modifications of Geomorphic Processes This mitigation measure is identical to Mitigation Measure Bot-7 (CP2)Implementation of this mitigation measure would reduce Impact Wild-23 (CP2) to a less than significant level.

Mitigation Measure Wild-26 (CP2): Implement Mitigation Measure Bot-7 (CP2): Develop and Implement a Riverine Ecosystem Mitigation and Adaptive Management Plan to Promote Consistency with Local and Regional Plans with Goals of Promoting Riparian Habitat along the Lower Sacramento River and in the Delta This mitigation measure is identical to Mitigation Measure Bot-7 (CP2)Implementation of this mitigation measure would reduce Impact Wild-26 (CP2) to a less than significant level.

CP3 – 18.5-Foot Dam Raise, Anadromous Fish Survival and Water Supply

No mitigation is needed for Impacts Wild-18 (CP3), Wild-19 (CP3), Wild-21 (CP3), Wild-22 (CP3), Wild-24 (CP3), Wild-25 (CP3), and Wild-27 (CP3). Mitigation is provided below for the remaining impacts of CP3 on wildlife species.

Mitigation Measure Wild-1 (CP3): Avoid, Relocate, and Acquire Mitigation Lands for Shasta Salamander This mitigation measure is identical to Mitigation Measure Wild-1 (CP1). Implementation of this mitigation measure will reduce impacts on the Shasta salamander; however, because impacts cannot be fully mitigated, Impact Wild-1 (CP3) is considered significant and unavoidable.

Mitigation Measure Wild-2 (CP3): Avoid, Relocate, and Acquire Mitigation Lands for Foothill Yellow-Legged Frog and Tailed Frog This mitigation measure is identical to Mitigation Measure Wild-2 (CP1). Implementation of this mitigation measure will reduce impacts to these species; however, because impacts cannot be fully mitigated, Impact Wild-2 (CP3) is considered significant and unavoidable.

Mitigation Measure Wild-3 (CP3): Avoid, Relocate, and Acquire Mitigation Lands for Northwestern Pond Turtle This mitigation measure is identical to Mitigation Measure Wild-3 (CP1). Implementation of this mitigation measure will reduce impacts to these species; however, because impacts cannot be fully mitigated, Impact Wild-3 (CP3) is considered significant and unavoidable.

Mitigation Measure Wild-4 (CP3): Conduct Preconstruction Surveys for the American Peregrine Falcon and Establish Buffers This mitigation measure is identical to Mitigation Measure Wild-4 (CP1). Implementation of

this mitigation measure will reduce Impact Wild-4 (CP3) to a less than significant level.

Mitigation Measure Wild-5 (CP3): Acquire and Preserve Mitigation Lands; Conduct Protocol-Level Surveys for the Bald Eagle and Establish Buffers This mitigation measure is identical to Mitigation Measure Wild-5 (CP1). Implementation of this mitigation measure will reduce impacts on individual bald eagles nesting during the implementation of the project; however, all nest trees in the inundation zone will be lost; therefore, Impact Wild-5 (CP3) is considered significant and unavoidable.

Mitigation Measure Wild-6 (CP3): Acquire and Preserve Mitigation Lands; Conduct Protocol-Level Surveys for the Northern Spotted Owl and Establish Buffers This mitigation measure is identical to Mitigation Measure Wild-6 (CP1). Implementation of this mitigation measure will reduce impacts on individual northern spotted owls nesting during the implementation of the project; however, nest trees located within the inundation zone will be lost; therefore, Impact Wild-6 (CP3) is considered significant and unavoidable.

Mitigation Measure Wild-7 (CP3): Conduct a Preconstruction Survey for the Purple Martin and Establish Buffers This mitigation measure is identical to Mitigation Measure Wild-7 (CP1). Implementation of this mitigation measure will reduce impacts on individual purple martins nesting during the implementation of the project; however, these measures might not fully mitigate the loss of snags used for nesting; therefore, Impact Wild-7 (CP3) is considered significant and unavoidable.

Mitigation Measure Wild-8 (CP3): Acquire and Preserve Mitigation Lands; Conduct a Preconstruction Survey for the Willow Flycatcher, Vaux's Swift, Yellow Warbler, and Yellow-Breasted Chat and Establish Buffers This mitigation measure is identical to Mitigation Measure Wild-8 (CP1). Implementation of this mitigation measure will reduce impacts to these species; however, because impacts cannot be fully mitigated, Impact Wild-8 (CP3) is considered significant and unavoidable.

Mitigation Measure Wild-9 (CP3): Acquire and Preserve Mitigation Lands; Conduct Preconstruction Surveys for the Long-Eared Owl, Northern Goshawk, Cooper's Hawk, and Great Blue Heron and Establish Buffers This mitigation measure is identical to Mitigation Measure Wild-9 (CP1). Implementation of this mitigation measure will reduce impacts to these species; however, because impacts cannot be fully mitigated, Impact Wild-9 (CP3) is considered significant and unavoidable.

Mitigation Measure Wild-10 (CP3): Acquire and Preserve Mitigation Lands; Conduct Preconstruction Surveys for the Pacific Fisher and Establish Buffers This mitigation measure is identical to Mitigation Measure Wild-10 (CP1). Implementation of this mitigation measure will reduce impacts

to these species; however, because impacts cannot be fully mitigated, Impact Wild-10 (CP3) is considered significant and unavoidable.

Mitigation Measure Wild-11 (CP3): Acquire and Preserve Mitigation Lands; Conduct Preconstruction Surveys for Special-Status Bats, American Marten, and Ringtails and Establish Buffers This mitigation measure is identical to Mitigation Measure Wild-11 (CP1). Implementation of this mitigation measure will reduce impacts to these species; however, because impacts cannot be fully mitigated, Impact Wild-11 (CP3) is considered significant and unavoidable.

Mitigation Measure Wild-12 (CP3): Avoid Suitable Habitat; Acquire and Preserve Mitigation Lands for Special-Status Terrestrial Mollusks This mitigation measure is identical to Mitigation Measure Wild-12 (CP1). Implementation of this mitigation measure will reduce impacts on special-status terrestrial mollusks; however, because impacts cannot be fully mitigated, Impact Wild-12 (CP3) is considered significant and unavoidable.

Mitigation Measure Wild-13 (CP3): Acquire and Preserve Mitigation Lands for Permanent Loss of General Wildlife Habitat This mitigation measure is identical to Mitigation Measure Wild-13 (CP1). Implementation of this mitigation measure will reduce impacts to these species; however, because impacts cannot be fully mitigated, Impact Wild-13 (CP3) is considered significant and unavoidable.

Mitigation Measure Wild-14 (CP3): Conduct Preconstruction Survey for Other Nesting Raptors and Migratory Birds and Establish Buffers This mitigation measure is identical to Mitigation Measure Wild-14 (CP1). Implementation of this mitigation measure will reduce impacts to these species; however, because impacts cannot be fully mitigated, Impact Wild-14 (CP3) is considered significant and unavoidable.

Mitigation Measure Wild-15 (CP3): Acquire and Preserve Mitigation Lands for Permanent Loss of Critical Deer Wintering and Fawning Range This mitigation measure is identical to Mitigation Measure Wild-15 (CP1). Implementation of this mitigation measure will reduce impacts to these species; however, because impacts cannot be fully mitigated, Impact Wild-15 (CP3) is considered significant and unavoidable.

Mitigation Measure Wild-16 (CP3) Mitigation has yet to be determined for potential impacts to the California red-legged frog. At this time, no feasible mitigation has been determined. This impact is considered significant and unavoidable.

Mitigation Measure Wild-17 (CP3): Implement Mitigation Measure Bot-7 (CP3) to Reduce Impacts on Riparian-Associated and Aquatic Special-Status Wildlife in the Primary Study Area This mitigation measure is identical to Mitigation Measure Bot-7 (CP3)Implementation of this mitigation measure would reduce Impact Wild-17 (CP3) to a less than significant level.

Mitigation Measure Wild-20 (CP3): Implement Mitigation Measure Bot-7 (CP3) to Promote Consistency with Local and Regional Plans with Goals of Promoting Riparian Habitat in the Primary Study Area This mitigation measure is identical to Mitigation Measure Bot-7 (CP3). Implementation of this mitigation measure would reduce Impact Wild-20 (CP3) to a less than significant level.

Mitigation Measure Wild-23 (CP3): Implement Mitigation Measure Bot-7 (CP3) to Reduce Impacts on Riparian-Associated and Aquatic Special-Status Wildlife along the Lower Sacramento River Resulting from Modifications of Geomorphic Processes This mitigation measure is identical to Mitigation Measure Bot-7 (CP3). Implementation of this mitigation measure would reduce Impact Wild-23 (CP3) to a less than significant level.

Mitigation Measure Wild-26 (CP3): Implement Mitigation Measure Bot-7 (CP3) to Promote Consistency with Local and Regional Plans with Goals of Promoting Riparian Habitat along the Lower Sacramento River and in the Delta This mitigation measure is identical to Mitigation Measure Bot-7 (CP3). Implementation of this mitigation measure would reduce Impact Wild-26 (CP3) to a less than significant level.

CP4 – 18.5-Foot Dam Raise, Anadromous Fish Focus with Water Supply Reliability

No mitigation is needed for Impacts Wild-18 (CP4), Wild-19 (CP4), Wild-22 (CP4), Wild-24 (CP4), Wild-25 (CP4), and Wild-27 (CP4). Mitigation is provided below for the remaining impacts of CP4 on wildlife species.

Mitigation Measure Wild-1 (CP4): Avoid, Relocate, and Acquire Mitigation Lands for Shasta Salamander This mitigation measure is identical to Mitigation Measure Wild-1 (CP1). Implementation of this mitigation measure will reduce impacts on the Shasta salamander; however, because impacts cannot be fully mitigated, Impact Wild-1 (CP4) is considered significant and unavoidable.

Mitigation Measure Wild-2 (CP4): Avoid, Relocate, and Acquire Mitigation Lands for Foothill Yellow-Legged Frog and Tailed Frog This mitigation measure is identical to Mitigation Measure Wild-2 (CP1). Implementation of this mitigation measure will reduce impacts to these species; however, because impacts cannot be fully mitigated, Impact Wild-2 (CP4) is considered significant and unavoidable.

Mitigation Measure Wild-3 (CP4): Avoid, Relocate, and Acquire Mitigation Lands for Northwestern Pond Turtle This mitigation measure is identical to Mitigation Measure Wild-3 (CP1). Implementation of this mitigation measure will reduce impacts to these species; however, because impacts cannot be fully mitigated, Impact Wild-3 (CP4) is considered significant and unavoidable.

Mitigation Measure Wild-4 (CP4): Conduct Preconstruction Surveys for the American Peregrine Falcon and Establish Buffers This mitigation measure is identical to Mitigation Measure Wild-4 (CP1). Implementation of this mitigation measure will reduce Impact Wild-4 (CP4) to a less than significant level.

Mitigation Measure Wild-5 (CP4): Acquire and Preserve Mitigation Lands; Conduct Protocol-Level Surveys for the Bald Eagle and Establish Buffers This mitigation measure is identical to Mitigation Measure Wild-5 (CP1). Implementation of this mitigation measure will reduce impacts on individual bald eagles nesting during the implementation of the project; however, all nest trees in the inundation zone will be lost; therefore, Impact Wild-5 (CP4) is considered significant and unavoidable.

Mitigation Measure Wild-6 (CP4): Acquire and Preserve Mitigation Lands; Conduct Protocol-Level Surveys for the Northern Spotted Owl and Establish Buffers This mitigation measure is identical to Mitigation Measure Wild-6 (CP1). Implementation of this mitigation measure will reduce impacts on individual northern spotted owls nesting during the implementation of the project; however, nest trees located within the inundation zone will be lost; therefore, Impact Wild-6 (CP4) is considered significant and unavoidable.

Mitigation Measure Wild-7 (CP4): Conduct a Preconstruction Survey for the Purple Martin and Establish Buffers This mitigation measure is identical to Mitigation Measure Wild-7 (CP1). Implementation of this mitigation measure will reduce impacts on individual purple martins nesting during the implementation of the project; however, these measures might not fully mitigate the loss of snags used for nesting; therefore, Impact Wild-7 (CP4) is considered significant and unavoidable.

Mitigation Measure Wild-8 (CP4): Acquire and Preserve Mitigation Lands; Conduct a Preconstruction Survey for the Willow Flycatcher, Vaux's Swift, Yellow Warbler, and Yellow-Breasted Chat and Establish Buffers This mitigation measure is identical to Mitigation Measure Wild-8 (CP1). Implementation of this mitigation measure will reduce impacts to these species; however, because impacts cannot be fully mitigated, Impact Wild-8 (CP4) is considered significant and unavoidable.

Mitigation Measure Wild-9 (CP4): Acquire and Preserve Mitigation Lands; Conduct Preconstruction Surveys for the Long-Eared Owl, Northern Goshawk, Cooper's Hawk, and Great Blue Heron and Establish Buffers This mitigation measure is identical to Mitigation Measure Wild-9 (CP1). Implementation of this mitigation measure will reduce impacts to these species; however, because impacts cannot be fully mitigated, Impact Wild-9 (CP4) is considered significant and unavoidable.

Mitigation Measure Wild-10 (CP4): Acquire and Preserve Mitigation Lands; Conduct Preconstruction Surveys for the Pacific Fisher and Establish Buffers This mitigation measure is identical to Mitigation Measure Wild-10 (CP1). Implementation of this mitigation measure will reduce impacts to these species; however, because impacts cannot be fully mitigated, Impact Wild-10 (CP4) is considered significant and unavoidable.

Mitigation Measure Wild-11 (CP4): Acquire and Preserve Mitigation Lands; Conduct Preconstruction Surveys for Special-Status Bats, American Marten, and Ringtails and Establish Buffers This mitigation measure is identical to Mitigation Measure Wild-11 (CP1). Implementation of this mitigation measure will reduce impacts to these species; however, because impacts cannot be fully mitigated, Impact Wild-11 (CP4) is considered significant and unavoidable.

Mitigation Measure Wild-12 (CP4): Avoid Suitable Habitat; Acquire and Preserve Mitigation Lands for Special-Status Terrestrial Mollusks This mitigation measure is identical to Mitigation Measure Wild-12 (CP1). Implementation of this mitigation measure will reduce impacts on special-status terrestrial mollusks; however, because impacts cannot be fully mitigated, Impact Wild-12 (CP4) is considered significant and unavoidable.

Mitigation Measure Wild-13 (CP4): Acquire and Preserve Mitigation Lands for Permanent Loss of General Wildlife Habitat This mitigation measure is identical to Mitigation Measure Wild-13 (CP1). Implementation of this mitigation measure will reduce impacts to these species; however, because impacts cannot be fully mitigated, Impact Wild-13 (CP4) is considered significant and unavoidable.

Mitigation Measure Wild-14 (CP4): Conduct Preconstruction Survey for Other Nesting Raptors and Migratory Birds and Establish Buffers This mitigation measure is identical to Mitigation Measure Wild-14 (CP1). Implementation of this mitigation measure will reduce impacts to these species; however, because impacts cannot be fully mitigated, Impact Wild-14 (CP4) is considered significant and unavoidable.

Mitigation Measure Wild-15 (CP4): Acquire and Preserve Mitigation Lands for Permanent Loss of Critical Deer Wintering and Fawning Range This mitigation measure is identical to Mitigation Measure Wild-15 (CP1).

Implementation of this mitigation measure will reduce impacts to these species; however, because impacts cannot be fully mitigated, Impact Wild-15 (CP4) is considered significant and unavoidable.

Mitigation Measure Wild-16 (CP4) Mitigation has yet to be determined for potential impacts to the California red-legged frog. At this time, no feasible mitigation has been determined. This impact is considered significant and unavoidable.

Mitigation Measure Wild-17 (CP4): Implement Mitigation Measure Bot-7 (CP1) to Reduce Impacts on Riparian-Associated and Aquatic Special-Status Wildlife in the Primary Study Area This mitigation measure is identical to Mitigation Measure Bot-7 (CP1). Implementation of this mitigation measure would reduce Impact Wild-17 (CP4) to a less than significant level.

Mitigation Measure Wild-20 (CP4): Implement Mitigation Measure Bot-7 (CP1) to Promote Consistency with Local and Regional Plans with Goals of Promoting Riparian Habitat in the Primary Study Area This mitigation measure is identical to Mitigation Measure Bot-7 (CP1). Implementation of this mitigation measure would reduce Impact Wild-20 (CP4) to a less than significant level.

Mitigation Measure Wild-21 (CP4): Conduct Preconstruction Surveys for Elderberry Shrubs, Northwestern Pond Turtle, and Nesting Riparian Raptors and Other Nesting Birds. Avoid Removal or Degradation of Elderberry Shrubs and Avoid Vegetation Removal Near Active Nest Sites To avoid impacts on valley elderberry longhorn beetle, northwestern pond turtle, and nesting raptors, and other nesting birds, the following measures will be implemented:

Valley Elderberry Longhorn Beetle:

- A worker awareness training program for construction personnel will be conducted by a qualified biologist/restoration ecologist before augmentation activities begin. The program will inform all construction personnel about the life history and status of the beetle, the need to avoid damaging the elderberry plants, and the possible penalties for not complying with these requirements. Written documentation of the training will be submitted to USFWS within 30 days of the completion of training.

- Elderberry shrubs shall be protected through establishment of a fenced avoidance area. Fencing will be placed at least 20 feet from the dripline of the shrubs where they occur along the access trail. Signs will be posted along the avoidance area. The signs will state: “This area is the habitat of the valley elderberry longhorn beetle, a threatened species, and must not be disturbed. This species is protected by the Endangered Species Act of 1973, as amended. Violators are subject to

prosecution, fines, and imprisonment." Signs will be readable from a distance of 20 feet and will be maintained during construction activities.

- No insecticides, herbicides, fertilizers, or other chemicals that might harm the beetle or its host plant will be used within 100 feet of elderberry shrubs. Roadways and disturbed areas within 100 feet of elderberry shrubs will be watered at least twice a day and as needed to minimize dust emissions.

Northwestern Pond Turtle:

- When construction activities are to occur within suitable northwestern pond turtle habitat as defined in Impact Wild-3 (CP1), a qualified biologist will conduct a minimum of one preconstruction survey for northwestern pond turtles and their nests. The survey will be conducted no more than 1 week prior to construction. If a pond turtle nest is found, the biologist will flag the site and determine whether construction activities can avoid impacting the nest. If the nest cannot be avoided, DFG will be contacted for further direction and construction activities in that location will be halted.

- In the event that a pond turtle is observed within the construction limits, the contractor will temporarily halt construction activities until a qualified biologist has moved the turtle to a safe location within suitable habitat outside of the construction limits.

Birds:

- For each year of vegetation removal for gravel augmentation activity, all active bald eagle nests will be located and mapped using the National Bald Eagle Management Guidelines (USFWS 2007).

- In consultation with DFG and USFS, a 660-foot to 0.5-mile buffer will be established around active nests. Vegetation will be retained and no construction activities will occur within this buffer.

- If proposed vegetation removal would occur between April 1 and August 31, a qualified biologist will conduct a preconstruction survey for nesting special-status birds no more than 2 weeks before construction activities begin. If an active nest is found, a qualified biologist, in consultation with DFG, will determine a construction-free buffer zone to be established around the nest until the young have fledged. In consultation with DFG, a plan will be developed to monitor whether construction activity is disturbing the reproductive process and to determine when the young have fledged.

The avoidance measures for elderberry and the nest protection measures within the gravel augmentation sites would effectively mitigate impacts on riparian-associated special-status wildlife species to a less than significant level.

Mitigation Measure Wild-23 (CP4): Implement Mitigation Measure Bot-7 (CP1) to Reduce Impacts on Riparian-Associated and Aquatic Special-Status Wildlife along the Lower Sacramento River Resulting from Modifications of Geomorphic Processes This mitigation measure is identical to Mitigation Measure Bot-7 (CP1). Implementation of this mitigation measure would reduce Impact Wild-23 (CP4) to a less than significant level.

Mitigation Measure Wild-26 (CP4): Implement Mitigation Measure Bot-7 (CP1) to Promote Consistency with Local and Regional Plans with Goals of Promoting Riparian Habitat along the Lower Sacramento River and in the Delta This mitigation measure is identical to Mitigation Measure Bot-7 (CP1). Implementation of this mitigation measure would reduce Impact Wild-26 (CP4) to a less than significant level.

CP5 – 18.5-Foot Dam Raise, Combination Plan

No mitigation is needed for Wild-18 (CP5), Wild-19 (CP5), Wild-24 (CP5), Wild-25 (CP5), and Wild-27 (CP5). Mitigation is provided below for the remaining impacts of CP5 on wildlife species.

Mitigation Measure Wild-1 (CP5): Avoid, Relocate, and Acquire Mitigation Lands for Shasta Salamander This mitigation measure is identical to Mitigation Measure Wild-1 (CP1). Implementation of this mitigation measure will reduce impacts on the Shasta salamander; however, because impacts cannot be fully mitigated, Impact Wild-1 (CP5) is considered significant and unavoidable.

Mitigation Measure Wild-2 (CP5): Avoid, Relocate, and Acquire Mitigation Lands for Foothill Yellow-Legged Frog and Tailed Frog This mitigation measure is identical to Mitigation Measure Wild-2 (CP1). Implementation of this mitigation measure will reduce impacts to these species; however, because impacts cannot be fully mitigated, Impact Wild-2 (CP5) is considered significant and unavoidable.

Mitigation Measure Wild-3 (CP5): Avoid, Relocate, and Acquire Mitigation Lands for Northwestern Pond Turtle This mitigation measure is identical to Mitigation Measure Wild-3 (CP1). Implementation of this mitigation measure will reduce impacts to these species; however, because impacts cannot be fully mitigated, Impact Wild-3 (CP5) is considered significant and unavoidable.

Mitigation Measure Wild-4 (CP5): Conduct Preconstruction Surveys for the American Peregrine Falcon and Establish Buffers This mitigation measure is identical to Mitigation Measure Wild-4 (CP1). Implementation of

this mitigation measure will reduce Impact Wild-4 (CP5) to a less than significant level.

Mitigation Measure Wild-5 (CP5): Acquire and Preserve Mitigation Lands; Conduct Protocol-Level Surveys for the Bald Eagle and Establish Buffers This mitigation measure is identical to Mitigation Measure Wild-5 (CP1). Implementation of this mitigation measure will reduce impacts on individual bald eagles nesting during the implementation of the project; however, all nest trees in the inundation zone will be lost; therefore, Impact Wild-5 (CP5) is considered significant and unavoidable.

Mitigation Measure Wild-6 (CP5): Acquire and Preserve Mitigation Lands; Conduct Protocol-Level Surveys for the Northern Spotted Owl and Establish Buffers This mitigation measure is identical to Mitigation Measure Wild-6 (CP1). Implementation of this mitigation measure will reduce impacts on individual northern spotted owls nesting during the implementation of the project; however, nest trees located within the inundation zone will be lost; therefore, Impact Wild-6 (CP5) is considered significant and unavoidable.

Mitigation Measure Wild-7 (CP5): Conduct a Preconstruction Survey for the Purple Martin and Establish Buffers This mitigation measure is identical to Mitigation Measure Wild-7 (CP1). Implementation of this mitigation measure will reduce impacts on individual purple martins nesting during the implementation of the project; however, these measures might not fully mitigate the loss of snags used for nesting; therefore, Impact Wild-7 (CP5) is considered significant and unavoidable.

Mitigation Measure Wild-8 (CP5): Acquire and Preserve Mitigation Lands; Conduct a Preconstruction Survey for the Willow Flycatcher, Vaux's Swift, Yellow Warbler, and Yellow-Breasted Chat and Establish Buffers This mitigation measure is identical to Mitigation Measure Wild-8 (CP1). Implementation of this mitigation measure will reduce impacts to these species; however, because impacts cannot be fully mitigated, Impact Wild-8 (CP5) is considered significant and unavoidable.

Mitigation Measure Wild-9 (CP5): Acquire and Preserve Mitigation Lands; Conduct Preconstruction Surveys for the Long-Eared Owl, Northern Goshawk, Cooper's Hawk, and Great Blue Heron and Establish Buffers This mitigation measure is identical to Mitigation Measure Wild-9 (CP1). Implementation of this mitigation measure will reduce impacts to these species; however, because impacts cannot be fully mitigated, Impact Wild-9 (CP5) is considered significant and unavoidable.

Mitigation Measure Wild-10 (CP5): Acquire and Preserve Mitigation Lands; Conduct Preconstruction Surveys for the Pacific Fisher and Establish Buffers This mitigation measure is identical to Mitigation Measure Wild-10 (CP1). Implementation of this mitigation measure will reduce impacts

to these species; however, because impacts cannot be fully mitigated, Impact Wild-10 (CP5) is considered significant and unavoidable.

Mitigation Measure Wild-11 (CP5): Acquire and Preserve Mitigation Lands; Conduct Preconstruction Surveys for Special-Status Bats, American Marten, and Ringtails and Establish Buffers This mitigation measure is identical to Mitigation Measure Wild-11 (CP1). Implementation of this mitigation measure will reduce impacts to these species; however, because impacts cannot be fully mitigated, Impact Wild-11 (CP5) is considered significant and unavoidable.

Mitigation Measure Wild-12 (CP5): Avoid Suitable Habitat; Acquire and Preserve Mitigation Lands for Special-Status Terrestrial Mollusks This mitigation measure is identical to Mitigation Measure Wild-12 (CP1). Implementation of this mitigation measure will reduce impacts on special-status terrestrial mollusks; however, because impacts cannot be fully mitigated, Impact Wild-12 (CP5) is considered significant and unavoidable.

Mitigation Measure Wild-13 (CP5): Acquire and Preserve Mitigation Lands for Permanent Loss of General Wildlife Habitat This mitigation measure is identical to Mitigation Measure Wild-13 (CP1). Implementation of this mitigation measure will reduce impacts to these species; however, because impacts cannot be fully mitigated, Impact Wild-13 (CP5) is considered significant and unavoidable.

Mitigation Measure Wild-14 (CP5): Conduct Preconstruction Survey for Other Nesting Raptors and Migratory Birds and Establish Buffers This mitigation measure is identical to Mitigation Measure Wild-14 (CP1). Implementation of this mitigation measure will reduce impacts to these species; however, because impacts cannot be fully mitigated, Impact Wild-14 (CP5) is considered significant and unavoidable.

Mitigation Measure Wild-15 (CP5): Acquire and Preserve Mitigation Lands for Permanent Loss of Critical Deer Wintering and Fawning Range This mitigation measure is identical to Mitigation Measure Wild-15 (CP1). Implementation of this mitigation measure will reduce impacts to these species; however, because impacts cannot be fully mitigated, Impact Wild-15 (CP5) is considered significant and unavoidable.

Mitigation Measure Wild-16 (CP5) Mitigation has yet to be determined for potential impacts to the California red-legged frog. At this time, no feasible mitigation has been determined. This impact is considered significant and unavoidable.

Mitigation Measure Wild-17 (CP5): Implement Mitigation Measure Bot-7 (CP3) to Reduce Impacts on Riparian-Associated and Aquatic Special-Status Wildlife in the Primary Study Area This mitigation measure is

identical to Mitigation Measure Bot-7 (CP3). Implementation of this mitigation measure would reduce Impact Wild-17 (CP5) to a less than significant level.

Mitigation Measure Wild-20 (CP5): Implement Mitigation Measure Bot-7 (CP3) to Promote Consistency with Local and Regional Plans with Goals of Promoting Riparian Habitat in the Primary Study Area This mitigation measure is identical to Mitigation Measure Bot-7 (CP3). Implementation of this mitigation measure would reduce Impact Wild-20 (CP5) to a less than significant level.

Mitigation Measure Wild-21 (CP5): Implement Mitigation Measure Wild-21 (CP4) to Reduce Impacts on Riparian-Associated Special-Status Wildlife Species During Implementation of the Gravel Augmentation Program This mitigation measure is identical to Mitigation Measure Wild-21 (CP4). Implementation of this mitigation measure would reduce Impact Wild-21 (CP5) to a less than significant level.

Mitigation Measure Wild-22 (CP5): Conduct Preconstruction Surveys for Elderberry Shrubs, Northwestern Pond Turtle, and Nesting Riparian Raptors and Other Nesting Birds. Avoid Removal or Degradation of Elderberry Shrubs and Avoid Vegetation Removal near Active Nest Sites To avoid impacts on valley elderberry longhorn beetle, northwestern pond turtle, nesting raptors, and other nesting birds, the following measures will be implemented as part of the Reading Island project:

Valley Elderberry Longhorn Beetle:

- Prior to implementing any construction activities associated with Reading Island restoration plans, including constructing recreational facilities, a survey shall be conducted to identify and map all elderberry shrubs.

- New roads, trails, and recreational facilities shall be constructed a minimum of 100 feet from elderberry shrubs.

- Removal and disturbance of elderberry shrubs shall be avoided, to the extent feasible, during construction activities to restore connectivity between the Sacramento River and Anderson Slough and during rehabilitation of the boat ramp.

- A worker awareness training program for construction personnel will be conducted by a qualified biologist / restoration ecologist before gravel augmentation activities begin. The program will inform all construction personnel about the life history and status of the beetle, the need to avoid damaging the elderberry plants, and the possible penalties for not complying with these requirements. Written documentation of the training will be submitted to USFWS within 30 days of the completion of training.

- Elderberry shrubs shall be protected through establishment of a fenced avoidance area. Fencing will be placed at least 20 feet from the dripline of the shrubs. Signs will be posted along the avoidance area. The signs will state: "This area is the habitat of the valley elderberry longhorn beetle, a threatened species, and must not be disturbed. This species is protected by the Endangered Species Act of 1973, as amended. Violators are subject to prosecution, fines, and imprisonment." Signs will be readable from a distance of 20 feet and will be maintained during construction activities.

- No insecticides, herbicides, fertilizers, or other chemicals that might harm the beetle or its host plant will be used within 100 feet of elderberry shrubs. Roadways and disturbed areas within 100 feet of elderberry shrubs will be watered at least twice a day and as needed to minimize dust emissions.

- If removal of elderberry shrubs during construction of the river connection is unavoidable, Reclamation shall consult with USFWS. No project construction shall proceed in areas potentially containing valley elderberry longhorn beetle until a BO has been issued by USFWS, and Reclamation has abided by all pertinent conditions in the BO relating to the proposed construction. Relocation of existing elderberry shrubs and planting of new elderberry seedlings shall be implemented on a no-net-loss basis. Compensatory mitigation for elderberry shrubs that would be removed from their current locations would be developed in consultation with USFWS during the Section 7 consultation process. Compensatory mitigation may include planting replacement elderberry seedlings or cuttings and associated native plants within BLM managed public lands on Reading Island or purchasing credits at an approved mitigation bank, or a combination thereof. Relocated and replacement shrubs and associated native plantings shall be placed in conservation areas providing a minimum of 1,800 square feet per transplanted shrub.

Northwestern Pond Turtle:

This mitigation measure is identical to Mitigation Measure Wild-21 (CP4) for northwestern pond turtles.

Birds:

- For each year of vegetation removal for Reading Island restoration and recreation construction, all active bald eagle nests will be located and mapped using the National Bald Eagle Management Guidelines (USFWS 2007b).

- In consultation with DFG and USFS, a 660-foot to 0.5-mile buffer will be established around active nests. Vegetation will be retained and no construction activities will occur within this buffer.

- If proposed vegetation removal would occur between April 1 and August 31, a qualified biologist will conduct a preconstruction survey for nesting special-status birds no more than 2 weeks before construction activities begin. If an active nest is found, a qualified biologist, in consultation with DFG, will determine a construction-free buffer zone to be established around the nest until the young have fledged. In consultation with DFG, a plan will be developed to monitor whether construction activity is disturbing the reproductive process and to determine when the young have fledged.

The avoidance measures for elderberry and the nest protection measures within the Reading Island construction sites would effectively mitigate impacts on riparian-associated special-status wildlife species to a less than significant level.

Mitigation Measure Wild-23 (CP5): Implement Mitigation Measure Bot-7 (CP3) to Reduce Impacts on Riparian-Associated and Aquatic Special-Status Wildlife along the Lower Sacramento River Resulting from Modifications of Geomorphic Processes This mitigation measure is identical to Mitigation Measure Bot-7 (CP3). Implementation of this mitigation measure would reduce Impact Wild-23 (CP5) to a less than significant level.

Mitigation Measure Wild-26 (CP5): Implement Mitigation Measure Bot-7 (CP3) to Promote Consistency with Local and Regional Plans with Goals of Promoting Riparian Habitat along the Lower Sacramento River and in the Delta This mitigation measure is identical to Mitigation Measure Bot-7 (CP3). Implementation of this mitigation measure would reduce Impact Wild-26 (CP5) to a less than significant level.

13.3.6 Cumulative Effects

A large number of past actions have occurred in the study area. These past actions have substantially degraded wildlife resources within the primary and extended study areas. This degradation is indicated by the number of species that have been listed as threatened or endangered under the CESA and ESA, or considered species of special concern by DFG.

Past actions have caused these effects by converting habitat to developed or agricultural land uses, altering biotic interactions or physical processes, and damaging or causing mortality from human activities (e.g., vegetation removal during road, levee, or utility maintenance).

Flood control and water supply projects have also altered physical processes within the study area's remaining natural vegetation. Levees have isolated large areas of floodplain from rivers and streams throughout the study area, reducing the frequency of inundation and sediment scour and deposition and altering the extent and quality of riparian habitats. By reducing the magnitude and frequency of winter and spring peak flows and increasing the volume of summer and fall flows, water storage projects have altered the riparian habitats

that were not isolated from rivers by levees. In particular, the operation of Shasta Dam (beginning in 1945) and the other major reservoirs of the CVP and SWP has strongly affected aquatic and riparian communities along the Sacramento River, other Central Valley rivers, and in the Delta (Fremier 2003; TNC et al. 2008).

The effects of climate change on operations at Shasta Lake could potentially affect wildlife both at the lake and downstream. As described in the Climate Change Projection Appendix, climate change could result in higher reservoir releases in the future because of an increase in winter and early-spring inflow into the lake from high-intensity storm events. The change in reservoir releases could be necessary to manage for flood events resulting from these potentially larger storms. The potential increase in releases from the reservoir could lead to long-term changes in flooding frequency, downstream habitat for wildlife, and water temperatures which could affect habitat along the Sacramento River and in the Delta. Climate change is also expected to result in changes to conditions for agricultural land and forest land, which are both habitat types. See Chapter 10, "Agriculture and Important Farmland," for a detailed discussion of effects on these habitat types.

Shasta Lake and Vicinity

The construction of Shasta Dam and the subsequent flooding of the area now known as Shasta Lake affected botanical and wildlife resources endemic to the region. For example, based on population locations, Shasta snow-wreath populations may have connected at the confluence of the Pit River, Squaw Creek, McCloud River, and Sacramento River prior to inundation. The creation of Shasta Lake fragmented this species habitat and populations. As a result, these populations are more vulnerable to extirpation.

As described in Section 13.3, without mitigation, CP1 through CP5 could cause potentially significant effects on wildlife habitats and special-status wildlife species in the primary and extended study areas. These effects could be caused by project construction activities; increased elevations of the water surface of Shasta Lake; and alteration of the flow regime of the Sacramento River and associated geomorphic processes, and thus of riparian vegetation. Although causing similar effects, CP1 through CP5 differ in the magnitude of their effects. At Shasta Lake and its vicinity, these potential adverse effects would be similar for all alternatives, but differ with the height of the dam raise: the effects of CP2 would be greater than CP1, but less than CP3 through CP5 (which would be identical). Along the upper Sacramento River and in the extended study area, potential adverse effects would be the result of altered flow regimes and would differ with both the height of the dam raise and operation of the dam: the effects of CP2 would be greater than CP1 and CP4 (which would be identical), but less than CP3 and CP5 (which also would have identical effects).

At Shasta Lake and vicinity, CP1 through CP5 would cause the take and loss of habitat for numerous species including Shasta salamander, foothill yellow-

legged frog, tailed frog, Northwestern pond turtle, American peregrine falcon, bald eagle, northern spotted owl, purple martin, Vaux's swift, yellow warbler, yellow-breasted chat, long-eared owl, northern goshawk, Cooper's hawk, osprey, Pacific fisher, and other special-status species. The wildlife mitigation measures described in Section 13.3.5 would reduce impacts on wildlife resources, although the adverse effects of CP1 through CP5 caused by construction activities and inundation would not be eliminated. Because the overall effect of past actions on these species has been cumulatively significant, and the likely additional effects of reasonably foreseeable future actions on wildlife habitat at Shasta Lake and in its vicinity, the adverse effects under CP1 through CP5 would cause a cumulatively considerable incremental contribution to the significant cumulative impact on wildlife.

Upper Sacramento River and Extended Study Area

CP1 – 6.5-Foot Dam Raise, Anadromous Fish Survival and Water Supply Reliability As described in Chapter 2, "Alternatives" without mitigation, CP1 could cause potentially significant effects on vegetation, wildlife habitats, and special-status wildlife species in the primary and extended study areas. These effects could be caused by alteration of the flow regime of the Sacramento River and associated geomorphic processes in the primary study area or the extended study area, or both. Given major past alterations to vegetation and wildlife habitat along the Sacramento River, the contributing adverse effects from CP1 would be cumulatively considerable. With implementation of Mitigation Measure Bot-7, "Develop and Implement a Riverine Ecosystem Mitigation and Adaptive Management Plan to Avoid and Compensate for the Impact of Altered Flow Regimes on Riparian and Wetland Communities" (see Chapter 12, "Botanical Resources and Wetlands"), adverse effects from CP1 would no longer result in a cumulatively considerable incremental contribution to significant cumulative effects on these resources.

As stated previously, effects of climate change on operations at Shasta Lake could include a higher frequency of high flow events, potentially resulting in changes to downstream habitats. Potentially significant effects on vegetation, wildlife habitats, and special-status wildlife species that would occur with implementation of CP1 could contribute to potentially significant affects of climate change on habitat acreages and distribution. However, with implementation of the mitigation measures listed above to reduce project-related impacts of CP1, CP1 would not make a considerable contribution to a potentially significant cumulative effect.

CP2 – 12.5-Foot Dam Raise, Anadromous Fish Survival and Water Supply Reliability The cumulative effects of CP2 would be similar to those of CP1, but greater in magnitude. Given major past alterations to vegetation and wildlife habitat along the Sacramento River, the contributing adverse effects from CP2 would be cumulatively considerable. With implementation of Mitigation Measure Bot-7, "Develop and Implement a Riverine Ecosystem Mitigation and Adaptive Management Plan to Avoid and Compensate for the Impact of Altered

Flow Regimes on Riparian and Wetland Communities" (see Chapter 12, "Botanical Resources and Wetlands"), adverse effects from CP2 would no longer result in a cumulatively considerable incremental contribution to significant cumulative effects on these resources.

As stated previously, effects of climate change on operations at Shasta Lake could include a higher frequency of high flow events, potentially resulting in changes to downstream habitats. Potentially significant effects on vegetation, wildlife habitats, and special-status wildlife species that would occur with implementation of CP2 could contribute to potentially significant affects of climate change on habitat acreages and distribution. However, with implementation of the mitigation measures listed above to reduce project-related impacts of CP2, CP2 would not make a considerable contribution to a potentially significant cumulative effect.

CP3 – 18.5-Foot Dam Raise, Anadromous Fish Survival and Water Supply The cumulative effects of CP3 would be similar to those of CP1, but greater in magnitude. Given major past alterations to vegetation and wildlife habitat along the Sacramento River, the contributing adverse effects from CP3 would be cumulatively considerable. With implementation of Mitigation Measure Bot-7, "Develop and Implement a Riverine Ecosystem Mitigation and Adaptive Management Plan to Avoid and Compensate for the Impact of Altered Flow Regimes on Riparian and Wetland Communities" (see Chapter 12, "Botanical Resources and Wetlands"), adverse effects from CP3 would no longer result in a cumulatively considerable incremental contribution to significant cumulative effects on these resources.

As stated previously, effects of climate change on operations at Shasta Lake could include a higher frequency of high flow events, potentially resulting in changes to downstream habitats. Potentially significant effects on vegetation, wildlife habitats, and special-status wildlife species that would occur with implementation of CP3 could contribute to potentially significant affects of climate change on habitat acreages and distribution. However, with implementation of the mitigation measures listed above to reduce project-related impacts of CP3, CP3 would not make a considerable contribution to a potentially significant cumulative effect.

CP4 – 18.5-Foot Dam Raise, Anadromous Fish Focus with Water Supply Reliability The cumulative effects of CP4 would be similar to those of CP1, but greater in magnitude. Given major past alterations to vegetation and wildlife habitat along the Sacramento River, the contributing adverse effects from CP4 would be cumulatively considerable. With implementation of Mitigation Measure Bot-7, "Develop and Implement a Riverine Ecosystem Mitigation and Adaptive Management Plan to Avoid and Compensate for the Impact of Altered Flow Regimes on Riparian and Wetland Communities" (see Chapter 12, "Botanical Resources and Wetlands"), adverse effects from CP4 would no

longer result in a cumulatively considerable incremental contribution to significant cumulative effects on these resources.

As stated previously, effects of climate change on operations at Shasta Lake could include a higher frequency of high flow events, potentially resulting in changes to downstream habitats. Potentially significant effects on vegetation, wildlife habitats, and special-status wildlife species that would occur with implementation of CP4 could contribute to potentially significant affects of climate change on habitat acreages and distribution. However, with implementation of the mitigation measures listed above to reduce project-related impacts of CP4, CP4 would not make a considerable contribution to a potentially significant cumulative effect.

CP5 – 18.5-Foot Dam Raise, Combination Plan The cumulative effects of CP5 would be similar to those of CP1, but greater in magnitude. Given major past alterations to vegetation and wildlife habitat along the Sacramento River, the contributing adverse effects from CP5 would be cumulatively considerable. With implementation of Mitigation Measure Bot-7, "Develop and Implement a Riverine Ecosystem Mitigation and Adaptive Management Plan to Avoid and Compensate for the Impact of Altered Flow Regimes on Riparian and Wetland Communities" (see Chapter 12, "Botanical Resources and Wetlands"), adverse effects from CP5 would no longer result in a cumulatively considerable incremental contribution to significant cumulative effects on these resources.

As stated previously, effects of climate change on operations at Shasta Lake could include a higher frequency of high flow events, potentially resulting in changes to downstream habitats. Potentially significant effects on vegetation, wildlife habitats, and special-status wildlife species that would occur with implementation of CP5 could contribute to potentially significant affects of climate change on habitat acreages and distribution. However, with implementation of the mitigation measures listed above to reduce project-related impacts of CP5, CP5 would not make a considerable contribution to a potentially significant cumulative effect.

Chapter 14
Cultural Resources

This chapter describes the affected environment and environmental consequences related to cultural resources for the dam and reservoir modifications proposed under the SLWRI. More detailed discussion of cultural resources is presented in *Cultural Resources Alternatives Assessment for the Shasta Lake Water Resources Investigation, Shasta and Tehama Counties, California* (Byrd et al. 2008) and *Native American Tribal Coordination, Shasta Lake Water Resources Investigation, California* (Nilsson et al. 2008), which were prepared for the project. These Technical Reports will not be publicly distributed because they contain confidential information on the locations of cultural resources.

14.1 Affected Environment

For the purposes of the cultural resources assessment, studies were limited to the Shasta Lake and vicinity (77,088 acres) and the upper Sacramento River (16,113 acres), for a total of 93,201 acres (see Byrd et al. (2008) for a complete discussion of the study area extent by alternative). Project impacts to cultural resources are not expected to extend beyond this primary study area. Shasta Lake and vicinity includes the existing reservoir, the maximum inundation area, and a 0.25-mile buffer. The 0.25-mile buffer encompasses the area around the reservoir where infrastructure would need to be relocated (recreation facilities, roads, utilities, trails, etc.).The upper Sacramento River is defined by the 100-year floodplain from Keswick Dam, north of Redding, southward to the Red Bluff Diversion dam.

To evaluate the potential effects that the proposed undertaking may have on cultural resources within the 93,201-acre study area, archival and records searches were conducted. Information concerning potential Native American concerns within the study area was gathered from historic and ethnographic literature and from initial discussions with tribes and Native American individuals. The results of these efforts are summarized below, following a brief discussion of the regional context.

14.1.1 Regional Setting

This section provides a regional framework of the study area including sections on the prehistoric, ethnohistorical, and historical context of the study area. Because of the regional nature of cultural resources, the Shasta Lake vicinity and upper Sacramento River area are discussed together.

Prehistoric Context

The following presentation provides a temporally organized discussion of the archaeological record. There is a long history of archaeological investigations in the upper Sacramento Valley region, although the early investigations were sporadic rather than sustained research programs. Notably, a great deal of fieldwork has been carried out around Shasta Lake, largely on USFS lands. Radiocarbon dating and temporally diagnostic artifacts have been used to create a framework for understanding the age of cultural resources in the area as well as changes through time. This framework provides baseline information on how cultural resources can contribute to history and regional research issues.

The Terminal Pleistocene time segment (ca. 13,500-11,600 before present, calibrated using radiocarbon dating (cal BP)) is minimally represented and poorly understood in this region. What little evidence exists suggests that people passing through the area were wide-ranging, mobile hunters and gatherers who periodically exploited large game (Haynes 2002). Archaeological data from this time period, primarily represented by isolated fluted and/or bifacially thinned spear points and Pleistocene fauna remains, is limited to two cave sites in the study area.

The earliest evidence for occupation of the region largely falls between ca. 8000-5000 BP. Most assemblages dating to this interval are affiliated with the Borax Lake Pattern (Fredrickson 1974) and include wide-stemmed projectile points, handstones, milling slabs, ovoid flake tools, along with a variety of other utilitarian items. The diversified nature of these artifact assemblages indicates people occupying the area were likely foragers who moved their residential bases frequently to exploit seasonal changes in resource distribution (Hildebrandt and Hayes 1983, 1993; Kowta et al. 2000; Sundahl and Henn 1993).

Several new projectile point forms appeared in the archaeological record around 5000 BP, including Squaw Creek Contracting-stemmed, Pollard Diamond-shaped, and McKee series. These points have been assigned to the Squaw Creek Pattern (5700-3200 BP) by Sundahl (1992b). Despite the appearance of these new forms, similarities in the rest of the assemblage composition with the preceding Borax Lake Pattern suggest people occupying the area during this time period were also relatively mobile foragers (Basgall and Hildebrandt 1989, Kowta et al. 2000).

A major change in the regional settlement-subsistence pattern appears to have occurred between ca. 4,000 to 1,600 years ago. This period has been identified as the Whiskeytown Pattern (Sundahl 1992b), and is represented by a wide range of corner- and side-notched projectile points assigned to the Clikapudi series, as well as hand stones, milling slabs, notched pebble net weights, and mortars and pestles (see also the Deadman and Kingsley complexes in Tehama County; Greenway 1982, Johnson 1984). Analysis of data from archaeological sites dating to this time period, has led Basgall and Hildebrandt (1989) to propose a shift from the preceding generalized forager strategy to a "fission-fusion" model of subsistence-settlement where larger groups of people occupied residential camps during the fall and winter months, but then split into smaller foraging groups who moved between productive resource patches during the remainder of the year. The fall-winter residential sites are thought to have been concentrated along the northern Sacramento Valley foothills, where salmon and acorns could be readily obtained (Baker 1990, Bevill and Nilsson 1993, Sundahl 1999).

Two distinct patterns have been identified as corresponding with the most recent time period (from 1,600 years ago to contact) in the region. The first, referred to as the Augustine Pattern/Shasta Complex, is thought to reflect a more sedentary subsistence-settlement adaptation than what was practiced in the preceding time periods. Initially, from 1,250 to 750 years ago, square-stemmed Gunther Barbed projectile points (with lower frequencies of expanding-stem variants), winged drills, bipointed fish gorges, bone gaming pieces, incised bone pendants, and varied shell beads are characteristic. These materials have been associated with the arrival of the Wintu in Northern California, and are thought to reflect a sedentary adaptation made possible by a subsistence system dependent on the large-scale storage of salmon and acorns (Broughton 1988; George 1981; Sundahl 1982, 1992a; Wohlgemuth 1992).

During this same time frame, a contrasting record is found in upland areas surrounding the northern Sacramento Valley. It is represented by much smaller sites and rather simple assemblages consisting of small side- and corner-notched projectile points, a limited number of Gunther series forms, hopper mortars and pestles, hand stones, milling slabs, and notched pebble weights. On the east side of the valley, these findings are assigned to the Tehama Pattern (Clewett and Sundahl 1982, Sundahl 1992a), and are thought to reflect a more mobile pattern of settlement by populations speaking Hokan languages (e.g., Yana) pushed to the hinterlands by the late-arriving Wintu, who ultimately restricted access to the Sacramento River.

Ethnohistorical Context

Ethnohistorical investigations indicate that at the end of the prehistoric era and into the historic era, much of the study area was primarily occupied by the Wintu (LaPena 1978), but some of their territorial boundaries have been contested for many years. The most commonly accepted map of Wintu territory was produced by Du Bois (1935), and shows that the Wintu controlled the

Sacramento, McCloud, and Squaw Creek drainages, and all but the easternmost segment of the Pit River Arm. This arm crosses into a boundary area between Northern Yana (Johnson 1978, Sapir and Spier 1943) and Achomawi (Pit River) tribes (Olmsted and Stewart 1978). Wintu people also lived along the Sacramento River from Shasta Dam down to the confluence of the river with Cottonwood and Battle creeks. Nomlaki territory took over south of Cottonwood Creek/Battle Creek and extended down past what is now the Red Bluff Diversion Dam (Goldschmidt 1951, 1978).

There has been a great deal of ethnohistoric and ethnographic discussion of the Wintu owing largely to the records amassed by late nineteenth- and early twentieth-century observers. Therefore, the Wintu can be considered one of the best known Native American groups in California. Most of the villages were located on the McCloud and Pit rivers and the general area south of the Pit River to just south of Redding. One hundred and six (43 percent) of the named Wintu ethnographic villages fall within the current study area.

Historical Context

The area that would become Shasta and Tehama counties was not explored by Europeans during the Spanish period of California history. Initial exploration occurred in 1821 when a Mexican expedition explored the Sacramento River nearly as far north as the future site of Redding, encountering Native populations as they traversed the region. Subsequently, European trappers in Northern California spread European diseases that had disastrous effects on the Native Americans. Notably, a devastating epidemic spread through the Sacramento Valley during the 1830s that may have killed as much as 75 percent of the native population.

In 1848, mining (especially for copper) began along the Trinity River and other Sacramento River tributaries, bringing as many as 50,000 people to the area. American immigrants increasingly occupied territory, and new logging and mining operations destroyed hunting grounds and salmon fisheries that were part of the traditional home of Native Americans such the Wintu. Criminal violence and the policy of relocation to reservations nearly eliminated the Native American population in the upper Sacramento River Valley by 1870. Those who remained lived in the mountains, like the Wintu, who maintained a salmon fishery along the McCloud River.

The mining boom lead to the construction of smelters, mills, and towns (such as Keswick) that flourished in the late 1800s and early 1900s. Falling copper prices, growing environmental concerns over pollution from smelters, and the U.S. Government’s efforts at protection and conservation of public lands ended major operations by the 1920s.

Logging started in 1852 and included sugar pine, white pine, red fir, and cedar. Sawmills quickly sprang up, along with associated roads. Transporting logs and milled lumber became easier after the completion of the railroad through Red

Bluff and Redding, and the Blue Ridge Flume, completed in 1874. These transportation advances allowed lumber milling to be concentrated in the valley, and Red Bluff and other mill towns to thrive.

Agriculture dominated the valley land along the Sacramento River. Cattle farming was key initially, and remained an important product in the area through the mid-twentieth century, especially with the development of the dairy industry. Early settlers practiced dry farming, growing wheat and fruit, including peaches, pears, and plums. Farmers later diversified and transitioned from wheat to fruits, nuts, vineyards, and vegetable crops in the late 1800s through the 1920s. Ultimately, intensive irrigated agriculture dominated the area.

Throughout the historic era, transportation was an important focus of infrastructure development. Over time, foot travel and transportation by horse or stage coach on a number of historic trails gave way to river, railroad, and ultimately, automobile travel. Hopeful settlers and miners poured into the study area along the California-Oregon Trail between 1840 and 1860, passing thorough the upper Sacramento River and Pit River valleys. A segment of the Siskiyou Trail was used by the northern railroad in 1877 and Interstate 5 follows this route today. Many early roads in the study area operated in conjunction with ferries across the Sacramento River. Several important bridges are located in the study area, along with the remains of many others, including the Centennial Bridge in Red Bluff and the Dog Creek Bridge in Shasta County.

Towns such as Red Bluff, Redding, Keswick, and Kennett boomed, along with the region's developing transportation network. The construction of Shasta and Keswick dams promoted a new period of prosperity that carried through the expansion of the lumber industry and the rise of the recreation industry in the mid-twentieth century.

Efforts to preserve the Nation's forests began in the late 1800s. The Shasta Forest Reserve was created in 1905. The area also included many homesteads and Indian allotments granted to local Wintus in the 1880s. In preparation for inundation by Shasta Lake, the United States purchased land including these allotments, homesteads, and many other properties in the late 1930s. Around the same time, fish were recognized as an important natural resource in California, and the first of several salmon fish hatcheries were constructed in 1872 at the salmon spawning grounds near the confluence of the McCloud and Pit rivers.

Recreation, especially in the mountains, also played an important role in the region's history. In the early twentieth century, private fishing clubs, such as the Bollibokka Club, flourished. In the 1930s, USFS began to encourage the recreational use of the forests by the broader public, constructing campgrounds and picnic areas. Recreation in the national forests expanded with the formation

of Shasta Lake. New campgrounds were added, along with boat launches and access roads.

Hydroelectric power and water storage were also important facets of the region's history. Starting in 1922, Pacific Gas and Electric Company built dams and power plants in the Pit River area. In 1935, the Federal Government decided to proceed with building the Central Valley Project to store and deliver Sacramento River water as far south as Fresno County. Work was completed in the 1940s at Shasta Dam and Keswick Dam and Powerhouse, located downriver from Shasta Dam. Power generated at Shasta Dam and transmitted to the Central Valley Project pumps provided electricity to supply the lift pumps raising water into the main canal system. The system used the natural channels of the Delta to move water from Redding to Tracy, the head of the Delta-Mendota Canal.

14.1.2 Archaeological Resources and Historical Structures

This section discusses known archaeological resources and historic structures within the primary study area.

Shasta Lake and Vicinity

A total of 134 cultural resources studies has been previously conducted that intersect or are fully contained within the Shasta Lake area. Of these, 80 percent were surveys, the remainder being overview/research designs, excavations, or other compliance reports. More than half of the surveys are considered to have had systematic coverage; the rest were either reconnaissance efforts or the methods were unknown. Overall, only 8 percent of the study area has been surveyed; 5 percent in a systematic manner and 3 percent using reconnaissance methods.

The records search identified 261 cultural resources within the study area, including 190 prehistoric sites, 45 historic-era resources, and 26 resources with both prehistoric and historic-era components.

The 215 recorded prehistoric-era resources and components are widely distributed throughout the study area and include the following:

- Forty-two major residential sites
- Thirty-seven residential sites
- Fifty-five artifact scatters
- Seventy-seven scatters of flaked stone tools and manufacturing debris
- Two caves
- Two sites of unknown character

The 71 recorded historic-era resources and components include the following:

- Thirteen structures, including seven bridges, one dam, one railroad bridge and grade, one aerial-tramway, one rock wall/alignment complex, one building foundation, and one concentration of wooden A-frames
- Seven linear features consisting of one railroad, five road segments and one line of wooden poles
- Seven mining locales that include two quarries and five sites with various mining-related features and residential elements.
- Fifteen artifact scatters
- Two ranching complexes
- Fourteen residential sites
- Two town complexes – both are mining-related and one includes a cemetery
- Two orchards represented by wooden poles and fruit trees
- One cemetery represented by two grave stones
- Seven historic-era Native American cemeteries, all but one of which is also associated with a major prehistoric residential component. Each of these cemeteries was subject to government removal of burials and reburial in a government cemetery outside the Shasta Lake inundation area
- One historic-era Native American residential site that also has a prehistoric residential component

Another 19 historic-era cemeteries (containing both Native American and Euro-American burials) within the footprint of Shasta Lake have not been formally recorded. They were subject to burial removal and subsequent reburial outside the reservoir area. It is possible that a number of these cemeteries may retain additional human remains, and are potentially subject to periodic exposure when the reservoir level fluctuates.

The Dog Creek Bridge is currently listed on the National Register of Historic Places (NRHP). The NRHP is the Nation's official list of cultural resources worthy of preservation. Authorized under the National Historic Preservation Act of 1966, the NRHP is part of a national program to coordinate and support public and private efforts to identify, evaluate, and protect our historic and

archeological resources. Properties listed in the NRHP include districts, sites, buildings, structures, and objects that are significant in American history, architecture, archeology, engineering, and culture. All properties and districts listed in or determined eligible for listing in the NRHP must be considered in the planning of Federal undertakings. Shasta Dam and property has been determined eligible for the NRHP as part of the Central Valley Project through a consensus determination with the State Historic Preservation Officer (SHPO). Another 24 resources have been determined ineligible by consensus determination with SHPO. These include 15 historic-era resources, seven prehistoric sites, and two resources with both prehistoric and historic-era components.

Upper Sacramento River (Keswick Dam to Red Bluff)

Based on the records search results, 97 cultural resources studies intersect or are fully contained within this area. Of these, 86 percent are surveys, along with overviews, excavation reports, and historical architectural evaluation reports. Most of the surveys had systematic coverage methods (75 percent). In all, 23 percent of the area has been surveyed, mostly by systematic methods (15 percent), and the rest by reconnaissance methods.

A total of 79 recorded cultural resources fall within this area. These include 45 prehistoric sites, 20 historic-era resources, and 14 resources with both historic-era and prehistoric components.

The 59 prehistoric resources and components within the study area include the following:

- Thirteen major residential sites
- Twenty-two residential sites
- Seven rock shelters
- Five artifact scatters.
- Five flaked stone tool and manufacturing debris scatters
- Four rock art (petroglyph) sites
- Three sites of unknown character

The recorded prehistoric sites are concentrated in the southern portion of the study area, from Battle Creek near Table Mountain southward (71 percent), along with a small concentration of sites at the northern end of the upper Sacramento River area near Redding (18.6 percent). Eleven prehistoric sites have been subjected to some form of archaeological excavation.

The 34 recorded historic-era resources and components within the study area include the following:

- Ten structures
- Seven linear features consisting of five roads, one wagon train, and a powerline
- Five flume remnants (two of which were associated with orchards)
- Three mining locales, including a mining complex and two adits
- Five artifact scatters
- One ranching complex
- The historic-era structures include five bridges, a ferry crossing, a rock wall, a dam, one concrete dance pavilion, and a power substation building complex
- Three historic-era Native American residential sites

One archaeological site (referred to as the Benton Track Site or *Magmas*) is currently listed on the NRHP. In addition, the Diestelhorst Bridge in Redding and the Anderson-Cottonwood Irrigation District Diversion Dam have been determined eligible for the NRHP. Two sites are listed as ineligible for the NRHP by the California Office of Historic Preservation.

Native American Traditional Cultural Properties and Sacred Sites

A traditional cultural property is generally defined based on its association with cultural practices or beliefs of a living community rooted in a community's history, and are important in maintaining community cultural identity (Parker and King 1998). Executive Order No. 13007 defines a sacred site as "any specific, discrete, narrowly delineated location on Federal land that is identified by an Indian tribe, or Indian individual determined to be an appropriately authoritative representative of an Indian religion, as sacred by virtue of its established religious significance to, or ceremonial use by, an Indian religion; provided that the tribe or appropriately authoritative representative of an Indian religion has informed the agency of the existence of such a site."

The records search at the Information Center revealed that no traditional cultural properties have been formally recorded. The Native American Heritage Commission (NAHC) reviewed its sacred lands file and identified sacred land filings within the study area. Their locations are confidential.

There is a strong likelihood that additional traditional cultural properties are present within the study area based on ethnohistoric data and initial discussions with Native Americans. The study area was the focus of intensive Native American occupation during historic times, with a variety of religious, economic, historic, and other values identified by Native American groups. Ten

groups, including those listed by the Native American Heritage Commission, represent Native American interests in the study area. They include the following: Grindstone Indian Rancheria, Paskenta Band of Nomlaki Indians, Pit River Environmental Council, Pit River Tribe of California, Redding Rancheria, Shasta Nation, United Tribe of Northern California, Inc., Winnemem Wintu Tribe, Wintu Educational and Cultural Council, and the Wintu Tribe of Northern California. Notably, the Winnemem Wintu and the Pit River tribes live within the Shasta Lake area, where they continue to actively practice many aspects of their traditional culture. Both groups have related that a complex cultural landscape of village sites, ceremonial areas, sacred sites, burial sites, and resource areas intersects the study area.

Tribal consultation has clearly indicated that all local Native American groups are deeply concerned regarding the environmental and cultural effects of the project. Native Americans who supplied information for the SLWRI were, by and large, unwilling to provide comprehensive information on traditional cultural properties within the study area at this point in the investigation. They did, however, provide some general information on the number of potential traditional cultural properties (TCP) in the general region and these statements are well supported by ethnohistoric studies.

Members of the Pit River Madesi Band stated that 22 ethnographic villages and associated burial grounds are located within the existing reservoir and proposed reservoir areas. One tribal member also noted that several TCPs exist within the Pit 6 and Pit 7 Dam areas.

The Winnemem Wintu have identified important localities within the study area, many of which are locations where ceremonies are regularly conducted. Along the McCloud River, these include Children’s Rock, Coyote Rock, Dekkas Rock, doctoring pools near Nawtawaket Creek, Eagle Rock and Samwel Cave, Hirz Bay, *Kaibai* village, North Gray Rocks, Puberty Rock, Saddle Rock, and *Watawacket* village and spiritual area. Along the Sacramento River, important localities include the Antlers area, Delta area, Doney Creek, Gregory Creek, LaMoine area, Packers Bay, Pollard’s area, middle Salt Creek, and Sims area. The Winnemem Wintu have strong traditional and contemporary connections with the land, and their ongoing use of many archaeological and religious sites is fundamental to the well-being of their culture, particularly the education of their youth.

The Winnemem Wintu have also documented the location of some 155 ancestral villages within the Shasta Lake area. At least 81 village locations are known along the lower McCloud River and lower Pit River. An additional 73 villages are known to have existed on the eastern side of the Sacramento River. These village locations once contained between one and 30 houses each, some had associated cemeteries, and each had a power place. Some of these villages are already under the waters of Shasta Lake, while others are just above the

current Shasta Lake water level. The Winnemem Wintu have estimated that 120 of the known villages are still accessible (above the current high-water line).

14.2 Regulatory Framework

Under Federal and State law, effects to significant cultural resources—which include archaeological remains, historic-period structures, and traditional cultural properties—must be considered as part of the environmental analysis of a proposed project. Federal guidelines define TCPs as those that have "association with cultural practices or beliefs of a living community that (a) are rooted in that community's history, and (b) are important in maintaining the continuing cultural identity of the community" (Parker and King 1998). Examples of traditional cultural properties include: a location associated with the traditional beliefs of a Native American group about its origins, its cultural history, or the nature of the world; a location where Native American religious practitioners have historically gone, and are known or thought to go today, to perform ceremonial activities in accordance with traditional cultural rules of practice.

Criteria for defining significant cultural resources are stipulated in 36 Code of Federal Regulations (CFR) Part 60.4 (Determinations of Eligibility for Inclusion in the National Register of Historic Places); the National Historic Preservation Act (NHPA) of 1966, as amended (NHPA; 16 U.S. Code (USC) 470 et seq.); and the California Environmental Quality Act (CEQA, revised 2005). Both NHPA and CEQA are applicable to Federal projects in California. In addition, 36 CFR 800 outlines the compliance process for Section 106 of the NHPA. Eligible properties are those which "(a)...are associated with events that have made a significant contribution to the broad patterns of our history; or (b) that are associated with the lives of persons significant in our past; or (c) that embody the distinctive characteristics of a type, period, or method of construction, or that represent a significant and distinguishable entity whose components may lack individual distinction; or (d) that have yielded, or may be likely to yield, information important in prehistory or history" (36 CFR 60.4).

14.2.1 Federal

Under Section 106 of the NHPA, Federal agencies must consider effects to eligible resources ("historic properties") from the proposed undertaking, in consultation with SHPO and other parties. This includes identification (usually through archival research, field inventories, public interpretation, and/or test evaluations) of cultural resources eligible for the NRHP, assessment of adverse effects to eligible properties, and resolution of adverse effects. The revised regulations emphasize consultation with appropriate Native American communities (in the case of prehistoric, ethnographic, or traditional cultural properties), and the preparation of Memoranda of Agreement (MOA) among involved agencies and parties.

Native American burials are also protected by Federal law. The Native American Graves Protection and Repatriation Act (Public Law 101-601; 25 USC 3001-3013) protects Native American burial sites and controls the removal of human remains, funerary objects, sacred objects, and items of cultural patrimony on Federal and tribal lands.

The American Indian Religious Freedom Act (42 USC Section 1996) states that it is the policy of the United States to "protect and preserve for American Indians their inherent right of freedom to exercise the traditional religions of the American Indian, Eskimo, Aleut, and Native Hawaiians, including but not limited to access to sites, use and possession of sacred objects, and the freedom to worship through ceremonials and traditional rites." The provisions of American Indian Religious Freedom Act guarantee access to traditional sites on Federal lands and noninterference with religious practices. Consultation under American Indian Religious Freedom Act with American Indian groups can simultaneously satisfy the requirements of NEPA as well.

Indian Sacred Sites as also addressed in Executive Order 13007 (24 May 1996) and establishes that Federal agencies are responsible for allowing American Indian religious practitioners access to and ceremonial usage of sacred American Indian sites on Federal land. The agency will keep the locations of such sites confidential and will avoid adversely affecting the integrity of these sites.

14.2.2 State

Under CEQA, the lead non-Federal agency (state, county, city, or other) must consider potential effects to important or unique cultural resources. While the language and consultation process is somewhat different between the NHPA and CEQA, the definitions of eligible properties and of adverse impacts are essentially the same. Evaluations under CEQA consider a resource's potential eligibility to the California Register of Historical Resources.

California law also protects Native American burials, skeletal remains, and associated grave goods regardless of their antiquity, and provides for the sensitive treatment and disposition of those remains (California Health and Safety Code Section 7050.5, California Public Resources Code Sections 5097.94 et seq.).

14.2.3 Regulatory Compliance

Currently, there is no undertaking authorized by Congress involving the raising of Shasta Dam. Reclamation has initiated the Section 106 process to notify the SHPO and Native American groups of the study and to begin the consultation process to obtain information regarding Native American cultural resources in the study area. If a project involving raising of the dam is authorized by Congress, the Section 106 process would continue with additional efforts to refine an area of potential effect (APE) and further identify historic properties. Initially, a complete inventory of cultural resources would be conducted within

the APE of the selected alternative. The APE would include, at a minimum, the new inundation area, construction areas (including dam construction and ecosystem enhancements), staging areas, and facility and utility relocations. Additional investigations would likely include the following:

- Archaeological survey of previously unsurveyed areas to inventory surface sites, including areas sensitive for buried resources
- Historic archival investigations to place historic-era sites in a local context
- Ethnographic and ethnohistoric investigations to obtain greater detail regarding areas of importance to Native American tribes and groups
- Evaluations to determine whether cultural resources identified within the APE are eligible for inclusion in the NRHP, assess potential adverse effects to historic properties, and consult in an effort to resolve any identified adverse effects

Cultural resources are evaluated for inclusion in the NRHP based on criteria found at 36 CFR Part 60. Typically, the cultural resources consultant provides eligibility recommendations, and Reclamation makes determinations of eligibility in consultation with SHPO, the public (if they are consulting parties) and tribes (for sites of religious or cultural significance). In this process, previous determinations of eligibility may need to be reevaluated because of the passage of time or other factors, and it is important to acknowledge the special expertise of Indian tribes when assessing the eligibility of properties to which they attach ceremonial and cultural significance. It would be possible to evaluate some cultural resources with survey-level data. However, test excavations would be required to accurately evaluate many archaeological resources to determine if they are, in fact, historic properties.

Reclamation is required to consider the effects of any potential project on historic properties within the APE. The criteria for assessing adverse effects are found in 36 CFR Part 800.5(a)(1), which states that “an adverse effect is found when an undertaking may alter, directly or indirectly, any characteristic of a historic property that qualify the property for inclusion in the National Register…” Examples of adverse effects include physical destruction, alteration, a change in the property’s setting, or the introduction of visual, atmospheric, or audible elements that diminish the integrity of the property’s significant historic features (36 CFR Part 800.5(a)(2)).

As part of the Section 106 process, Reclamation is responsible for making a finding regarding whether the undertaking would have an adverse effect on historic properties. This assessment of adverse effects is made in consultation with SHPO and Indian tribes that attach religious and cultural significance to

identified historic properties. Reclamation would then seek concurrence from SHPO on the determination of effect.

Consultation then continues among Reclamation, SHPO, and other consulting parties on possible options for avoiding, minimizing, or mitigating the adverse effects. This includes notifying the Council when adverse effects are found and inviting the Council to participate. Archaeological data recovery excavation is the most frequent way to resolve or mitigate adverse effects on historic properties determined eligible under Criterion D. Properties determined eligible under Criteria A through C typically require more varied actions to resolve adverse effects. If SHPO, Reclamation, and the Council (if participating) agree to measures to resolve adverse effects to historic properties, these are formalized in an MOA. Other consulting parties may be invited to sign the MOA. The Section 106 process is completed once the terms of the MOA have been met. In rare cases, if consultation fails to result in agreement on resolving adverse effects, consultation may be terminated pursuant to the process detailed in 36 CFR Part 800.7

14.3 Environmental Consequences and Mitigation Measures

This chapter is organized by the project alternatives described in Chapter 2, "Alternatives," and discusses environmental consequences associated with implementation of the project alternatives. It also describes potential mitigation measures associated with impacts to cultural resources that are significant or potentially significant.

The environmental setting for this chapter includes only the primary study area, Shasta Lake and vicinity, and the upper Sacramento River between Keswick and the Red Bluff Diversion Dam, as explained in Section 14.1. No potential impacts are expected in the extended study area; therefore, cultural resources investigations were conducted only in the primary study area. The extended study area is not discussed further in this section.

14.3.1 Impact Assessment Methods and Assumptions

The standard Section 106 process of the NHPA follows a series of steps that are described in the 36 CFR Part 800 regulations that implement the NHPA. These steps are as follows:

- Initiate Section 106 Process, 36 CFR Part 800.3
- Identify Historic Properties, 36 CFR Part 800.4
- Assess Adverse Effects, 36 CFR Part 800.5
- Resolve Adverse Effects, 36 CFR Part 800.

In the event that historic properties within the APE for an undertaking would be subject to adverse effects, the Section 106 process is most often completed with

the signing of an agreement document specifying measures that will be taken to avoid, minimize, or mitigate those effects.

The SLWRI is a feasibility-level study, and there is no authorization for raising Shasta Dam at this time. Reclamation will not have a specific undertaking until such time as Congress makes a decision regarding whether to authorize a project that would involve raising the dam and appropriates funding for this purpose. Therefore, this feasibility study has gathered existing data and information that can be used in environmental documents to estimate the impact of the proposed action on historic properties or sites of cultural significance. The Section 106 regulations allow Federal agencies to conduct "nondestructive project planning activities before completing compliance with Section 106" (36 CFR Part 800.1[c]), and the regulations encourage Federal agencies to consider a broad range of alternatives during the planning process for the undertaking. Given the schedule for the feasibility study and the Environmental Impact Statement, and the sizes of the alternatives, cultural resource surveys for the purpose of Section 106 compliance will not be completed until such time as an alternative is selected and funding is authorized by Congress. In the interim, the assessment of effects to cultural resources presented in this document is based on existing knowledge of site locations and an analysis of the sensitivity of the study area to contain additional sites.

As part of compliance with 36 CFR Part 800 regulations, Reclamation conducted a records search for the APE to assess which portions of the APE have been previously inventoried, and to identify all previously recorded cultural resources. Methods used for the cultural resources analysis included archival records searches (that identified previously records sites, site records and Native American ethnographic studies), agency consultation, Native American consultations, and comparisons of the study alternatives. Information on archaeological and historical structures was obtained for sites within the primary study area that may be affected by alternative plans. Sensitivity analyses were also conducted for prehistoric and historic-era resources to address data gaps using methods tailored to each data set. Native American issues and resource locations within the primary study area were discussed during meetings with Native American groups and individuals.

Archaeological and Historic-Era Structural Resources

Overall, the frequency and distribution of formally recorded cultural resources within the study area gives only a limited and incomplete picture of the actual number of resources. This is mainly due to limited systematic surveys: 5 percent of the Shasta study area and 15 percent of the upper Sacramento River. As such, many cultural resources have not been identified or formally recorded.

A comparative sensitivity analysis was therefore conducted that took into account both documented and undocumented cultural resources (including archaeological sites and historic-era structures) for each of the alternatives proposed for raising Shasta Dam. The sensitivity analysis was restricted to the

Shasta Lake and vicinity, and did not include the upper Sacramento River since no impact differences between alternatives have been identified within this area.

Separate sensitivity analyses using methods tailored to each data set were conducted for prehistoric and historic-era sites to estimate the total number of cultural resources present within each alternative (see Byrd et al. (2008) for methodological details and specific data). The prehistoric sensitivity analysis used a weights-of-evidence quantitative analysis to predict the overall density and distribution of sites. In contrast, the historic-era sensitivity study gathered archival data (mainly maps) within the study area to make predictions regarding the number and type of potential unrecorded historic-era resources (both structures and sites) by alternative. Results of the prehistoric and historic-era sensitivity analyses were integrated to provide quantitative estimates of the total number of cultural resources after full inventory.

A second records search was completed to identify recorded cultural resources in specific areas of the upper Sacramento River where construction activities would take place in certain alternatives associated with ecosystem restoration, including spawning gravel augmentation and floodplain and riparian habitat restoration. For these construction areas, existing access roads were excluded, but a records search buffer of 0.125-mile was added to all other project elements. It should be noted that the proposed construction areas are concept-level, and may be relocated or deleted as a result of design development, consultation, or other factors.

Traditional Cultural Properties and Sacred Sites

Public and stakeholder coordination meetings were conducted on behalf of Reclamation with Native American tribal groups whose traditional territories overlap the study area. This included meetings and/or workshops with groups and individuals representing major tribes and/or extended family groups in the Shasta/Redding area regarding potential effects to cultural resources from a plan to enlarge Shasta Dam and Reservoir. The primary intent of these meetings was to strengthen communication with tribal groups and individuals; solicit, clarify, and document major concerns and issues; and establish a preferred method/ approach to maintaining effective communication during the remainder of the SLWRI and in future endeavors.

Federally recognized Native American tribes were invited to begin the consultation process at an information meeting, followed by additional contact by telephone to learn of their concerns regarding the SLWRI, and to gain an initial sense of where sensitive resource localities are situated within the primary study area. Non-Federally recognized Native American groups and individuals with an interest in the study area were also contacted. There were also in-person visits to tribal members to collect information.

Seven tribal groups were invited to an information meeting held on April 4, 2007, in Redding, California. The purpose of the meeting was to provide

general information about the SLWRI, initiate Section 106 consultation with groups desiring to participate in the project, and introduce Elena Nilsson, a consultant for Reclamation, as the Native American Tribal Coordination study lead. Invitations were sent to the following: Grindstone Rancheria, Paskenta Rancheria, Pit River Tribe, Redding Rancheria, Shasta Nation, Winnemem Wintu, and Wintu Tribe and Toyon-Wintu Center. The meeting was attended by representatives from the Winnemem Wintu and the Madesi Band of the Pit River Tribe.

From August 2007 to March 2008, nine meetings were held with Native American groups whose traditional territories overlap with the SLWRI study area. The purpose of the meetings was to solicit, clarify, and document major concerns and issues regarding the project, and to establish a preferred method/approach to maintaining effective communication during the remainder of the SLWRI study and in future endeavors. Five groups participated in these meetings, including the Grindstone Indian Rancheria (one meeting), Paskenta Band of Nomlaki Indians (one meeting), Pit River Tribe (three meetings), Shasta Nation (one meeting), and Winnemem Wintu (three meetings).

Currently, no traditional cultural properties are formally recorded at the Information Center. The Native American Heritage Commission, however, has stated that sacred sites are present in the study area. No additional investigations have been undertaken to identify and formally document traditional cultural properties in large part because Native American groups are unwilling to provide sufficiently detailed information at this stage in the study. Based on initial statements provided by Native Americans and previous ethnographic and ethnohistoric studies, it is predicted that a considerable number of traditional cultural properties are present in the study area.

14.3.2 Criteria for Determining Significance of Effects

An environmental document prepared to comply with NEPA must consider the context and intensity of the environmental effects that would be caused by, or result from, the proposed action. Under NEPA, the significance of an effect is used solely to determine whether an Environmental Impact Statement must be prepared. An environmental document prepared to comply with CEQA must identify the potentially significant environmental effects of a proposed project. A "[s]ignificant effect on the environment" means a substantial, or potentially substantial, adverse change in any of the physical conditions within the area affected by the project (State CEQA Guidelines, Section 15382). CEQA also requires that the environmental document propose feasible measures to avoid or substantially reduce significant environmental effects (State and CEQA Guidelines, Section 15126.4(a).

Federal Criteria

Under Federal regulation (36 CFR Section 800(a)(1)):

> *"An adverse effect is found when an undertaking may alter, directly or indirectly, any of the characteristics of a historic property that qualify the property for inclusion in the National Register in a manner that would diminish the integrity of the property's location, design, setting, materials, workmanship, feeling, or association. Consideration shall be given to all qualifying characteristics of a historic property, including those that may have been identified subsequent to the original evaluation of the property's eligibility for the National Register. Adverse effects may include reasonably foreseeable effects caused by the undertaking that may occur later in time, be farther removed in distance or be cumulative."*

Examples of adverse effects (36 CFR Section 800(a)(2)) include the following:

- Physical destruction, damage, or alteration, including moving the property from its historic location
- Isolation from, or alteration of, the setting
- Introduction of intrusive elements
- Neglect leading to deterioration or destruction
- Transfer, sale, or lease from Federal ownership

State Criteria

California regulations require that effects to cultural resources must be considered only for resources meeting the criteria for eligibility to the California Register of Historical Resources, outlined in Section 5024.1 of the California Public Resources Code. Demolition, replacement, substantial alteration, or relocation of an eligible resource are all actions that could change those elements of the resource which make it eligible. The following significance criteria were developed based on guidance provided by the State CEQA Guidelines, and consider the context and intensity of the environmental effects as required under NEPA. Under the State CEQA Guidelines, impacts on cultural resources may be considered significant if a project alternative would result in any of the following:

- Cause a substantial adverse change in the significance of a historical resource, as defined in Guidelines Section 15064.5
- Cause a substantial adverse change in the significance of an archaeological resource pursuant to Guidelines Section 15064.5

- Disturb human remains, including those interred outside formal cemeteries

According to the above criteria, the project would be considered to have a significant impact on cultural resources if it would result in any of the following:

- Substantial adverse change in the significance of an historical resource
- Substantial adverse change in the significance of a unique archaeological resource
- Disturbance or destruction of unique paleontological resource or site or unique geologic feature
- Disturbance of any human remains, including those interred outside of formal cemeteries
- Elimination of important examples of the major periods of California history or prehistory

Statements of impact significance are relative to both existing conditions (Year 2005) and future conditions (Year 2030), unless stated otherwise. Only those elements of a resource which contribute to its eligibility need to be considered; effects to noncontributing elements are less than significant.

14.3.3 Direct and Indirect Effects

This section describes the environmental consequences of the SLWRI alternatives, and proposed mitigation measures for any impacts determined to be significant or potentially significant.

No-Action Alternative

Dam construction, infrastructure and facilities relocation, additional reservoir area inundation, and construction activities adjacent to the upper Sacramento River would not occur under the No-Action Alternative. Therefore, no additional traditional cultural properties or areas of concern above the current reservoir level would be impacted, and conditions would be the same as existing.

Shasta Lake and Vicinity

Impact Culture-1 (No-Action): Disturbance or Destruction of Archaeological and Historical Resources Due to Construction or Inundation Archaeological sites (as well as historic cemetery locations) within the existing Shasta Lake fluctuation zone will continue to be impacted by fluctuations in the height of the reservoir during ongoing operations with the No-Action Alternative. As stated above, dam construction, infrastructure and facilities relocation, and additional reservoir area inundation would not occur under the No-Action Alternative;

therefore, no impacts on cultural resources related to construction or inundation are expected. Mitigation is not required for the No-Action Alternative.

Impact Culture-2 (No-Action): Inundation of Traditional Cultural Properties and Sacred Sites Traditional cultural properties and sacred sites within the existing Shasta Lake fluctuation zone will continue to be impacted by fluctuations in the height of the reservoir during ongoing operations with the No-Action Alternative. As stated above, additional reservoir area inundation would not occur under the No-Action Alternative; therefore, no impacts on cultural resources related to inundation are expected. Mitigation is not required for the No-Action Alternative.

Upper Sacramento River (Shasta Dam to Red Bluff)

Impact Culture-3 (No-Action): Disturbance or Destruction of Archaeological and Historical Resources near the Upper Sacramento River Due to Construction Archaeological sites (as well as historic cemetery locations) in or near the upper Sacramento River will continue to be impacted by water operations with the No-Action Alternative. As stated above, construction activities adjacent to the upper Sacramento River would not occur under the No-Action Alternative; therefore, no impacts on cultural resources related to construction are expected. Mitigation is not required for the No-Action Alternative.

CP1 – 6.5-Foot Dam Raise, Anadromous Fish Survival and Water Supply Reliability

Cultural resources potentially impacted by this alternative include those within: (1) the proposed additional 1,229-acre inundation area; (2) the portion of the proposed fluctuation zone for this alternative within the existing reservoir area; and (3) those portions of the 0.25-mile buffer around the reservoir where infrastructure would need to be relocated (recreation facilities, roads, utilities, trails, etc.). It should be noted that sites typically extend into the inundation and reservoir area for more than one alternative.

Shasta Lake and Vicinity

Impact Culture-1 (CP1): Disturbance or Destruction of Archaeological and Historical Resources Due to Construction or Inundation Raising Shasta Dam would have a direct impact on cultural resources. This impact would be significant. Sensitivity studies estimate that, with complete surveys, impacts associated with CP1 inundation and areas would include approximately 212±54 prehistoric resources (Table 14-1). The historic-era archival study documented 355 localities that may potentially contain historic-era remains within this inundation area.

Sensitivity studies estimate that, with complete surveys, the CP1 fluctuation zone would include approximately 675±172 prehistoric resources. The historic-era archival study documented 529 localities that may potentially contain historic-era remains.

Table 14-1. Cultural Resources Impacts for CP1

Inundation Area	
Prehistoric sites	212±54
Historic-era archival localities	355
Fluctuation Zone	
Prehistoric sites	675±172
Historic-era archival localities	529
0.25-Mile Buffer	
All cultural resources	Fewer than CP2

Note:
Mean prehistoric site estimates are based on weights-of-evidence quantitative analysis.
An undetermined number of sites will actually be subject to mitigation under NHPA Sec 106.

Sensitivity studies estimate that with complete surveys, the ¼-mile buffer area for CP1 would include approximately 728±212 prehistoric resources. The historic-era archival study documented 773 localities that may potentially contain historic-era remains. Although the full extent and locations of project impacts within the buffer zone related to construction are not yet available for CP1, impacts would occur within only a small percentage of the overall buffer zone concentrated near the reservoir.

Although it is impossible at this stage to say how many of these resources will be determined eligible for listing under NHPA, and how many of the eligible resources will sustain adverse impacts from this alternative, this impact would be significant. Mitigation for this impact is proposed in Section 14.3.1.

Impact Culture-2 (CP1): Inundation of Traditional Cultural Properties and Sacred Sites This impact would be significant and unavoidable. Due to the confidential nature of sacred land filings, it is unknown whether these locations are situated within the study area. Several tribal groups have identified traditional cultural properties and sacred sites that would be adversely impacted by CP1.

The NAHC identified sacred land filings within the study area. These locations are confidential, thus making it unclear whether or not they are situated within the CP1 area.

Two particularly important Winnemem Wintu locations that would be impacted by CP1 include Puberty Rock and the doctoring pools near Nawtawaket Creek. CP1 could submerge Puberty Rock, restricting the Winnemem Wintu from holding the puberty ceremony at this important location. Although Puberty Rock would still be accessible for portions of the year, when lake levels are lower, CP1 would increase the frequency of inundation. The relocation of the rock to higher ground is not possible, as, in the Winnemem worldview, its location is preordained and connected with the nearby “two sisters” mountain (Bollibokka Mountain). Puberty Rock also marks the location of an extensive village with housepits and burials. CP1 would inundate additional burials at this

location, which would require removal and relocation. The Winnemem Wintu have estimated that 120 ancestral villages still accessible above the current high waterline of Shasta Lake would be adversely impacted by CP1.

The Pit River Madesi Band members state that 22 ethnographic villages, associated burial grounds, and several TCPs are located within the existing reservoir and proposed inundation or fluctuation areas.

The local Native American community has identified several locations in the study area that they consider to be sacred; notable among these are Puberty Rock and the doctoring pools near Nawtawaket Creek. Inundation or other adverse impacts to these places likely cannot be mitigated because the importance of the identified properties and sacred sites is inextricably tied to physical location, and relocation of these features away from the inundation area is not possible.

Although it is impossible at this stage to say how many of these resources will be adversely impacted due to inundation as a result of implementing CP1, this impact would be significant and unavoidable. Mitigation for this impact is not available.

Upper Sacramento River (Shasta Dam to Red Bluff)
Impact Culture-3 (CP1): Disturbance or Destruction of Archaeological and Historical Resources near the Upper Sacramento River Due to Construction
Construction activities adjacent to the upper Sacramento River associated with downstream ecosystem enhancements would not occur under CP1; therefore, no impacts on cultural resources related to construction are expected. Mitigation for this impact is not needed, and thus not proposed.

CP2 – 12.5-Foot Dam Raise, Anadromous Fish Survival and Water Supply Reliability

Cultural resources potentially impacted by this alternative include those within (1) the proposed additional 1,734-acre inundation area, (2) the portion of the proposed fluctuation zone for this alternative within the existing reservoir area, and (3) those portions of the 0.25-mile buffer around the reservoir where infrastructure would need to be relocated (recreation facilities, roads, utilities, trails, etc.).

Shasta Lake and Vicinity
Impact Culture-1 (CP2): Disturbance or Destruction of Archaeological and Historical Resources Due to Construction or Inundation Raising Shasta Dam would have a direct impact on cultural resources. This impact would be significant. Sensitivity studies estimate that, with complete surveys, inundation associated with CP2 would include approximately 224±57 prehistoric resources (Table 14-2). The historic-era archival study documented 371 localities that may potentially contain historic-era remains within this inundation area.

Table 14-2. Cultural Resources Impacts for CP2

Inundation Area	
Prehistoric sites	224±57
Historic-era archival localities	371
Fluctuation Zone	
Prehistoric sites	675±172
Historic-era archival localities	529
0.25-Mile Buffer	
All cultural resources	Fewer than CP3

Note:
Mean prehistoric site estimates are based on weights-of-evidence quantitative analysis.
An undetermined number of sites will actually be subject to mitigation under NHPA Sec. 106.

Sensitivity studies estimate that, with complete surveys, the fluctuation zone for CP2 would include approximately 675±172 prehistoric resources. The historic-era archival study documented 529 localities that may potentially contain historic-era remains.

Sensitivity studies estimate that, with complete surveys, the 0.25-mile buffer zone for CP2 would include approximately 728±212 prehistoric resources. The historic-era archival study documented 773 localities that may potentially contain historic-era remains. Although the full extent and locations of project impacts related to construction activities within the buffer zone are not yet available for this alternative, they would occur within only a small percentage of the overall buffer zone concentrated near the reservoir.

Although it is impossible at this stage to say how many of these resources will be determined eligible, and how many of the eligible resources will sustain adverse impacts from CP2, this impact would be significant. Inundation or other adverse impacts to affected resources likely cannot be mitigated because the importance of the identified properties and sacred sites is inextricably tied to physical location, and relocation of these features away from the inundation area is not possible. Mitigation for this impact is proposed in Section 14.3.1.

Impact Culture-2 (CP2): Inundation of Traditional Cultural Properties and Sacred Sites Alternative CP2 is similar to Alternative CP1 with respect to its potential to cause or be affected by inundation. The NAHC identified sacred land filings within the study area. These locations are confidential, thus making it unclear whether or not they are situated within the CP2 area. For the same reasons that apply to CP1, this impact would be significant and unavoidable. Mitigation for this impact is not available.

Upper Sacramento River (Shasta Dam to Red Bluff)
Impact Culture-3 (CP2): Disturbance or Destruction of Archaeological and Historical Resources near the Upper Sacramento River Due to Construction
Construction activities adjacent to the upper Sacramento River associated with downstream ecosystem enhancements would not occur under CP2; therefore, no

impacts on cultural resources related to construction are expected. Mitigation for this impact is not needed, and thus not proposed.

CP3 – 18.5-Foot Dam Raise, Anadromous Fish Survival and Water Supply Reliability

Cultural resources potentially impacted by this alternative include those within (1) the proposed additional 2,497-acre inundation area, (2) the portion of the proposed fluctuation zone for this alternative within the existing reservoir area, and (3) those portions of the 0.25-mile buffer around the reservoir where infrastructure would need to be relocated (recreation facilities, roads, utilities, trails, etc.).

Shasta Lake and Vicinity

Impact Culture-1 (CP3): Disturbance or Destruction of Archaeological and Historical Resources Due to Construction or Inundation Raising Shasta Dam would have a direct impact on cultural resources. This impact would be significant. Sensitivity studies estimate that, with complete surveys, inundation associated with CP3 would include approximately 243±63 prehistoric resources (Table 14-3). The historic-era archival study documented 391 localities that may potentially contain historic-era remains within this inundation area.

Table 14-3. Cultural Resources Impacts for CP3

Inundation Area	
Prehistoric sites	243±63
Historic-era archival localities	391
Fluctuation Zone	
Prehistoric sites	675±172
Historic-era archival localities	529
0.25-Mile Buffer	
All cultural resources	Fewer than CP5, same as CP4

Note:
Mean prehistoric site estimates are based on weights-of-evidence quantitative analysis.
An undetermined number of sites will actually be subject to mitigation under NHPA Sec. 106.

Sensitivity studies estimate that, with complete surveys, the fluctuation zone for CP3 would include approximately 675±172 prehistoric resources. The historic-era archival study documented 529 localities that may potentially contain historic-era remains.

Sensitivity studies estimate that, with complete surveys, the 0.25-mile buffer zone for CP3 would include approximately 728±212 prehistoric resources. The historic-era archival study documented 773 localities that may contain historic-era remains. Although the full extent and locations of project impacts related to construction activities within the buffer zone are not yet available for this alternative, they would occur within only a small percentage of the overall buffer zone concentrated near the reservoir.

Although it is impossible at this stage to say how many of these resources will be determined eligible, and how many of the eligible resources will sustain adverse impacts from CP3, this impact would be significant. Inundation or other adverse impacts to affected resources likely cannot be mitigated because the importance of the identified properties and sacred sites is inextricably tied to physical location, and relocation of these features away from the inundation area is not possible. Mitigation for this impact is proposed in Section 14.3.1.

Impact Culture-2 (CP3): Inundation of Traditional Cultural Properties and Sacred Sites Alternative CP3 is similar to Alternative CP1 with respect to its potential to cause or be affected by inundation. The NAHC identified sacred land filings within the study area. These locations are confidential, thus making it unclear whether or not they are situated within the CP3 area. For the same reasons that apply to CP1, this impact would be significant and unavoidable. Mitigation for this impact is not available.

Upper Sacramento River (Shasta Dam to Red Bluff)

Impact Culture-3 (CP3): Disturbance or Destruction of Archaeological and Historical Resources near the Upper Sacramento River Due to Construction Construction activities adjacent to the upper Sacramento River associated with downstream ecosystem enhancements would not occur under CP3; therefore, no impacts on cultural resources related to construction are expected. Mitigation for this impact is not needed, and thus not proposed.

CP4 – 18.5-Foot Dam Raise, Anadromous Fish Focus With Water Supply Reliability

Cultural resources potentially impacted by this alternative include those within (1) the proposed additional 2,497-acre inundation area, (2) the portion of the proposed fluctuation zone for this alternative within the existing reservoir area, and (3) those portions of the 0.25-mile buffer around the reservoir where infrastructure would need to be relocated (recreation facilities, roads, utilities, trails, etc.). CP4 also includes downstream ecosystem enhancements with spawning gravel augmentation and floodplain and riparian habitat restoration, both of which would entail construction activities adjacent to the upper Sacramento River.

Shasta Lake and Vicinity

Impact Culture-1 (CP4): Disturbance or Destruction of Archaeological and Historical Resources Due to Construction or Inundation Raising Shasta Dam would have a direct impact on cultural resources. This impact would be significant. Sensitivity studies estimate that with complete surveys, inundation associated with CP4 would include approximately 243±63 prehistoric resources (Table 14-4). The historic-era archival study documented 391 localities that may potentially contain historic-era remains within this inundation area.

Table 14-4. Cultural Resources Impacts for CP4

Inundation Area	
Prehistoric sites	243±63
Historic-era archival localities	391
Fluctuation Zone	
Prehistoric sites	601±154
Historic-era archival localities	524
0.25-Mile Buffer	
All cultural resources	Fewer than CP5, same as CP3

Note:
Mean prehistoric site estimates are based on weights-of-evidence quantitative analysis.
An undetermined number of sites will actually be subject to mitigation under NHPA Sec. 106.

Sensitivity studies estimate that, with complete surveys, the fluctuation zone for CP4 would include approximately 601±154 prehistoric resources. The historic-era archival study documented 524 localities that may potentially contain historic-era remains.

Sensitivity studies estimate that, with complete surveys, the 0.25-mile buffer zone for CP4 would include approximately 728±212 prehistoric resources. The historic-era archival study documented 773 localities that may potentially contain historic-era remains. Although the full extent and locations of project impacts related to construction activities within the buffer zone are not yet available for this alternative, they would occur within only a small percentage of the overall buffer zone concentrated near the reservoir.

Although it is impossible at this stage to say how many of these resources will be determined eligible, and how many of the eligible resources will sustain adverse impacts from CP4, this impact would be significant. Inundation or other adverse impacts to affected resources likely cannot be mitigated because the importance of the identified properties and sacred sites is inextricably tied to physical location, and relocation of these features away from the inundation area is not possible. Mitigation for this impact is proposed in Section 14.3.1.

Impact Culture-2 (CP4): Inundation of Traditional Cultural Properties and Sacred Sites Alternative CP4 is similar to Alternative CP1 with respect to its potential to cause or be affected by inundation. The NAHC identified sacred land filings within the study area. These locations are confidential, thus making it unclear whether or not they are situated within the CP4 area. For the same reasons that apply to CP1, this impact would be significant and unavoidable. Mitigation for this impact is not available.

Upper Sacramento River (Shasta Dam to Red Bluff)
Impact Culture-3 (CP4): Disturbance or Destruction of Archaeological and Historical Resources near the Upper Sacramento River Due to Construction This impact would be significant. Previous cultural resource studies indicated the presence of cultural resources in or near proposed downstream construction

areas related to spawning gravel augmentation and floodplain and riparian habitat restoration.

A total of 17 cultural resources have been recorded within the records search areas, consisting of eight prehistoric sites, six historic-era resources, and three resources with prehistoric and historic-era components. As mapped, thirteen of these cultural resources exist only in the 1/8-mile buffer areas, and only four of these cultural resources extend into proposed construction areas. It should be noted that the proposed construction areas are concept-level and may be relocated or deleted as a result of design development, consultation, or other factors.

Although it is impossible at this stage to say how many eligible resources will sustain adverse impacts from CP4, this impact would be significant. Mitigation for this impact is proposed in Section 14.3.1.

CP5 – 18.5-Foot Dam Raise, Combination Plan

Cultural resources potentially impacted by this alternative include those within (1) the proposed additional 2,497-acre inundation area, (2) the portion of the proposed fluctuation zone for this alternative within the existing reservoir area, and (3) those portions of the 0.25-mile buffer around the reservoir where infrastructure would need to be relocated (recreation facilities, roads, utilities, trails, etc.). CP5 also includes downstream ecosystem enhancements with spawning gravel augmentation and floodplain and riparian habitat restoration, both of which would entail construction activities adjacent to the upper Sacramento River.

Shasta Lake and Vicinity

Impact Culture-1 (CP5): Disturbance or Destruction of Archaeological and Historical Resources Due to Construction or Inundation Raising Shasta Dam would have a direct impact on cultural resources. This impact would be significant. Sensitivity studies estimate that, with complete surveys, inundation associated with CP5 would include approximately 243±63 prehistoric resources (Table 14-5). The historic-era archival study documented 391 localities that may potentially contain historic-era remains within this inundation area.

Sensitivity studies estimate that, with complete surveys, the fluctuation zone for CP5 would include approximately 675±172 prehistoric resources. The historic-era archival study documented 529 localities that may potentially contain historic-era remains.

Table 14-5. Cultural Resources Impacts for CP5

Inundation Area	
Prehistoric sites	243±63
Historic-era archival localities	391
Fluctuation Zone	
Prehistoric sites	675±175
Historic-era archival localities	529
0.25-Mile Buffer	
All cultural resources	Largest quantity

Note:
Mean prehistoric site estimates are based on weights-of-evidence quantitative analysis.
An undetermined number of sites will actually be subject to mitigation under NHPA Sec. 106.

Sensitivity studies estimate that, with complete surveys, the 0.25-mile buffer zone for CP5 would include approximately 728±212 prehistoric resources. The historic-era archival study documented 773 localities that may potentially contain historic-era remains. Although the full extent and locations of project impacts related to construction activities within the buffer zone are not yet available for this alternative, they would occur within only a small percentage of the overall buffer zone concentrated near the reservoir.

Although it is impossible at this stage to say how many of these resources will be determined eligible, and how many of the eligible resources will sustain adverse impacts from CP5, this impact would be significant. Inundation or other adverse impacts to affected resources likely cannot be mitigated because the importance of the identified properties and sacred sites is inextricably tied to physical location, and relocation of these features away from the inundation area is not possible. Mitigation for this impact is proposed in Section 14.3.1.

Impact Culture-2 (CP5): Inundation of Traditional Cultural Properties of Native American Concern Alternative CP5 is similar to Alternative CP1 with respect to its potential to cause or be affected by inundation. The NAHC identified sacred land filings within the study area. These locations are confidential, thus making it unclear whether or not they are situated within the CP5 area. For the same reasons that apply to CP1, this impact would be significant and unavoidable. Mitigation for this impact is not available.

Upper Sacramento River (Shasta Dam to Red Bluff)
Impact Culture-3 (CP5): Disturbance or Destruction of Archaeological and Historical Resources near the Upper Sacramento River Due to Construction This impact would be significant. Previous cultural resource studies indicated the presence of cultural resources in or near in proposed downstream construction areas related to spawning gravel augmentation and floodplain and riparian habitat restoration.

A total of 17 cultural resources have been recorded within the records search areas, consisting of eight prehistoric sites, six historic-era resources, and three

resources with prehistoric and historic-era components. As mapped, thirteen of these cultural resources exist only in the 1/8-mile buffer areas, and only four of these cultural resources extend into proposed construction areas. It should be noted that the proposed construction areas are concept-level and may be relocated or deleted as a result of design development, consultation, or other factors.

Although it is impossible at this stage to say how many eligible resources will sustain adverse impacts from CP5, this impact would be significant. Mitigation for this impact is proposed in Section 14.3.1.

14.3.4 Mitigation Measures

This section discusses mitigation measures for each significant impact described in the environmental consequences section, as presented in Table 14-6.

Table 14-6. Summary of Mitigation Measures for Cultural Resources

Impact		No-Action Alternative	CP1	CP2	CP3	CP4	CP5
Impact Culture-1: Disturbance or Destruction of Archaeological and Historical Resources Due to Construction or Inundation	LOS before Mitigation	NI	S	S	S	S	S
	Mitigation Measure	None required.	Mitigation Measure Culture-1: Comply with Section 106 of the NHPA.				
	LOS after Mitigation	NI	LTS	LTS	LTS	LTS	LTS
Impact Culture-2: Inundation of Traditional Cultural Properties and Sacred Sites	LOS before Mitigation	NI	SU	SU	SU	SU	SU
	Mitigation Measure	None required.	None available.				
	LOS after Mitigation	NI	SU	SU	SU	SU	SU
Impact Culture-3: Disturbance or Destruction of Archaeological and Historical Resources near the Upper Sacramento River Due to Construction	LOS before Mitigation	NI	NI	NI	NI	S	S
	Mitigation Measure	None required.	No mitigation needed; thus, none proposed.			Mitigation Measure Culture-3: Implement Mitigation Measure Culture-1: Comply with Section 106 of the NHPA.	
	LOS after Mitigation	NI	NI	NI	NI	LTS	LTS

Key:
LOS = level of significance
LTS = less than significant
NHPA = National Historic Preservation Act
NI = No Impact
S = significant
SU = significant and unavoidable

No-Action Alternative

No mitigation measures are required for this alternative.

CP1 – 6.5-Foot Dam Raise, Anadromous Fish Survival and Water Supply Reliability

As this alternative is likely to cause significant, adverse impacts to historic properties, it will be necessary to mitigate those impacts.

Mitigation Measure Culture-1 (CP1): Comply with Section 106 of the NHPA Process Reclamation is committed to and will comply with the Federal NHPA Section 106 consultation process to avoid, minimize, or mitigate any significant, adverse impacts to cultural resources and historic properties due to CP1, to the extent possible. The following measures, consisting of inventory, evaluation, and treatment processes, would be conducted by Reclamation as part of the environmental reviews to ensure compliance with Section 106 of the NHPA. Coordination will continue with the relevant Native American tribes and other interested parties in the area. The mitigation measures that would reduce the impacts of the site-specific studies to less than significant levels are:

- **Conduct Class III cultural resources surveys of portions of the project APE that have not been surveyed** – Before any ground disturbance takes place in the project area (including areas of ancillary activities, such as staging areas and access routes), Class III cultural resource surveys covering the APE would be conducted to locate and record cultural resources. Where appropriate, subsurface discovery efforts also would be undertaken to identify buried archaeological sites.

- **Plan activities to avoid known cultural resources** – Before carrying out ground-disturbing activities, areas that have been delineated as containing cultural resources would be demarcated, and all ground-disturbing or related activities would be planned to avoid these areas.

- **Evaluate significance of resources that cannot be avoided** – If cultural resources cannot be avoided through careful planning of the activities associated with an alternative, additional research or test excavation (as appropriate) would be undertaken to determine whether the resources meet NRHP and/or CEQA significance criteria.

- **Develop treatment process to mitigate effects of project upon significant resources** – Impacts on significant resources that cannot be avoided would be mitigated in a manner that is deemed appropriate for the particular resources. Mitigation for significant resources may include, but would not be limited to, data recovery, public interpretation, performance of a Historic American Building Survey or Historic American Engineering Record, or preservation by other means.

These impacts would be less than significant after mitigation. It is possible, however, that adverse impacts to traditional cultural properties likely cannot be mitigated. Therefore, these impacts are potentially significant and unavoidable.

CP2 – 12.5-Foot Dam Raise, Anadromous Fish Survival and Water Supply Reliability

As this alternative is likely to cause significant, adverse impacts to historic properties, it will be necessary to mitigate those impacts.

Mitigation Measure Culture-1 (CP2): Comply with Section 106 of the NHPA Reclamation is committed to and will comply with the Federal NHPA Section 106 consultation process to avoid, minimize, or mitigate any significant, adverse impacts to cultural resources and historic properties due to CP2, to the extent possible. The following measures, consisting of inventory, evaluation, and treatment processes, would be conducted by Reclamation as part of the environmental reviews to ensure compliance with Section 106 of the NHPA. Coordination will continue with the relevant Native American tribes and other interested parties in the area. The mitigation measures that would reduce the impacts of the site-specific studies to less than significant levels are:

- **Conduct Class III cultural resources surveys of portions of the project APE that have not been surveyed** – Before any ground disturbance takes place in the project area (including areas of ancillary activities, such as staging areas and access routes), Class III cultural resource surveys covering the APE would be conducted to locate and record cultural resources. Where appropriate, subsurface discovery efforts also would be undertaken to identify buried archaeological sites.

- **Plan activities to avoid known cultural resources** – Before carrying out ground-disturbing activities, areas that have been delineated as containing cultural resources would be demarcated, and all ground-disturbing or related activities would be planned to avoid these areas.

- **Evaluate significance of resources that cannot be avoided** – If cultural resources cannot be avoided through careful planning of the activities associated with an alternative, additional research or test excavation (as appropriate) would be undertaken to determine whether the resources meet NRHP and/or CEQA significance criteria.

- **Develop treatment process to mitigate effects of project upon significant resources** – Impacts on significant resources that cannot be avoided would be mitigated in a manner that is deemed appropriate for the particular resources. Mitigation for significant resources may include, but would not be limited to, data recovery, public interpretation, performance of a Historic American Building Survey or Historic American Engineering Record, or preservation by other means.

These impacts would be less than significant after mitigation. It is possible, however, that adverse impacts to traditional cultural properties likely cannot be mitigated. Therefore, these impacts are potentially significant and unavoidable.

CP3 – 18.5-Foot Dam Raise, Anadromous Fish Survival and Water Supply Reliability

As this alternative is likely to cause significant, adverse impacts to historic properties, it will be necessary to mitigate those impacts.

Mitigation Measure Culture-1 (CP3): Comply with Section 106 of the NHPA Reclamation is committed to and will comply with the Federal NHPA Section 106 consultation process to avoid, minimize, or mitigate any significant, adverse impacts to cultural resources and historic properties due to CP3 to the extent possible. The following measures, consisting of inventory, evaluation, and treatment processes, would be conducted by Reclamation as part of the environmental reviews to ensure compliance with Section 106 of the NHPA. Coordination will continue with the relevant Native American tribes and other interested parties in the area. The mitigation measures that would reduce the impacts of the site-specific studies to less than significant levels are:

- **Conduct Class III cultural resources surveys of portions of the project APE that have not been surveyed** – Before any ground disturbance takes place in the project area (including areas of ancillary activities, such as staging areas and access routes), Class III cultural resource surveys covering the APE would be conducted to locate and record cultural resources. Where appropriate, subsurface discovery efforts also would be undertaken to identify buried archaeological sites.

- **Plan activities to avoid known cultural resources** – Before carrying out ground-disturbing activities, areas that have been delineated as containing cultural resources would be demarcated, and all ground-disturbing or related activities would be planned to avoid these areas.

- **Evaluate significance of resources that cannot be avoided** – If cultural resources cannot be avoided through careful planning of the activities associated with an alternative, additional research or test excavation (as appropriate) would be undertaken to determine whether the resources meet NRHP and/or CEQA significance criteria.

- **Develop treatment process to mitigate effects of project upon significant resources** – Impacts on significant resources that cannot be avoided would be mitigated in a manner that is deemed appropriate for the particular resources. Mitigation for significant resources may include, but would not be limited to, data recovery, public interpretation, performance of a Historic American Building Survey or Historic American Engineering Record, or preservation by other means.

These impacts would be less than significant after mitigation. It is possible, however, that adverse impacts to traditional cultural properties likely cannot be mitigated. Therefore, these impacts are potentially significant and unavoidable.

CP4 – 18.5-Foot Dam Raise, Anadromous Fish Focus With Water Supply Reliability

As this alternative is likely to cause significant, adverse impacts to historic properties, it will be necessary to mitigate those impacts.

Mitigation Measure Culture-1 (CP4): Comply with Section 106 of the NHPA Reclamation is committed to and will comply with the Federal NHPA Section 106 consultation process to avoid, minimize, or mitigate any significant, adverse impacts to cultural resources and historic properties due to CP4 to the extent possible. The following measures, consisting of inventory, evaluation, and treatment processes, would be conducted by Reclamation as part of the environmental reviews to ensure compliance with Section 106 of the NHPA. Coordination will continue with the relevant Native American tribes and other interested parties in the area. The mitigation measures that would reduce the impacts of the site-specific studies to less than significant levels are:

- **Conduct Class III cultural resources surveys of portions of the project APE that have not been surveyed** – Before any ground disturbance takes place in the project area (including areas of ancillary activities, such as staging areas and access routes), Class III cultural resource surveys covering the APE would be conducted to locate and record cultural resources. Where appropriate, subsurface discovery efforts also would be undertaken to identify buried archaeological sites.

- **Plan activities to avoid known cultural resources** – Before carrying out ground-disturbing activities, areas that have been delineated as containing cultural resources would be demarcated, and all ground-disturbing or related activities would be planned to avoid these areas.

- **Evaluate significance of resources that cannot be avoided** – If cultural resources cannot be avoided through careful planning of the activities associated with an alternative, additional research or test excavation (as appropriate) would be undertaken to determine whether the resources meet NRHP and/or CEQA significance criteria.

- **Develop treatment process to mitigate effects of project upon significant resources** – Impacts on significant resources that cannot be avoided would be mitigated in a manner that is deemed appropriate for the particular resources. Mitigation for significant resources may include, but would not be limited to, data recovery, public interpretation, performance of a Historic American Building Survey or Historic American Engineering Record, or preservation by other means.

These impacts would be less than significant after mitigation. It is possible, however, that adverse impacts to traditional cultural properties likely cannot be mitigated. Therefore, these impacts are potentially significant and unavoidable.

Mitigation Measure Culture-3 (CP4): Implement Mitigation Measure Culture-1 (CP4): Comply with Section 106 of the NHPA This mitigation measure is the same as Mitigation Measure Culture-1 (CP4). Implementation of mitigation measure Culture-1 would reduce Impact Culture-3 (CP4) to a less than significant level.

CP5 – 18.5-Foot Dam Raise, Combination Plan

As this alternative is likely to cause significant, adverse impacts to historic properties, it will be necessary to mitigate those impacts.

Mitigation Measure Culture-1 (CP5): Comply with Section 106 of the NHPA Reclamation is committed to and will comply with the Federal NHPA Section 106 consultation process to avoid, minimize, or mitigate any significant, adverse impacts to cultural resources and historic properties due to CP5 to the extent possible. The following measures, consisting of inventory, evaluation, and treatment processes, would be conducted by Reclamation as part of the environmental reviews to ensure compliance with Section 106 of the NHPA. Coordination will continue with the relevant Native American tribes and other interested parties in the area. The mitigation measures that would reduce the impacts of the site-specific studies to less than significant levels are:

- **Conduct Class III cultural resources surveys of portions of the project APE that have not been surveyed** – Before any ground disturbance takes place in the project area (including areas of ancillary activities, such as staging areas and access routes), Class III cultural resource surveys covering the APE would be conducted to locate and record cultural resources. Where appropriate, subsurface discovery efforts also would be undertaken to identify buried archaeological sites.

- **Plan activities to avoid known cultural resources** – Before carrying out ground-disturbing activities, areas that have been delineated as containing cultural resources would be demarcated, and all ground-disturbing or related activities would be planned to avoid these areas.

- **Evaluate significance of resources that cannot be avoided** – If cultural resources cannot be avoided through careful planning of the activities associated with an alternative, additional research or test excavation (as appropriate) would be undertaken to determine whether the resources meet NRHP and/or CEQA significance criteria.

- **Develop treatment process to mitigate effects of project upon significant resources** – Impacts on significant resources that cannot be avoided would be mitigated in a manner that is deemed appropriate for

the particular resources. Mitigation for significant resources may include, but would not be limited to, data recovery, public interpretation, performance of a Historic American Building Survey or Historic American Engineering Record, or preservation by other means.

These impacts would be less than significant after mitigation. It is possible, however, that adverse impacts to traditional cultural properties likely cannot be mitigated. Therefore, these impacts are potentially significant and unavoidable.

Mitigation Measure Culture-3 (CP5): Implement Mitigation Measure Culture 1 (CP5): Comply with Section 106 of the NHPA This mitigation measure is the same as Mitigation Measure Culture-1 (CP5). Implementation of mitigation measure Culture-1 would reduce Impact Culture-3 (CP5) to a less than significant level.

14.3.5 Cumulative Effects

It is not possible to predict all future impacts to cultural resources within the study area. However, given the large number of archaeological sites and Native American sacred areas (villages, cemeteries, and ceremonial places) that have already been inundated by the reservoir, it is likely that raising Shasta Dam by any height would have a significant cumulative effect to resources in the study area.

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Chapter 15
Indian Trust Assets

15.1 Affected Environment

This section describes the affected environment related to Indian Trust Assets (ITA) for the proposed dam and reservoir modifications at Shasta Lake.

The affected environment for ITAs is the primary study area, within which all construction activities will take place, and which includes Shasta Lake's expanded inundation area, relocations within approximately 0.25 miles of the shoreline, and the upper Sacramento River from Shasta Dam to the Red Bluff Diversion Dam.

The extended study area would only be affected by changes in CVP and SWP operations, and includes the Sacramento River to the Delta and the CVP and SWP water service areas. For additional details on the primary and extended study areas, please refer to Section 1.3 and Figures 1-1 and 1-2 of the PDEIS. The action alternatives are not anticipated to have impacts on ITAs as a result of changes in CVP and SWP operations; therefore, the extended study area was not evaluated for ITAs.

Indian Trust Lands in the region around the primary study area are shown in Figure 15-1.

Several Federally recognized tribes are located in the region surrounding the primary study area (Table 15-1).

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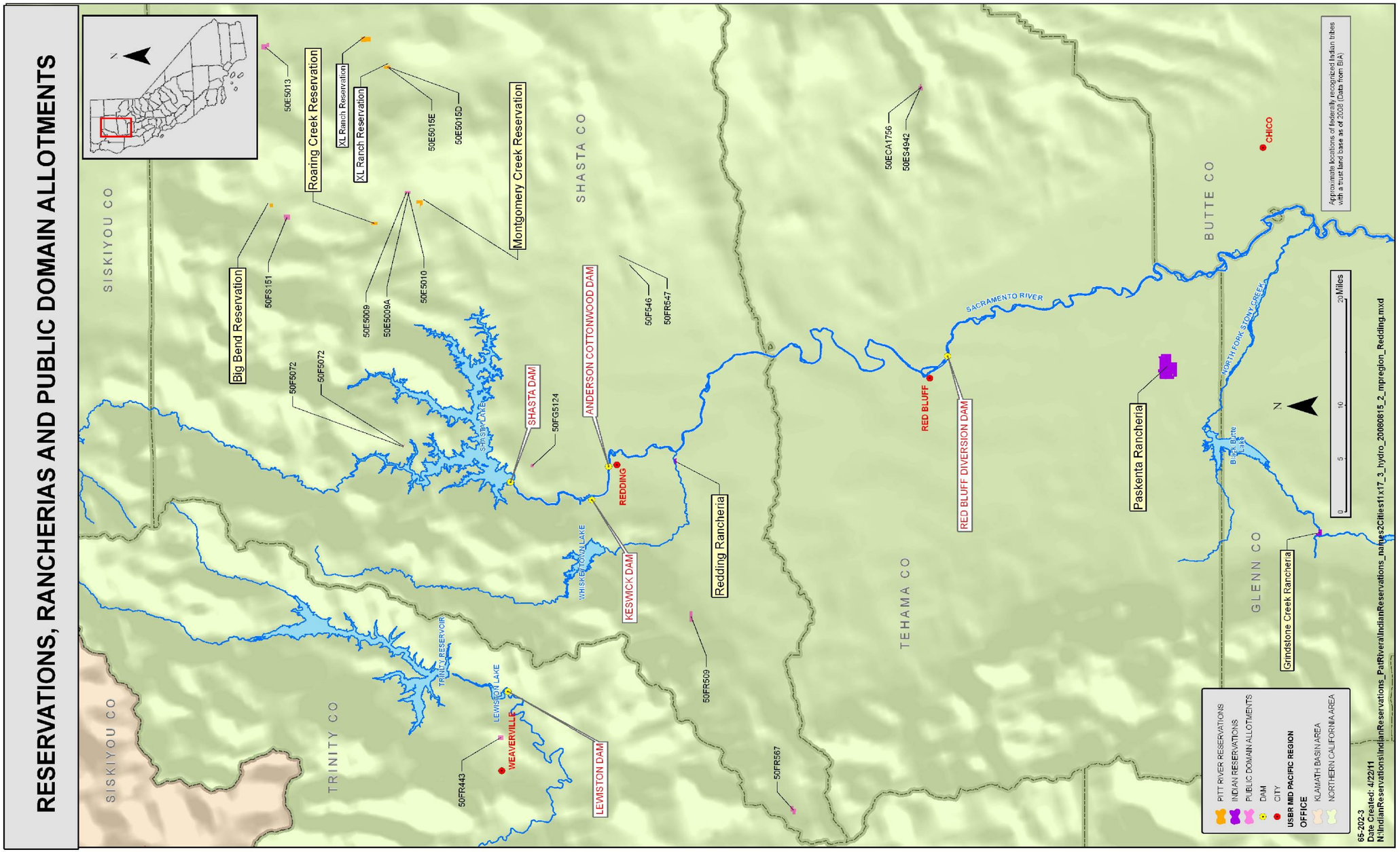


Figure 15-1. Reservations, Rancherias and Public Domain Allotments in Primary Study Area

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Table 15-1. Federally Recognized Tribes in Region Surrounding Primary Study Area

Tribe	Affiliation
Grindstone Indian Rancheria of Wintun- Wailaki Indians	Wintun, Wailaki
Paskenta Band of Nomlaki Indians	Nomlaki
Pit River Tribe Environmental Office	Pit River, Wintun
Pit River Tribe	Pit River Achumawi Wintun
Redding Rancheria	Wintu, Pit River, Yana

15.2 Regulatory Framework

ITAs are legal interests in property held in trust by the U.S. for Federally recognized Indian tribes or individual Indians. An Indian trust has three components: (1) the trustee, (2) the beneficiary, and (3) the trust asset. ITAs can include land, minerals, Federally reserved hunting and fishing rights, Federally reserved water rights, and in-stream flows associated with trust land. Beneficiaries of the Indian trust relationship are Federally recognized Indian tribes with trust land; the United States is the trustee. By definition, ITAs cannot be sold, leased, or otherwise encumbered without approval of the United States. The characterization and application of the United States trust relationship have been defined by case law that interprets Congressional acts, executive orders, and historic treaty provisions.

The Federal Government, through treaty, statute, or regulation, may take on specific, enforceable fiduciary obligations that give rise to a trust responsibility to Federally recognized tribes and individual Indians possessing trust assets. Courts have recognized an enforceable Federal fiduciary duty with respect to Federal supervision of Indian money or natural resources, held in trust by the Federal Government, where specific treaties, statutes, or regulations create such a fiduciary duty.

Consistent with President William J. Clinton's 1994 memorandum, *Government-to-Government Relations with Native American Tribal Governments* (Federal Register, Vol. 59, No. 85, May 4, 1994, pages 22951–22952), Reclamation assesses the effect of its programs on tribal trust resources and Federally recognized tribal governments. Reclamation is tasked to actively engage Federally recognized tribal governments and consult with such tribes on government-to-government level when its actions affect ITAs. The U.S. Department of the Interior Departmental Manual, Part 512.2 (1995), ascribes the responsibility for ensuring protection of ITAs to the heads of bureaus and offices. The Department of the Interior is required to "protect and preserve Indian trust assets from loss, damage, unlawful alienation, waste, and depletion"

(Secretarial Order No. 3215, *Principles for the Discharge of the Secretary's Trust Responsibility*, Reclamation 2000). It is the general policy of the Department of the Interior to perform its activities and programs in such a way as to protect ITAs and avoid adverse effects whenever possible. Reclamation complies with procedures contained in Departmental Manual, Part 512.2, guidelines, which protect ITAs. Reclamation carries out its activities in a manner that protects trust assets and avoids adverse impacts, when possible. When Reclamation cannot avoid adverse impacts, it will provide appropriate mitigation or compensation. Reclamation is responsible for assessing whether action alternatives CP1 through CP5 have the potential to affect ITAs. Reclamation will comply with procedures contained in Departmental Manual, Part 512.2, guidelines, which protect ITAs.

15.3 Environmental Consequences and Mitigation Measures

This section discusses environmental consequences and potential mitigation associated with ITAs that could result from implementing the alternatives described in this PDEIS.

15.3.1 Methods and Assumptions

A detailed description of both the primary and extended study areas was provided to the Bureau of Indian Affairs' Regional ITA Coordinator. The Regional ITA Coordinator examined both the project area descriptions and records held by the Bureau of Indian Affairs and Reclamation, and determined that the proposed action does not have potential to affect ITAs. There are no ITAs in the primary study area.

15.3.2 Direct and Indirect Effects

The following section describes the potential environmental consequences of the project.

No-Action Alternative

Under the No-Action Alternative, there are no impacts to ITAs because no new facilities would be constructed and existing operations would continue as historically.

CP1 Through CP5

There are no tribes possessing legal property interests held in trust by the United States in the study area for any of the proposed comprehensive plans (CP1 through CP5). The nearest ITA is a Public Domain Allotment approximately 5 miles north-northwest of the project location.

Cumulative Impacts

There are no impacts to ITAs as a result of the proposed action; therefore, the proposed action would not contribute to cumulative impacts to ITAs.

Chapter 16
Socioeconomics, Population, and Housing

16.1 Affected Environment

This section describes socioeconomics, population, and housing characteristics in the primary and extended study areas. For a more in-depth description, see the *Socioeconomics, Population, and Housing Technical Report*.

16.1.1 Socioeconomics

Socioeconomics covers age, race/ethnicity, income/poverty, employment and labor force, business and industry, and government and finance. The data presented in this section reflect conditions that existed before the U.S. recession that began in late 2007 and became apparent beginning in 2008. Changes to the California and U.S. economies attributable to the recession resulted in increases in unemployment rates statewide; therefore, actual unemployment rates in the study area are now generally higher than presented in this section. This section uses the pre-recession figures to reflect economic conditions that were current in 2005, when the notice of intent for the SLWRI was released. Using these earlier figures does not affect the conclusions in the environmental impact analysis presented in this Environmental Impact Statement (except that with a higher unemployment rate, employment generated by project construction could result in a greater benefit to the local economy). For more details, see the *Socioeconomics, Population, and Housing Technical Report*.

Shasta Lake and Vicinity and Upper Sacramento River (Shasta Dam to Red Bluff)

Race/Ethnicity In 2005, the white population represented more than 83 percent of the populations of Shasta and Tehama counties, but substantial increases were observed in many minority groups (U.S. Census Bureau 2006a, 2006b). Tehama County's minority populations also increased between 2000 and 2005. Trends observed in the two counties generally coincide with statewide trends, where Hispanic, Asian–Pacific Islander, and American Indian populations all grew by more than approximately 12 percent over the 5-year period.

Income/Poverty Jurisdictions within the primary study area have underperformed when compared to the statewide averages for income levels and poverty rates. Median household incomes in Shasta and Tehama counties were sizably lower than the statewide average in 2000 and 2005, although Shasta County experienced a substantial increase in incomes in the 5-year period. With median household incomes of $34,520 and $42,227 in 2004 and 2005,

respectively, Shasta County and Tehama County had incomes averaging between $11,000 and $19,000 less than the statewide average for 2005. Overall poverty rates and child poverty rates have also been higher in the primary study area than in California as a whole.

Employment and Labor Force Since 1990, employment rates in both Shasta and Tehama counties have consistently been below the statewide average. Because of the cyclical nature of the area's natural resource–related industries and other factors, Shasta and Tehama counties were characterized by substantially higher unemployment rates during the 1990s (Shasta County 2004). In 2005, Tehama County registered a 7.3 percent unemployment rate, while unemployment in Shasta County totaled 6.9 percent of the population. As a result of its larger population, Shasta County maintained a labor force of just under 83,000 people in 2005, or more than three times that of Tehama County.

Business and Industry Economic activities in the primary study area coincide in many ways with the industrial composition of California as a whole. Trade, transportation, and utilities, followed by governmental services made up the top two industrial sectors both locally and statewide in 2002. In Shasta and Tehama counties, government employees and employees in the trade, transportation, and utilities sectors account for more than 20 percent of the total workforce. Similarly, educational and health services, including teachers and health workers, also ranks in the top five industries in both counties and California generally.

Some differences also exist between the industrial makeup of the two counties and that of California as a whole. For example, manufacturing plays an important role in Tehama County (14.9 percent) and California (11.3 percent) as a whole, but a comparatively small role in Shasta County. Professional and business services registers as the third largest industry at the statewide level (14.6 percent), but represents a smaller portion of employment in Shasta County (9.1 percent) and Tehama County (5.4 percent). Additionally, farm employment makes up a sizeable portion of the total workforce in Tehama County (7.4 percent), but accounts for a comparatively small portion of the workforce in Shasta County (1.6 percent) and California as a whole (2.5 percent).

Projections of future growth depict slightly different economic trends in Shasta and Tehama counties than at the statewide level. California's professional and business industry is expected to grow by almost 30 percent by 2014 (compared to 2004 levels) and the educational and health services industry is expected to grow by more than 25 percent in that time. These industries also represent the top two growth industries in Shasta County, but growth rates are expected to be slightly less in the county (24 percent and 22 percent, respectively).

Established businesses, along with new businesses that locate in the area, will play an important role in the expansion of the local economy projected by the State. Table 1-11 in the *Socioeconomics, Population, and Housing Technical*

Report displays a number of the major employers in the primary study area. This list of employers includes a range of businesses with a payroll of more than 500 people. Three of the nine businesses provide health care to local residents. Other employers include a wholesale distribution center, a wholesale nursery, and a manufacturer of industrial materials.

Government and Finance Shasta and Tehama counties are the critical local governments in the primary study area. Each county has a primary urban center (Redding in Shasta County and Red Bluff in Tehama County), with a limited number of small cities and towns and large amounts of rural land surrounding it. Because the two counties are largely rural, their total revenues and expenditures are relatively low when compared to other jurisdictions in California.

Revenues generated by Shasta County are used for a range of governmental activities. As described in the *Socioeconomics, Population, and Housing Technical Report*, expenditures increased from $302.8 million in the 2007–2008 fiscal year to $319.7 million in the 2008-2009 fiscal year. Expenditures decreased substantially in the 2009-2010 fiscal year to $309.6 million as a result of decreased spending on transportation-related projects. Welfare, social services, and other public assistance has consistently been the largest expenditure for Shasta County (more than $94.1 million in 2010), but remained relatively constant between 2007 and 2010. Police, fire, and other public safety activities represented the second largest expenditure category with more than $79.7 million in the 2009-2010 fiscal year.

Observed trends in Tehama County's revenues and expenditures have been generally similar to those experienced in Shasta County. Because of its smaller size, Tehama County's total revenues are substantially less than those of Shasta County ($112.3 million in the 2009-2010 fiscal year, compared to $309.6 million in Shasta County), but Tehama County experienced an overall decrease in revenue growth between 2007 and 2010.

Expenditures in Tehama County are also consistent with trends observed in Shasta County.

Lower Sacramento River and Delta

Race/Ethnicity Overall, the majority of people in the nine-county lower Sacramento River and Delta portion of the extended study area are white (53.0 percent), but the proportion of population identified as white varies substantially between counties. The white population of Butte County (79.1 percent) in 2005 was the highest proportion of any county in the area, while San Joaquin County had the lowest proportion of white residents (42.9 percent) (DOF 2007a). These proportions are still generally higher than that observed at the statewide level in 2005 (44.4 percent).

Income/Poverty Income and poverty characteristics for the lower Sacramento River and Delta area are similar to those for California as a whole. The median

household income of the majority of counties within the nine-county area is similar to or higher than the statewide median household income ($53,629).

Poverty levels for both individuals and children in the lower Sacramento River and Delta counties were similar to the statewide level. San Joaquin (14.2 percent), Butte (16.4 percent), and Yolo (17.8 percent) counties had higher overall poverty rates than California as a whole (13.3 percent) in 2006. The percentage of people below the poverty level is expected to follow national and statewide economic trends.

Employment and Labor Force Employment and labor trends in the nine counties of the lower Sacramento River and Delta are generally consistent with statewide trends. The area maintains a labor force of more than 1.9 million people, representing approximately 11 percent of California's labor force (17.7 million).

In the nine-county area in 2005, approximately 5.3 percent of the labor force was classified as unemployed. This unemployment rate compared to a statewide total of 5.4 percent for the same period. Although the total unemployment rate was similar to California's unemployment rate, unemployment within the lower Sacramento River and Delta counties varied substantially. Generally, the counties with the highest unemployment rates in 2005 had greater dependence on the agricultural industry and a reduced industrial diversity. Four of the five counties with unemployment rates above the statewide average maintained more than 60 percent of their land mass in agricultural production (DOF 2007b, 2007c, 2007d, 2007e, 2007f).

Business and Industry Business and industry in the lower Sacramento River and Delta counties is composed primarily of five industries: government; trade, transportation, and utilities; educational and health services; professional and business services; and leisure and hospitality. These five industries consistently rank in the top five industries of the nine counties of the lower Sacramento River and Delta portion of the extended study area.

Government and Finance A total of 55 cities and towns and a range of special districts are located within the nine counties of the lower Sacramento River and Delta. This collection of governmental entities provides valuable public services to the lower Sacramento River and Delta area—education, fire protection, employment development, emergency services, and crime prevention and control. These agencies and special districts rely primarily on tax revenue disbursed by State government, local sales and property taxes and fees, and the disbursement of Federal funds. This greater reliance on existing tax structures and rates, and a productive economic base, makes relatively reliable and affordable CVP and SWP water and power even more valuable, because its availability and affordability helps foster local business activity and thus indirectly helps sustain the fiscal health of local service providers. Similarly, flood protection provided by Shasta Dam helps protect and sustain

the appraised value of property within the dam's floodplain, again helping to protect the fiscal health of local service providers.

Total revenues and expenditures vary substantially between the nine counties of the lower Sacramento River and Delta because of the relative sizes of the counties and the services they provide. Revenues include payments received through taxes, licenses and permits, grants from other governments, charges for services, and others. Expenditures include payments made by a jurisdiction to buy goods, pay its employees, and provide services to its residents. Revenues and expenditures range from the approximately $65 million budgeted in Glenn County for 2006-2007 to Contra Costa County's approximately $1.2 billion budget.

CVP/SWP Service Areas

Race/Ethnicity The population within the CVP and SWP service areas continues to diversify. The proportion of the statewide population made up of minority groups has been steadily increasing. Almost all of the minority groups in the CVP and SWP service areas (except Black or African-American) experienced double-digit population growth between 2000 and 2005 (U.S. Census Bureau 2002, 2006b). Hispanics are the largest minority population in California and many members of this ethnic group work on farms that receive some or all of their water from the CVP and SWP.

Income/Poverty Poverty levels for both individuals and children in California decreased slightly between 2000 and 2005. The percentage of people below the poverty level is expected to follow national and statewide economic trends.

Employment and Labor Force Employment and labor force trends observed in the CVP and SWP service areas are generally synonymous with the trends observed at the statewide level because of the expanse of the CVP and SWP service areas. California's total labor force increased consistently from year to year between 2002 and 2005. In each year, California added between 100,000 and 200,000 individuals to the labor force. (As stated previously, the data presented in this section reflect conditions that existed before the U.S. recession that began in late 2007. This section uses the pre-recession figures to reflect economic conditions that were current in 2005, when the notice of intent for the SLWRI was released.)

Increases in California's total labor force have been relatively consistent; the statewide unemployment rate has fluctuated slightly since 2000. California's unemployment rate was lowest in 2000 (5.0 percent) and increased steadily over the subsequent 3 years (to 6.8 percent in 2003). The unemployment rate was 5.4 percent in 2005, equal to the state's 2001 unemployment rate.

Business and Industry Business and industry trends for the CVP and SWP service areas are assumed to be equal to those at the statewide level because of the expanse of these service areas. The trade, transportation, and utilities

industry represents the largest industry, measured by total employees, in California. Government is California's second largest industry, and the professional and business services, educational and health services, and leisure and hospitality industries all play important roles in the state's economy.

Government and Finance The state of California represents the most appropriate level of detail for the CVP and SWP service areas because of the expanse of the service areas and the interdependent nature of government and finance provision. California currently ranks as the seventh largest economy in the world and provides goods and services to more than 37 million people, making it the largest state in the nation. As a result, State government manages a large annual volume of revenues and expenditures. The State of California's proposed 2011–2012 budget includes a total of approximately $123 billion in revenues and transfers and a total of more than $127 billion in total expenditures (State of California 2011). Many of the State's expenditures represent grants and other funding made available to local jurisdictions throughout California. These funds may be used for a variety of services, such as health and human services, environmental protection, and resource management.

16.1.2 Population

Shasta Lake and Vicinity and Upper Sacramento River (Shasta Dam to Red Bluff)

The area surrounding Shasta Dam comprises generally smaller cities and towns with two larger, primary urban areas in each of the two counties (Shasta County and Tehama County). Almost 39 percent of the population in Shasta County and more than 65 percent in Tehama County lived in unincorporated areas in 2006. By comparison, only 17.7 percent of the population in the entire state of California lived in unincorporated areas in 2005. In total, the populations of Shasta and Tehama counties make up less than 1 percent of the total population in California.

The cities of Redding and Red Bluff are the two largest urban areas in the primary study area. Redding, with a total of 89,162 residents in 2006, is the most populous city in the region. Red Bluff is the second largest city in the region and the largest city in Tehama County, with a total of 13,529 residents in 2006. Remaining cities within the primary study area – Anderson, Shasta Lake, and Tehama – all contained fewer than 11,000 residents in 2006.

Although Shasta and Tehama counties are still comparatively small, both counties have been growing substantially during the past 15-20 years. Since 1990, the population of Shasta County has increased by more than 22 percent. During that time, the populations of Redding and Anderson have increased by approximately 33 percent and 26 percent, respectively. A similar situation has been observed in Tehama County, where total population has grown by almost

23 percent since 1990. Most of this new growth has occurred in the unincorporated areas of Tehama County, rather than in existing cities.

Shasta and Tehama counties are expected to continue this growth trend, with substantial growth in Tehama County. The State of California projects that Shasta County's population will increase by 86 percent by 2050 to a total of approximately 332,000 residents (DOF 2007g). This increase is approximately 26 percent higher than expected at the statewide level (60.0 percent).

Lower Sacramento River and Delta

As described in the *Socioeconomics, Population, and Housing Technical Report*, roughly 4 million people live in the nine-county area that makes up the lower Sacramento River and Delta area (Butte, Colusa, Contra Costa, Glenn, Sacramento, San Joaquin, Sutter, and Yolo counties). This population represents approximately 11 percent of California's total population. Sacramento County and Contra Costa County are the two largest counties in the area, with approximately 1.4 million and 1.0 million residents, respectively, in 2006 (DOF 2007a). Of the nine counties in the area, only Sacramento County (56.8 percent) is expected to have grown at a slower rate than California as a whole (60.0 percent increase) through 2050. All other counties in the area are expected to increase their populations by at least 72 percent over that time.

CVP/SWP Service Areas

In 2006, California contained a total of 37,195,240 residents. Approximately 80 percent of the state's population resides in the incorporated areas of its 58 counties (DOF 2007a). Similar to the state as a whole, most of the population of the CVP and SWP service areas is concentrated within urban areas. Outside of these fast-growing population centers, most of the lands within the CVP and SWP service areas are rural, with irrigated agriculture being the predominant land use and driver of the local and regional economies.

California's population has increased by almost 25 percent since 1990 and is projected to increase by approximately 60 percent to more than 59 million people by 2050. This substantial population increase will result in a sizeable increase in water and energy demand across the state. The proportion of the statewide population made up of minority groups has been steadily increasing.

16.1.3 Housing

Shasta Lake and Vicinity and Upper Sacramento River (Shasta Dam to Red Bluff)

As shown in the *Socioeconomics, Population, and Housing Technical Report*, as would be expected, provision of housing in the primary study area generally coincides with the population trends discussed above. Shasta County (75,240 units in 2006) maintains almost three times the amount of housing units in Tehama County (25,881 units). Of the nearby cities, Redding provides the largest supply of housing in the region, with more than 37,000 housing units.

Redding's units represent roughly half the total housing units in Shasta County. Red Bluff provides the second largest housing stock in the area, with almost 6,000 units.

Overall, single-family dwelling units are the predominant housing type in the primary study area. Vacancy rates were generally higher than the statewide average (5.9 percent), with the exception of Redding (5.0 percent) and Anderson (5.8 percent). Tehama County registered the highest vacancy rate in the primary study area, with 10.8 percent of all housing units vacant. The average household size in jurisdictions of the primary study area ranged from as low as 2.39 persons per household (Tehama) to as high as 2.66 persons per household (Anderson and Shasta Lake). All of these totals were lower than the average persons per household at the statewide level (2.94 persons).

Lower Sacramento River and Delta

As shown in the *Socioeconomics, Population, and Housing Technical Report*, housing characteristics in the nine-county area that makes up the lower Sacramento River and Delta are generally similar to those at the statewide level. In 2006, the area contained approximately 1.5 million housing units. Similar to population, this total represents approximately 11 percent of California's housing stock (approximately 13 million houses). Overall, single-family housing makes up a larger proportion of the total housing stock in the nine-county area (72.5 percent) than recorded at the statewide level (57.3 percent) in 2006 (DOF 2007a).

The vacancy rate in the nine-county area in 2006 was lower (4.0 percent) than the rate observed at the statewide level (5.9 percent). Vacancy in the majority of counties (six of nine) within the lower Sacramento River and Delta area was substantially lower than California as a whole (DOF 2007a).

Average household size in the lower Sacramento River and Delta area is generally lower than that observed at the statewide level. In total, an average of 2.74 persons lived in the households of the nine-county area in 2006. This compared to an average of 2.94 persons for California as a whole (DOF 2007a).

CVP/SWP Service Areas

A description of housing in the CVP and SWP service areas is not included because it would not be affected by the project.

16.2 Regulatory Framework

The assessment of socioeconomic resources is guided primarily by Federal laws and policies. State and local laws and policies typically promote economic development and diversity, environmental justice, public health and safety, housing, and other concerns of the residents within their jurisdictions. As noted

below, NEPA documents must include an assessment of potential conflicts with State and local plans and policies.

16.2.1 Federal

The major Federal laws and regulations guiding the assessment of socioeconomic resources are summarized below.

National Environmental Policy Act

Section 102 of NEPA requires Federal agencies to "insure the integrated use of the natural and social sciences" in planning and decision making (42 U.S. Code Section 4332).

Section 1502.16(c) of NEPA requires Federal agencies to identify potential conflicts between a proposed action and related plans and policies of Federal, state, and local agencies and Indian tribes. This requirement helps Federal agencies identify potential conflicts that may cause adverse effects on the social and economic environment of a study area because many agency and tribal plans and policies are designed to protect the people residing within their jurisdictions and/or the local economy they depend upon for their economic livelihoods.

Council on Environmental Quality

The Council on Environmental Quality's "Regulations for Implementing the Procedural Provisions of NEPA" (40 Code of Federal Regulations (CFR) 1500 to 1508) provide guidance related to social and economic impact assessment by noting that the "human environment" assessed under NEPA is to be "interpreted comprehensively" to include "the natural and physical environment and the relationship of people with that environment" (40 CFR 1508.14). Furthermore, these regulations require agencies to assess "aesthetic, historic, cultural, economic, social, or health" effects, whether direct, indirect, or cumulative (40 CFR 1508.8). Some Federal agencies, including the U.S. Bureau of Land Management and U.S. Forest Service, have developed socioeconomics-related handbooks and instructional memoranda to help the preparers of Environmental Impact Statements comply with NEPA with respect to socioeconomics resources.

Executive Order 12898—Environmental Justice

In 1994, President Bill Clinton issued Executive Order 12898 regarding environmental justice. This order requires Federal agencies to "identify and address" disproportionately high and adverse human health or environmental effects of their programs, policies, and activities on minority populations and low-income populations in the United States. The Council on Environmental Quality issued guidance in 1997 to help Federal agencies incorporate environmental justice concerns into their NEPA procedures. Environmental justice issues are specifically addressed in Chapter 24, "Environmental Justice," of this PDEIS.

16.2.2 State

Most state and local governments have plans and policies intended to protect and expand the local and regional economies affecting the communities and residents within their jurisdictions. Some of these plans and policies are also intended to promote public health and safety while minimizing conflicts between new development projects of all types; their associated traffic, air, and noise impacts; and the social environment within which local residents live and work. State plans and policies also frequently address other social and economic impact topics, including fiscal conditions and related public services that affect local residents' quality of life.

In California, the California Environmental Protection Agency adopted its own environmental justice policy in 2004. Pursuant to Sections 71110 to 71113 of the California Public Resources Code, the California Environmental Protection Agency has developed this policy (or strategy) to provide guidance to its resource boards, departments, and offices. It is intended to help achieve the State's goal of "achieving fair treatment of people of all races, cultures and incomes with respect to the development, adoption, implementation and enforcement of environmental laws and policies."

16.2.3 Regional and Local

Each of California's counties, including Shasta and Tehama counties, has its own plans, ordinances, and other policies designed to protect and improve a wide range of socioeconomic conditions. Specifically addressed in these plans, ordinances, and policies are housing, employment opportunities for minorities and low-income populations and others, economic diversification, and business activity in general.

Shasta County

Shasta County General Plan Two primary elements of the *Shasta County General Plan* (Shasta County 2004) address socioeconomic resources: Housing and Economic Development. The Housing Element of the *Shasta County General Plan* establishes several goals and policies related to ensuring adequate housing provision, especially affordable housing, in the county. Shasta County's housing policies and programs are grouped into six primary categories, each supporting an identified goal. These categories and the goal associated with each are listed below.

- **Housing Supply**
  - **Goal –** To establish and implement policies and programs that will:
    - Contribute to the provision of an adequate supply and diversity of safe, healthy, and affordable housing for all income levels to meet the needs of residents in the unincorporated areas of Shasta County.

  - Satisfy the requirements of the Regional Housing Needs Allocation Plan for Shasta County for the 2004-2009 Housing Element period, specifically to realize the construction of new units as follows: Very Low Income – 300 units; Low Income – 255 units; Moderate Income – 1,035 units; and Above Moderate Income – 810 units.

- **Conserve and Improve Existing Affordable Housing**
  - **Goal –** To conserve, improve, and expand the inventory of existing affordable housing stock in the incorporated areas of the County, specifically to realize the conservation and/or rehabilitation of the following units: Rehabilitation (150): 60 units – Very Low Income; 55 units – Low Income; 25 units – Moderate Income; and 10 units – Above Moderate Income; Conservation (150): 90 units – Very Low Income; 53 units – Low Income; and 7 units – Moderate Income.
- **Housing Development Constraints**
  - **Goal –** To continue to remove all County constraints, as is practical and legal, which have the potential to hinder or impede the development of affordable housing projects.
- **Special Needs**
  - **Goal –** To continue to work collectively with local agencies to enhance and expand the outreach programs designed to provide accessible and affordable housing, including supportive services, for those persons with special needs including the elderly, large families, single mothers, children, developmentally and physically disabled persons, the mentally ill, farmworkers, and the homeless.
- **Energy Conservation**
  - **Goal –** To explore, implement, and promote energy conservation practices in all eligible existing and new housing projects.
- **Fair Housing**
  - **Goal –** To continue to utilize all feasible means to promote, expand, and ensure equal access to available, safe, decent, affordable housing opportunities in the unincorporated area without bias or prejudice for any reason for all economic segments of the County.

The Economic Development Element of the *Shasta County General Plan* (Shasta County 2004) establishes the following two overall objectives for economic development:

- **ED-1 –** Economic development plans, programs, and policies shall contribute to a stable and healthy economy in Shasta County, which includes provision of a land development pattern, planning process, and

regulatory atmosphere conducive to maintaining employment opportunities for County residents and fostering new economic development.

- **ED-2** – Seek economic diversity that increases the variety, type and scale of business, industrial, and manufacturing activities.

To support these objectives, Shasta County has established three primary policies for implementation. These policies emphasize the reuse and revitalization of existing development and full use of existing infrastructure for new business opportunities. To attract business to Shasta County, a number of incentive programs are employed, including community development block grants, economic assistance through a county redevelopment agency, and business development and retention assistance through an economic development corporation. Additionally, a 50-square-mile State-defined enterprise zone (one of only 39 in California) has been designated in portions of Redding, Shasta Lake, Anderson, and unincorporated Shasta County. Enterprise zones are generally designated in locations characterized by high poverty rates. Businesses locating within these areas may receive State-supported incentives such as sales and use tax credits, hiring assistance tax credits, and special business expense deductions (Shasta County 2004).

Tehama County

In the *Tehama County General Plan*, updated in 2009 (Tehama County 2009), Tehama County set out three "fundamental concepts" that relate to population growth and demographic shifts: (1) accommodating growth, but not limiting growth or accepting uncontrolled growth; (2) locating major growth along the Interstate 5 transportation corridor; and (3) organizing growth according to a range of community types. These concepts emphasize where Tehama County expects to locate new growth and how they plan to accommodate it. Specifically, the Interstate 5 corridor plays a significant role for the placement of new development, and Tehama County attempts to provide a range of housing types for the diversity of needs created within the community. This emphasis on housing diversity may become more crucial as aging residents' housing preferences change.

The following housing-related goals in the general plan are relevant to the project:

- **Goal HE-3: Adequate Sites** – Ensure the provision of adequate sites and facilities to support future housing needs.

- **Goal HE-5: Housing Conservation** – Work to improve, maintain and conserve the County's existing housing stock.

- **Goal HE-6: Addressing Constraints** – Address and wherever possible remove, governmental constraints to the maintenance, improvement, or development of housing to meet the needs of County residents.

- **Goal HE-7: Fair Housing/Equal Opportunity** – Promote equal housing opportunities for all persons without discrimination regardless of age, race, sex, marital status, ethnic background, household composition, sources of income, or other arbitrary factors.

Relevant economic development–related goals contained in the draft general plan are as follows:

- **Goal ED-3** – Expand the economic base while maintaining a healthy and diverse local economy that meets the present and future employment, shopping, recreational, public safety, and service needs of Tehama County residents.

- **Goal ED-4** – Work toward providing adequate infrastructure to support commercial, industrial, and recreational development within Tehama County including clean-up of contaminated industrial sites.

- **Goal ED-7:** Protect and enhance environmentally sensitive lands and natural resources while, at the same time, promoting business expansion, retention, and recruitment.

Shasta and Tehama counties function as the primary agencies responsible for implementing policies and programs aimed at addressing employment and labor force issues within the project's primary study area.

16.3 Environmental Consequences and Mitigation Measures

Based on the review of the affected environment provided in Section 16.1 of this chapter, this section describes the potential environmental consequences resulting from each of the proposed alternatives. Direct, indirect, and cumulative effects of the alternatives are discussed below. When potential environmental consequences are identified, specific mitigation measures to offset the potential effects of the alternatives are presented. Potential effects and mitigation measures address topics related to population and housing, employment and labor force, business and industry, and government and finance.

16.3.1 Methods and Assumptions

Population, Housing, and Demographics

The evaluation and discussion of the potential impacts of the project alternatives on population, demographic, and housing characteristics was based on a review

of published material pertaining to the primary and extended study areas. California Department of Finance population and demographics databases and projections, U.S. Census Bureau population and demographics data, the general plans of jurisdictions within the study areas, and other similar source documents were reviewed.

Population effects were evaluated based on changes in the total number of temporary and/or permanent residents resulting from construction and operations activities that would be completed as a part of project implementation. Housing effects were assessed based on estimated short- and long-term housing needs resulting from population changes expected as a result of the project's construction and operational activities. Effects of the project on local and regional demographic characteristics were assessed quantitatively, when available data allowed. When quantitative analysis of effects was not possible at this broader geographic level, qualitative effects were identified based on the projected makeup (e.g., ethnicity, economic class) of any population changes expected to result from project implementation.

Employment and Labor Force

The determination of potential impacts on employment and the labor force was based on a review of relevant information related to current conditions. Existing documents such as the California Employment Development Department's employment and labor force databases, the Economic Development and Housing elements of the *Shasta County General Plan* (2004), and the *Tehama County General Plan* (2009) were reviewed, along with estimates of employment (temporary and permanent jobs created) for each proposed alternative.

To quantify the potential job creation resulting from each proposed alternative, IMPLAN (IMpact analysis for PLANning) modeling was completed by economists at Reclamation. Developed from the analytical work conducted by Wassily Leontief in the late 1930s, IMPLAN modeling uses a branch of economics known as Input/Output analysis. Input/Output models are essentially accounting tables that trace the linkages of interindustry purchases and sales within a given region, and within a given year. The Input/Output model yields "multipliers" that are used to calculate the total direct, indirect, and induced effects on jobs, income, and output generated per dollar of spending on various types of goods and services in the local economic study area. IMPLAN was originally developed by the U.S. Forest Service and is now maintained and marketed by the Minnesota IMPLAN Group, Inc.

Several assumptions were necessary to complete IMPLAN modeling of the project. The following assumptions were used:

- IMPLAN modeling was completed for CP1 (which involves raising Shasta Dam by 6.5 feet); CP2 (which involves raising the dam by 12.5

feet); and CP3, CP4, and CP5 (all of which involve raising the dam by 18.5 feet).

- Construction periods of approximately 36 months, 48 months, and 60 months, respectively, were assumed under CP1, CP2, and CP3, CP4, and CP5.

- The "local economic study area" was defined as the four-county region of Shasta, Siskiyou, Tehama, and Trinity counties.

- A total labor force of 350 construction workers would be needed for CP4, and a similar level for the other four alternatives in proportion to the required construction activities.

- All 350 construction workers would be drawn directly from the local economic area. (High unemployment in the primary study area and the availability of necessary worker skill sets supports this assumption.)

In addition to IMPLAN modeling, the) was used to determine the effects of the five dam raise alternatives on CVP agricultural users. The Central Valley Production Model (CVPM) is a regional economic model of irrigated agricultural production that simulates the decisions of agricultural producers (farmers) in the Central Valley of California. The model included 22 crop production regions in the Central Valley and 20 categories of crops. Based on the changes in water availability expected with each alternative, the CVPM predicts cropping patterns, land use, and water use in the Central Valley. These predictions are then used to calculate expected changes in net income resulting from each alternative during dry, wet, and average water years. Although the model's income-related projections were generally used to determine effects on business and industrial activity, the overall change in business net income (or profits) is a good indicator for potential changes in employment opportunities in affected sectors.

Business and Industry

The discussion of potential impacts on business and industry is based on a review of relevant information on current conditions, specifically existing documents such as California Employment Development Department documents, the Economic Development Element of the *Shasta County General Plan* (2004) and the *Tehama County General Plan* (2009), and estimates of business and industry effects for each action alternative.

To quantify the potential effect on job creation and personal incomes resulting from each alternative, IMPLAN modeling was completed by Reclamation economists. A description of IMPLAN modeling, generally, and the specific assumptions used related to the project are provided in the previous section.

Government and Finance

The determination and discussion of potential impacts on government and finance was based on a review of relevant information on current conditions, specifically documents such as the Economic Development Element of the *Shasta County General Plan* (2004) and the *Tehama County General Plan* (2009), and estimates of local government and finance effects for each dam-raise alternative.

Because no quantitative analysis of the effect of the action alternatives on local government and finance has yet been completed, this analysis depends heavily on a qualitative discussion of potential impacts. Areas of potential impacts were identified by comparing existing conditions and probable future conditions. In many cases, the estimates completed as part of the IMPLAN and CVPM modeling served as the basis for impact estimates. These two models determine expected trends in employment, personal incomes, business incomes, agricultural production, and other data types to quantifiably estimate the impacts of the proposed alternatives. Because these local characteristics directly influence activities at the local level, they represent critical considerations in the analysis and conclusions presented in this section.

16.3.2 Criteria for Determining Significance of Effects

An environmental document prepared to comply with NEPA must consider the context and intensity of the environmental effects that would be caused by, or result from, the proposed action. Under NEPA, the significance of an effect is used solely to determine whether an Environmental Impact Statement must be prepared. An environmental document prepared to comply with CEQA must identify the potentially significant environmental effects of a proposed project. A "[s]ignificant effect on the environment" means a substantial, or potentially substantial, adverse change in any of the physical conditions within the area affected by the project" (State CEQA Guidelines, Section 15382). CEQA also requires that the environmental document propose feasible measures to avoid or substantially reduce significant environmental effects (State CEQA Guidelines, Section 15126.4(a)).

The following significance criteria were developed based on guidance provided by the State CEQA Guidelines, and consider the context and intensity of the environmental effects as required under NEPA. Impacts of an alternative on socioeconomics, population, and housing would be significant if project implementation would do any of the following:

- Induce substantial population growth in an area, either directly (for example, by proposing new homes and businesses) or indirectly (for example, through extension of roads or other infrastructure)

- Displace substantial numbers of people or housing, necessitating the construction of replacement housing elsewhere

- Produce a substantial burden on the existing housing stock within the local community because of an increased housing demand created by nonlocal project employees

- Require sizeable numbers of new workers in a particular industrial sector from outside the local area during construction or operation for effective implementation

- Substantially increase the risk of housing or other property damage caused by flooding

- Cause a substantial decrease in the number of opportunities for temporary or long-term direct employment within the primary study area or the extended study area (within Shasta County, Tehama County, or nearby cities and towns, specifically Redding, Anderson, Shasta Lake, and Red Bluff)

- Compete with established industries for workers within the labor force or associated resources to the extent that there would be a shortage of workers available to related businesses

- Cause a substantial decrease in the number of opportunities for temporary or long-term increases in personal and/or disposable incomes within the primary or extended study area (within Shasta County, Tehama County, or nearby cities and towns, specifically Redding, Anderson, Shasta Lake, and Red Bluff)

- Considerably decrease the sales and/or incomes of businesses in the primary or extended study areas

Significance statements are relative to both existing conditions (2005) and future conditions (2030) unless stated otherwise.

16.3.3 Topics Eliminated from Further Discussion

In contrast to the primary study area and the lower Sacramento River and Delta portion of the extended study area, additional flood control capacity provided by CP1–CP5 is not expected to substantially affect the CVP and SWP service areas beyond the lower Sacramento River and Delta. Dam operations (i.e., storage and release scenarios) in the CVP and SWP service areas are expected to continue according to management plans similar to those currently in place. Therefore, no flood-related impact on population and housing would occur in the CVP and SWP service areas. This topic is not discussed further under CP1–CP5.

16.3.4 Direct and Indirect Effects

Similar to the approach used in Section 16.1, “Affected Environment,” the following discussion of environmental consequences in the primary study area

does not separate Shasta Lake and vicinity from the upper Sacramento River (Shasta Dam to Red Bluff) because of the regional interdependence of socioeconomic characteristics. Instead, environmental consequences are discussed for the entire primary study area and the two counties that encompass it, Shasta and Tehama counties.

No-Action Alternative

Under the No-Action Alternative, no additional Federal action would be taken to address water reliability issues or increase anadromous fish survival. Therefore, Shasta Dam and Shasta Lake would continue to operate as they currently do, with some future modifications (currently not known) expected into the future. With the No-Action Alternative, water reliability is expected to become an increasing issue as demand for water increases to meet the needs of California's growing population. Over time, water conservation and reuse efforts would increase and water provision is expected to shift from such areas as agricultural production to urban uses. Environmental restoration, flood control, and hydropower generation are expected to continue similar to existing conditions. Like water demand, electricity demand in California is expected to increase substantially in the future. This increased demand is expected to create localized shortages in energy availability over time.

Shasta Lake and Vicinity and Upper Sacramento River (Shasta Dam to Red Bluff) Under the No-Action Alternative, population, demographic, and housing conditions are expected to continue following current growth trends described in Section 16.1, "Affected Environment"; the projected employment and labor force characteristics summarized in Section 16.1 would also continue. The relatively large number of new construction-related jobs that would be created by all five action alternatives would not be created. Therefore, this alternative would have no impact on population and housing or on employment and the labor force.

In addition, the business and industrial activities of the primary study area would continue as summarized in Section 16.1. The relatively large and temporary increase in business activity that would occur during construction would not occur. Therefore, the No-Action Alternative would have no impact on business and industrial activity.

Furthermore, the local government and finance conditions and trends projected in Section 16.1 would continue because new facilities would not be constructed and existing facilities would not be altered, expanded, or demolished. The positive fiscal effects associated with the increase in sales and income tax revenue from construction-related spending would not occur. Therefore, the No-Action Alternative would have no impact on government and finance.

Lower Sacramento River and Delta Under the No-Action Alternative, the projected population, demographic, and housing conditions and development

conditions described in Section 16.1, "Affected Environment," would remain unchanged. There would be no impact on population, demographics, or housing.

In addition, the local government and finance conditions described in Section 16.1 would continue because no new facilities would be constructed and no existing facilities would be altered, expanded, or demolished. The positive fiscal effects associated with the increase in sales and income tax revenue resulting from construction-related spending would not occur. Therefore, the No-Action Alternative would have no impact on government and finance.

The impacts of the No-Action Alternative on employment and the labor force and on business and industrial activity in the lower Sacramento River and Delta area are described below.

Impact Socio-1 (No-Action): Potential for Reduced Employment Opportunities for Lower Sacramento River and Delta Area Residents The No-Action Alternative has the potential to result in periodic water and power supply disruptions from increasing demand on the existing supply caused by population growth. These disruptions could result in adverse economic effects on the lower Sacramento River and Delta portion of the extended study area. This impact would be potentially significant.

Under the No-Action Alternative, the risk of CVP and SWP water supply disruptions and Western Area Power Administration and DWR power supply disruptions in the lower Sacramento River and Delta area would be higher than the risk of such disruptions in the long term under each of the five action alternatives. Although the likelihood of such disruptions is difficult to predict, the CalSim-II modeling performed to simulate future water and power supply conditions under 2030 No-Action Alternative conditions, and 2030 conditions under each of the action alternatives, indicates that all five action alternatives would enhance CVP and SWP water and power supply conditions relative to 2030 No-Action Alternative conditions. (Please note that CalSim modeling of power supply conditions for the 2030 No-Action Alternative is not currently available.)

An increase in the risk of water and power supply disruptions could in turn increase the likelihood that temporary and adverse socioeconomic effects would take place during related reductions in economic activity, including reductions in employment opportunities. Adverse economic effects during times of drought, blackouts, or other types of water or power supply disruptions could also include delays in hiring employees or layoffs if businesses experience water and/or power rate increases as a result of water and power purveyors seeking other, more expensive replacement sources. This impact would be potentially significant. Mitigation is not required for the No-Action Alternative.

Impact Socio-2 (No-Action): Potential for Temporary Disruptions in Business and Industrial Activity in the Lower Sacramento River and Delta Area If water

or power supply disruptions were to occur, they could cause temporary reductions in business and industrial activity, especially where water- and power-intensive industries and businesses are found. This impact would be potentially significant.

As discussed under Impact Socio-1 (No-Action) above, an increase in the risk of water or power supply disruptions could occur in the lower Sacramento River and Delta portion of the extended study area under the No-Action Alternative. If such disruptions were to occur, they could cause temporary reductions in business and industrial activity, especially in areas where water- and power-intensive industries and businesses are found. Because the No-Action Alternative could have adverse effects on businesses and industrial activity in the case of drought, blackouts, or other types of water or power supply disruptions, this impact would be potentially significant. Mitigation is not required for the No-Action Alternative.

CVP/SWP Service Areas Under the No-Action Alternative, the projected population, demographic, and housing conditions and development conditions described in Section 16.1, "Affected Environment," would remain unchanged. No impact would occur. Therefore, potential effects of the No-Action Alternative on population, demographics, or housing in this geographic region are not discussed further.

In addition, the local government and finance conditions in the CVP and SWP service areas described in Section 16.1 would continue. The positive fiscal effects associated with the increase in sales and income tax revenue resulting from construction-related spending would not occur. Therefore, no impact would occur under the No-Action Alternative. Potential effects of this alternative on government and finance in this geographic region are not discussed further.

The impacts of the No-Action Alternative on employment and the labor force and on business and industrial activity in the CVP and SWP service areas are described below.

Impact Socio-3 (No-Action): Potential for Reduced Employment Opportunities for Residents Within the CVP and SWP Service Areas The No-Action Alternative has the potential to result in periodic water and power supply disruptions from increasing demand on the existing supply caused by population growth. These disruptions could result in variability in economic activity, which could reduce or delay employment opportunities in the CVP and SWP service areas. This impact would be potentially significant.

Under the No-Action Alternative, the risk of CVP and SWP water supply disruptions and Western Area Power Administration and DWR power supply disruptions would be higher than the risk of such disruptions in the long term under each of the five proposed action alternatives. The likelihood of such

disruptions is difficult to predict; however, the CalSim-II modeling performed to simulate future water and power supply conditions under 2030 No-Action Alternative conditions, and 2030 conditions under each of the action alternatives, indicates that all five action alternatives would enhance CVP and SWP water and power supply conditions relative to 2030 No-Action Alternative conditions. (Please note that CalSim modeling of power supply conditions for the 2030 No-Action Alternative is not currently available.)

An increase in the risk of water and power supply disruptions, including drought, blackouts, or other types of water or power disruptions, could in turn increase the likelihood of temporary and adverse socioeconomic effects. Adverse economic effects during times of these disruptions could reduce economic activity and also result in delays in hiring employees or layoffs if businesses were to experience water and/or power rate increases as a result of water and power purveyors seeking other, more expensive replacement sources. This impact would be potentially significant. Mitigation is not required for the No-Action Alternative.

Impact Socio-4 (No-Action): Potential for Temporary Disruptions in Business and Industrial Activity in the CVP and SWP Service Areas If water or power supply disruptions were to occur, they could cause temporary reductions in business and industrial activity, especially where water- and power-intensive industries and businesses are found. This impact would be potentially significant.

As discussed under Impact Socio-3 (No-Action) above, an increase in the risk of water or power supply disruptions could occur in the CVP and SWP service areas under the No-Action Alternative. If such disruptions were to occur, they could cause temporary reductions in business and industrial activity, especially in areas where water- and power-intensive industries and businesses are found. Because the No-Action Alternative could have adverse effects on businesses and industrial activity in the case of drought, blackouts, or other types of water or power supply disruptions, this impact would be potentially significant. Mitigation is not required for the No-Action Alternative.

CP1 – 6.5-Foot Dam Raise, Anadromous Fish Survival and Water Supply Reliability

CP1 would increase the full pool capacity of Shasta Lake to 4,810 thousand acre-feet (TAF) and increase the surface area of the pool to 30,710 acres. It is expected that implementing CP1 would result in the replacement or modification of eight bridges and relocation of approximately 45 existing structures. The total construction cost associated with CP1 would be approximately $827 million and the annual operational cost would be $42.6 million. This alternative would generate approximately $27.0 million in annual water supply reliability benefits and $15.1 million average annual equivalent anadromous fish restoration benefits. CP1 would increase hydropower

generation by approximately 42 gigawatt-hours (GWh) per year, equivalent to approximately $2.4 million in hydropower benefits.

Shasta Lake and Vicinity and Upper Sacramento River (Shasta Dam to Red Bluff)

Impact Socio-1 (CP1): Short-Term Increase in Population and Housing Demand in the Primary Study Area Resulting from Construction-Related Activities According to Reclamation estimates, approximately 450 new direct jobs would be created as a result of construction activities associated with CP1. All 450 construction workers are expected to come from the local labor force; therefore, a temporary population increase is not expected. This impact would be less than significant.

Approximately 450 new construction workers would be needed over the 36-month construction period to support the construction activities related to the 6.5-foot raise of Shasta Dam. Given the availability, experience, and expertise of the existing labor force within the primary study area, it is expected that the necessary workers would be available in the surrounding two-county area (Shasta and Tehama counties). Therefore, no construction workers are expected to be sourced from outside the primary study area, and no employees (or very few) would need to relocate to the project area during the construction period. Even if a relatively small number of workers were to come from outside the local area, sufficient housing capacity (e.g., rental housing, motel, and apartment vacancies) exists in the area. Thus, effects on population and housing in the primary and extended study areas are not expected; if they were to occur, they would be very minor. This impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact Socio-2 (CP1): Short-Term Increases in Direct, Indirect, and Induced Employment in the Primary Study Area Related to Construction Activities Construction activities associated with CP1 are assumed to generate approximately 450 new construction jobs, 580 indirect jobs in various construction-related support industries, and 790 induced jobs because of increased household spending in the primary study area. Individuals to fill these jobs are expected to be drawn from the local community. These new jobs are expected to provide important but temporary employment opportunities to many unemployed construction workers in the primary study area. This impact would be beneficial.

Concrete workers, workers with large-scale construction experience, general laborers, and others would be drawn from the existing local construction industry. These jobs represent a relatively small increase (less than 0.6 percent) in the total labor force in the two counties of the primary study area, but would represent a substantial increase in employment for many of the cities surrounding the project site, where employment has consistently been below the statewide average (EDD 2011).

Although the increase in employment represents a small percentage increase for the two-county area, the employment opportunities created by CP1 represent a substantial contribution in counties that have consistently registered high unemployment rates (EDD 2011). Both Shasta and Tehama counties were characterized by unemployment rates around 7 percent between 2002 and 2005. Similarly, since 2000, the cities of Anderson, Shasta Lake, and Red Bluff have all experienced unemployment rates 2 percentage points or more above the statewide average (EDD 2011).

As stated above, IMPLAN modeling calculates "direct" employment generated by individual alternatives as well as "indirect and induced" positions that are created by construction-related and operational activities. Indirect employment may be to support hiring in businesses that provide materials to the construction effort; in service-related industries that provide food, beverages, and other goods to construction workers; or in more technical industries, such as consulting firms and other businesses. Induced employment is jobs that are created in the region due to increased household spending and not limited to construction-related activities.

In addition to the 450 direct construction-related jobs to be created from CP1, an additional 580 indirect jobs are expected to be created from construction support industries, and 790 induced jobs from increased household spending near the project area. The generation of 1,820 new positions (direct, indirect, and induced) approximately represents a 1.5 percent increase in the total 2004 labor force of the four counties of the local economic study area used in the IMPLAN modeling (Shasta, Tehama, Trinity, and Siskiyou), which totaled approximately 123,000 employees. A 1.5 percent increase in employment represents a substantial increase in total employment, especially for an area experiencing the recent unemployment rates observed in the primary study area.

Because CP1 would create direct, indirect, and induced jobs in an area with high unemployment rates, this impact would be beneficial. Mitigation for this impact is not needed, and thus not proposed.

Impact Socio-3 (CP1): Potential for Temporary Reduction in the Labor Force of Related Industrial Sectors in the Primary Study Area as a Result of Direct Construction-Related Employment With the creation of 450 new construction jobs resulting from CP1, the potential exists for workers from other industries to move to jobs related to construction at Shasta Dam. Given the size of the construction industry in the primary study area, and the high unemployment rate in the area, this impact would be less than significant.

As the 450 new positions created under CP1 are filled, the potential exists for the positions to be filled by individuals currently working in related industries within the local community. This transfer of workers from related industries to the Shasta project could create a labor shortage in the related industry, if particularly skilled workers are required. In 2004, Shasta County registered

4,500 employees in the construction industry, while construction industry workers in Tehama County equaled only 650 individuals, for a total of 5,150 construction workers in the area (EDD 2011). Given total employment levels and current unemployment trends in the primary study area, the 450 new construction-related jobs are not expected to substantially affect the local labor force. If a high number of workers were to be sourced from Tehama County, a limited effect could be observed because of the small number of workers in the construction industry in that county. Overall, however, this impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact Socio-4 (CP1): Short-Term Increases in Direct, Indirect, and Induced Personal Income Paid to Employees in the Primary Study Area Hired for Construction-Related Activities Based on calculations completed as a part of Reclamation's IMPLAN socioeconomic model process, it is estimated that more than $126.1 million in personal income would be directly paid to employees in the primary study area each year of construction under CP1. This amount of personal income is a more than 1.6 percent increase in annual income in the local economic study area. In addition, more than $57.4 million is expected to be generated in various construction-related and other industries in the primary study area each year of construction under CP1. This impact would be beneficial.

In 2004, total personal income in the four counties of the local economic study area was in excess of $7.6 billion. With more than $4.8 billion in personal income that year, Shasta County contributed more than half of this total. Based on the results of modeling performed using Reclamation's IMPLAN model, an estimated $126.1 million would be directly paid each year to the approximately 450 construction workers required to complete the job during the proposed 36-month construction period for CP1. Based on the IMPLAN estimate, the increase in annual personal incomes expected from CP1 represents an increase of approximately 1.6 percent. The positions expected from implementation are anticipated to be union positions and would be paid according to union wage and benefit standards.

Based on the generation of 1,370 indirect and induced jobs resulting from implementation of CP1, it is estimated that $57.4 million in personal income would be available for residents of the local economic study area each year during the proposed 36-month construction period. This personal income would be generated in industries that would support the construction efforts at Shasta Dam.

Taken together, it is expected that direct, indirect, and induced personal income resulting from CP1 would exceed $183.6 million per year of construction activities within the local economic study area (used in IMPLAN modeling). The $183.6 million in personal income generated represents approximately 2.4 percent of all annual personal income in the local economic study area in 2004.

Increases in personal income projected for the local economic study area are expected to be most prominent in Siskiyou, Tehama, and Trinity counties, where total personal income recorded in 2004 was 25 percent of that registered in Shasta County. In general terms, this impact would be beneficial. Mitigation for this impact is not needed, and thus not proposed.

Impact Socio-5 (CP1): Short-Term Increases in Sales and Profits for Businesses in the Primary Study Area that Support the Construction Industry Most of the construction materials used for CP1 are expected to be purchased within the primary study area. These purchases would provide the local economy with increased sales and profits over the 36-month construction period. This impact would be beneficial.

A large amount of construction material (e.g., concrete, rock) would be needed to raise Shasta Dam by 6.5 feet, as prescribed in CP1. Of this material, it is expected that most would be sourced from businesses within the primary study area. As a result of the large quantity of purchases expected, local businesses would experience temporary increases in sales and profits over the 36-month construction period. Increased sales and profits could be reinvested into existing businesses, invested in new ventures or diversification, translated into increased salaries and wages for employees, or used in other ways. The exact scale of the increase in business sales and profits has not yet been calculated, but it is expected that this amount would be substantial. Therefore, this impact would be beneficial. Mitigation for this impact is not needed, and thus not proposed.

Impact Socio-6 (CP1): Short-Term Increase in State and Local Sales Tax Revenues in the Primary Study Area from Construction-Related Personal Income and Purchases As stated above, implementation of CP1 is expected to result in a substantial increase in total personal income (direct, indirect, and induced) during the construction period. This additional income, in combination with the construction-related purchases in the primary study area, would result in a substantial increase in local sales tax revenues from increased consumer spending in nearby cities and counties. Construction-related activities under CP1 would likely also result in a temporary increase in State sales and income tax revenues received from businesses and residents of the primary study area. The exact amount of State and local sales tax revenue increases has not yet been calculated; however, this impact would be beneficial.

Based on the results of modeling performed using Reclamation's IMPLAN model, implementation of CP1 is expected to generate more than $550.7 million in total personal income, with approximately $378.4 million in direct income and $172.3 million in indirect and induced income during the proposed 36-month construction period. In addition to this increase in personal incomes, most of the construction materials would be purchased within the primary study area, generating a substantial amount of revenue and profits for local businesses.

In combination, increased personal incomes and construction-related spending are expected to substantially increase the total sales tax revenues of local jurisdictions within the primary study area. Larger amounts of local sales tax revenue could then be used to establish new programs and initiatives or bolster existing ones through additional funding. New and improved programs and initiatives would provide benefits to local residents.

As a result of the increased employment and personal incomes anticipated from implementation of CP1, it is expected that a temporary increase in State sales and income tax would likely occur. During the construction period, more than $550.7 million in personal income is expected to be generated by direct, indirect, and induced employment produced by the project. The increase in personal income would increase spending at local businesses within the primary study area, and this additional spending would result in sizeable State sales tax revenues. This increased revenue source would likely return to the primary study area via statewide programs and policies.

For the reasons described above, this impact would be beneficial. Mitigation for this impact is not needed, and thus not proposed.

Impact Socio-7 (CP1): Long-Term Reduction in the Adverse Economic Effects of Flooding in the Primary Study Area As a result of the added reservoir capacity created by CP1, the overall risk of flooding below Shasta Dam and its related consequences to the primary study area are expected to be reduced. Although heavy-rain events would continue to occur in the region and locally, the project is intended to provide greater flexibility in flood control downstream because of the increased capacity of the reservoir. As a result, there would be less damage to existing structures and a smaller loss of potential future development; this, in turn, would reduce salary and wage losses for residents of the primary study area, as well as business and personal income losses from such damage. Therefore, this impact would be beneficial.

In Reclamation's *Initial Alternatives Information Report* (Reclamation 2004), flood control was identified as a secondary objective of the project. Increased flood control is to be emphasized when the two primary objectives of the project, increased fish survival and increased water supply reliability, can be met. Periodic flood events in the Sacramento Valley frequently cause substantial damage to properties adjacent to the valley's many waterways. Currently, Shasta Dam provides substantial protection from such flooding damage for downstream residents.

CP1 would increase the storage capacity of Shasta Lake by 256,000 acre-feet. This added capacity would provide greater flexibility in Reclamation's ability to use the reservoir for flood control purposes, thereby increasing the threshold at which seasonal heavy-rain events produce flood conditions downstream from the dam. The benefits of this increase in capacity and related flood control options would be most evident along the upper Sacramento River within the

primary study area. Structures and inhabitants in this floodplain experience the most direct effects from storage releases during flood events. CP1 would reduce the frequency, magnitude, and duration of future flood events that have affected structures and their residents in this part of the primary study area in the past.

The loss of jobs and adverse effects on economic well-being and livelihoods is an often-overlooked consequence of catastrophic flood events. Avoiding a larger number of these events, and possibly decreasing the magnitude and duration of flooding under certain high-flow events, is expected to reduce the overall economic hardships faced by residents of the primary study area.

Structures and businesses located on the river and inhabitants of the floodplain experience the most direct effects from flood releases downstream. However, flood events could also affect those who do not live on the river or in the floodplain but work downstream from the dam at businesses subject to flood damage. The reduced risk of flood events associated with CP1 is expected to also reduce the business and personal income losses resulting from substantial damage to structures and businesses located adjacent to downstream waterways in the primary study area.

Implementation of CP1 would reduce damage to structures, loss of business and personal income, loss of jobs, and other adverse effects on economic well-being in the primary study area. Therefore, this impact would be beneficial. Mitigation for this impact is not needed, and thus not proposed.

Impact Socio-8 (CP1): Long-Term Increases in Direct Employment in the Primary Study Area Related to Project Operations In the long term, it is expected that implementation of CP1 would create at least two new maintenance-related positions for the Shasta Dam facilities. These two positions are expected to be permanent and would continue once the 36-month construction period is complete. This impact would be beneficial.

Reclamation estimates that with the 6.5-foot increase of Shasta Dam proposed in CP1, at least two new permanent maintenance positions would be required to ensure efficient operation of dam facilities. These two positions are expected to be union positions, and would consequently provide union-level wages and benefits. Both positions would be filled after completion of the construction activities associated with CP1 and would continue for the foreseeable future. This impact, though small, would be beneficial. Mitigation for this impact is not needed, and thus not proposed.

Lower Sacramento River and Delta

Impact Socio-9 (CP1): Potential Temporary Increase in Indirect Employment in Construction-Related Businesses of the Lower Sacramento River and Delta
Construction activities associated with CP1 have the potential to result in a temporary increase in indirect employment within the lower Sacramento River and Delta portion of the extended study area. Depending on the location of

construction materials sourced outside of the primary study area, indirect increases in employment within construction-related businesses may result in the lower Sacramento River and Delta area. This impact would be beneficial.

As a result of construction activities that would be completed during implementation of CP1, temporary increases in indirect employment would be expected in the lower Sacramento River and Delta portion of the extended study area. It is expected that a small amount of the construction materials necessary for CP1 are expected to be obtained from outside the primary study area. During the construction period, businesses that provide construction materials would be expected to increase employment to meet project demand. This impact would be beneficial. Mitigation for this impact is not needed, and thus not proposed.

Impact Socio-10 (CP1): Short-Term Increases in Sales and Profits for Businesses in the Lower Sacramento River and Delta Area That Support the Construction Industry It is expected that a small amount of the construction materials used for CP1 are expected to be purchased within the extended study area. These purchases are predicted to increase sales and profits of businesses within the lower Sacramento River and Delta area during the construction period. This impact would be beneficial.

A significant amount of construction materials would be needed to raise Shasta Dam by 6.5 feet, as prescribed in CP1. Of these materials, it is expected that a small amount would be purchased from construction-related businesses in the extended study area, including the lower Sacramento River and Delta area. These purchases may include raw or refined materials, infrastructure-related products, and/or equipment required for the construction process. As a result of the purchases expected, businesses in the lower Sacramento River and Delta portion of the extended study area are expected to experience a temporary increase in sales and profits during the construction period. Similar to businesses within the primary study area, increased sales and profits could be reinvested into the existing businesses, invested in new ventures or diversification, translated into increased salaries and wages for employees, or used in other ways. The exact scale of the increase in business sales and profits within the lower Sacramento River and Delta area has not yet been calculated, but it is assumed that this amount would be substantial. Therefore, this impact would be beneficial. Mitigation for this impact is not needed, and thus not proposed.

Impact Socio-11 (CP1): Short-Term Increase in State Sales and Income Tax Revenues in the Lower Sacramento River and Delta Area from Construction-Related Personal Income and Purchases In addition to local tax revenues, CP1 is expected to increase short-term construction-related State sales and income tax revenues received from businesses and residents of the lower Sacramento River and Delta portion of the extended study area. These additional revenues are expected to be cycled back to local government coffers through statewide programs and policies. This impact would be beneficial.

As a result of the increased employment and personal incomes anticipated as a part of implementation of CP1, it is expected that a short-term increase in State sales and income tax revenues would also occur. In the construction period, more than $550.7 million in personal income would be generated by direct, indirect, and induced employment produced by the project. This large amount of income would direct substantial income tax revenues to the State via State income tax requirements. These additional revenues would contribute substantially to the State budget and would be distributed to jurisdictions within the lower Sacramento River and Delta portion of the extended study area via statewide programs and policies. This impact would be beneficial. Mitigation for this impact is not needed, and thus not proposed.

Impact Socio-12 (CP1): Long-Term Reduction in the Adverse Economic Effects of Flooding in the Lower Sacramento River and Delta Area As a result of the added reservoir capacity under CP1, the overall risk of flooding and its related consequences below Shasta Dam is expected to be reduced. Although heavy-rain events would continue to occur in the region, CP1 is intended to provide greater flexibility in flood control in the lower Sacramento River and Delta area because of the increased capacity of the reservoir. As a result, less damage to existing structures and a smaller loss of potential future development would be expected; this, in turn, would reduce salary and wage losses for residents in and near the lower Sacramento River floodplain and the Delta resulting from these catastrophic events, as well as business and personal income losses from such damage. Therefore, this impact would be beneficial.

Residents of the lower Sacramento River and Delta portion of the extended study area would benefit from the additional flexibility and flood control operations during flood events that would occur as a result of CP1. With the additional capacity provided by this alternative, the effects of large rain events would be reduced as a result of the improved management of systemwide flood control operations. Hydroelectric facilities within the lower Sacramento River and Delta area would likely experience flood events of somewhat less duration and magnitude, thus reducing the potential effects on vulnerable houses and property within the floodplain.

The loss of jobs and adverse effects on economic well-being and livelihoods is an often-overlooked consequence of catastrophic flood events. Avoiding a larger number of these events, and possibly decreasing the magnitude and duration of floods under certain high-flow events, is expected to reduce the overall economic hardships faced by residents of the lower Sacramento River and Delta areas. The effects of heavy-rain events would be better managed and the risk of flood-related effects could be reduced as far downstream as Sacramento.

In addition, fewer flooding events would result in less damage to businesses located adjacent to waterways during some flood events. This reduction in damage would reduce the amount of time employees would be without pay

because of flood conditions and damage. This reduction in flood damage would reduce residents' salary and wage losses from these catastrophic events.

Implementation of CP1 would reduce damage to structures, loss of business and personal income, loss of jobs, and other adverse effects on economic well-being in the lower Sacramento River and Delta areas. Therefore, this impact would be beneficial. Mitigation for this impact is not needed, and thus not proposed.

CVP/SWP Service Areas

Impact Socio-13 (CP1): Short-Term Increases in Sales and Profits for Businesses in the CVP and SWP Service Areas That Support the Construction Industry A small amount of the construction materials used during construction under CP1 are expected to be purchased within the extended study area, including the CVP and SWP service areas. These purchases are predicted to increase sales and profits of businesses within the CVP and SWP service areas during the construction period of CP1. This impact would be beneficial.

A small amount of the construction materials used during construction under CP1 are expected to be purchased from construction-related businesses in the extended study area, including the CVP and SWP service areas. These purchases may include raw or refined materials, infrastructure-related products, and/or equipment required for the construction process. As a result of the large quantity of purchases expected, businesses in the CVP and SWP service areas are expected to experience a short-term increase in sales and profits over the construction period. The exact scale of the increase in business sales and profits within the CVP and SWP service areas has not yet been calculated, but it is assumed that this amount would be substantial. Therefore, this impact would be beneficial. Mitigation for this impact is not needed, and thus not proposed.

Impact Socio-14 (CP1): Potential Temporary Reduction in Shasta Project Water or Hydropower Supplied to the CVP and SWP Service Areas During Construction Implementation of CP1 may require temporarily reducing the reservoir level either throughout the construction period or at critical times. This reduction in the reservoir level could temporarily reduce the amount of water or hydropower available from the dam and related hydropower infrastructure. Should this occur, sources of replacement water or hydropower would need to be secured. If these replacement resources were substantially more expensive, a minor negative effect on water or power customers may result. This impact would be potentially significant.

Construction activities implemented as part of CP1 would require adding large quantities of concrete to Shasta Dam. To complete this sizeable task, it may be necessary to reduce the reservoir's water table to accommodate construction. A reduced water table may be needed either for the duration of construction or at critical points in the construction process. Regardless of the approach needed, a reduced water table would limit the amount of water and/or hydropower that would be available from the dam for use in the CVP and SWP service areas. As

a result, there could be periods in which water or hydropower availability within the CVP and SWP system may be more limited, especially during dry periods.

To address potential temporary shortages in water or hydropower caused by reduced availability at Shasta Dam, replacement water or hydropower supplies would need to be sourced elsewhere to maintain current service needs. Depending on the conditions of the water or energy markets at the time of need, these replacement resources could be more expensive than water or hydropower obtained from Shasta Dam. The additional expense of obtaining water or hydropower resources could produce a minor negative effect on water and power customers if replacing these resources would be substantially more expensive. This impact would be potentially significant. Mitigation for this impact is proposed in Section 16.3.5.

Impact Socio-15 (CP1): Short-Term Increase in State Sales and Income Tax Revenues in the CVP and SWP Service Areas from Construction-Related Personal Income and Purchases CP1 is expected to increase short-term construction-related State sales and income tax revenues received from businesses and residents of the CVP and SWP service areas. These additional revenues are expected to be cycled back to local government coffers through statewide programs and policies. This impact would be beneficial.

As a result of the increased employment and personal incomes anticipated as a part of implementation of CP1, it is expected that a short-term increase in State sales and income tax revenues would occur. During the construction period for CP1, more than $550.7 million in personal income would be generated by direct, indirect, and induced employment produced by the project. This large amount of income would direct substantial income tax revenues to the State via State income tax requirements. These additional revenues would contribute substantially to the State budget and would be distributed to jurisdictions within the CVP and SWP service areas via statewide programs and policies. This impact would be beneficial. Mitigation for this impact is not needed, and thus not proposed.

Impact Socio-16 (CP1): Long-Term Increase in Agricultural Income and Jobs in the CVP and SWP Service Areas as a Result of Improved Water Availability and Reliability Based on CVPM modeling, improved water availability and reliability expected to result from implementation of CP1 would substantially increase agricultural net income in the CVP and SWP service areas and increase the number of agricultural positions in these areas. This increase in production and jobs would contribute substantially to the continuation of this already strong industry in California. This impact would be beneficial.

Of the CVP and SWP's water users, agricultural users benefit the most from increased water availability and reliability because of more consistent irrigation opportunities throughout the year. Based on the outputs of CVPM modeling, CP1 would improve long-term water availability and reliability within the CVP

and SWP service areas via adding water storage capacity. Long-term improvements to the availability and reliability of water are expected to allow farmers within the CVP and SWP service areas to substantially increase agricultural production, especially in dry years. It was estimated that CP1 would increase the net agricultural income within the 22 CVPM regions by more than $3.3 million in an average year and up to $11.1 million during dry years. In wet years, net income is projected to decrease slightly ($400,000).

To support the increased agricultural production expected during the implementation of CP1, more agricultural workers would be needed. The CVPM does not estimate the number of additional agricultural positions that would be created as a result of improved irrigation, but the resulting increase in water reliability and availability has the potential to strengthen and extend the existing growing season in the CVP and SWP service areas. This would enable existing employees to work for a longer period in the fields, while also increasing the total workers needed during the growing season. These additional agricultural workers are expected to be distributed across the CVP and SWP service areas. This impact would be beneficial. Mitigation for this impact is not needed, and thus not proposed.

Impact Socio-17 (CP1): Reduction in Risk of Potential Water and Power Shortages (and Related Economic Activity) in the CVP and SWP Service Areas as a Result of Long-Term Improvements to Water and Power Supply Reliability
Implementation of CP1 would substantially increase Shasta Dam's storage capacity. As stated in Impact Socio-16 (CP1), this additional storage capacity would improve the long-term availability and reliability of water in the CVP and SWP service areas. Beyond increasing agricultural production, this improved availability and reliability would reduce the long-term risk of urban water and power shortages, and their related adverse economic consequences, in the future. This impact would be beneficial.

In addition to improving agricultural production, implementation of CP1 would increase water availability and reliability for industrial and urban users within the CVP and SWP service areas. For these users, the additional 265,000 acre-feet of storage capacity proposed by CP1 is expected to substantially reduce the long-term risk of water and power shortages from periodic flow constraints. As a result, water and power users would likely experience fewer water and power shortages caused by reduced reservoir levels, such as those experienced in dry years. This reduction in water and power shortages, along with avoidance of the related loss of economic production, represents a substantial benefit for users in the CVP and SWP service areas. This benefit would be most pronounced for water- and power-intensive industries that are heavily dependent on consistent water and power availability. This impact would be beneficial. Mitigation for this impact is not needed, and thus not proposed.

CP2 – 12.5-Foot Dam Raise, Anadromous Fish Survival and Water Supply Reliability

CP2 would increase the full pool capacity of Shasta Lake to 4,995 TAF and increase the surface area of the pool of the reservoir to 31,350 acres. It is expected that implementing CP2 would result in the replacement or modification of eight bridges and relocation of approximately 100 existing structures. The total construction cost associated with CP2 would be approximately $913 million and the annual operational cost would be $46.4 million. This alternative would generate approximately $25.0 million in annual water supply reliability benefits and $9.6 million average annual equivalent anadromous fish restoration benefits. CP2 would increase hydropower generation by approximately 68 GWh per year, equivalent to approximately $3.9 million in hydropower benefits.

Shasta Lake and Vicinity and Upper Sacramento River (Shasta Dam to Red Bluff)

Impact Socio-1 (CP2): Short-Term Increase in Population and Housing Demand in the Primary Study Area Resulting from Construction-Related Activities According to Reclamation estimates, approximately 370 new direct jobs would be created as a result of construction activities associated with CP2. All 370 construction workers are expected to come from the local labor force; therefore, a short-term population increase is not expected. This impact would be less than significant.

This impact is similar to Impact Socio-1 (CP1). A 48-month construction period was considered here for CP2. As described above under Impact Socio-1 (CP1), a short-term population increase is not expected with implementation of CP2. This impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact Socio-2 (CP2): Short-Term Increases in Direct, Indirect, and Induced Employment in the Primary Study Area Related to Construction Activities Construction activities associated with CP2 are assumed to generate approximately 370 new direct construction jobs, 480 indirect jobs in various construction-related support industries, and 650 induced jobs because of increased household spending in the primary study area. Individuals to fill these jobs are expected to be drawn from the local community. These new jobs are expected to provide important but temporary employment opportunities to many unemployed construction workers in the primary study area. This impact would be beneficial.

This impact is similar to Impact Socio-2 (CP1). Under CP2, approximately 370 new short-term, direct construction jobs would be created, in addition to 480 indirect jobs expected to be created in various construction-related support industries, and 650 induced jobs created because of increased household spending near the project area. Total direct, indirect, and induced employment under CP2 would be less than CP1; however, these positions would last

approximately 48 months under CP2, compared to 36 months under CP1. This impact would be beneficial. Mitigation for this impact is not needed, and thus not proposed.

Impact Socio-3 (CP2): Potential for Temporary Reduction in the Labor Force of Related Industrial Sectors in the Primary Study Area as a Result of Direct Construction-Related Employment With the creation of 370 new construction jobs resulting from CP2, the potential exists for workers from other industries to move to jobs related to construction at Shasta Dam. Given the size of the construction industry in the primary study area, and the high unemployment rate in the area, this impact would be less than significant.

This impact would be similar to Impact Socio-3 (CP1) and would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact Socio-4 (CP2): Short-Term Increases in Direct, Indirect, and Induced Personal Income Paid to Employees in the Primary Study Area Hired for Construction-Related Activities Based on calculations completed as a part of Reclamation's IMPLAN socioeconomic model process, it is estimated that more than $104.4 million in personal income would be directly paid to employees in the primary study area each year of the 48 month construction period under CP2. This amount of personal income is a more than 1.4 percent increase in annual income in the local economic study area. In addition, approximately $47.6 million in indirect and induced income is expected to be generated in various construction-related and other industries in the primary study area each year of construction under CP2. This impact would be beneficial.

This impact is similar to Impact Socio-4 (CP1). CP2 is estimated to generate $104.4 million in direct personal income each year of construction from the 370 direct construction-related jobs that would be created. This amount of personal income is roughly a 1.4 percent increase in annual income in the local economic study area. In addition, indirect and induced personal income totaling $47.6 million per year of construction is expected to be generated in various construction-related and other industries in the primary study area that would support construction under CP2.

Taken together, it is expected that direct, indirect, and induced personal income resulting from CP2 would be approximately $152.0 million per year of construction within the local economic study. Direct, indirect, and induced annual personal income under CP2 would be less than CP1; however, this income would be generated over 48 months under CP2 (for a total of $608.0 million), compared to 36 months under CP1 (for a total of $550.7 million). This impact would be beneficial. Mitigation for this impact is not needed, and thus not proposed.

Impact Socio-5 (CP2): Short-Term Increases in Sales and Profits for Businesses in the Primary Study Area that Support the Construction Industry Most of the construction materials used for CP2 are expected to be purchased within the primary study area. These purchases would provide the local economy with increased sales and profits over the 48-month construction period. This impact would be beneficial.

This impact is similar to but more beneficial than Impact Socio-5 (CP1). Because of the longer project duration and larger dam raise proposed under CP2, short-term increases in sales and profits for businesses in the primary study area would be larger than those under CP1. The size of these increases has not yet been quantified, but it is expected that the additional time and materials required to implement CP2 would generate more sales and profits than CP1 for construction-related and service-oriented businesses. This impact would be beneficial. Mitigation for this impact is not needed, and thus not proposed.

Impact Socio-6 (CP2): Short-Term Increase in State and Local Sales Tax Revenues in the Primary Study Area from Construction-Related Personal Income and Purchases As stated above, implementation of CP2 is expected to result in a substantial increase in total personal income (direct, indirect, and induced) over the 48-month construction period. This additional income, in combination with the construction-related purchases in the primary study area, would result in a substantial increase in local sales tax revenues from increased consumer spending in nearby cities and counties. Construction-related activities under CP2 would likely also result in a temporary increase in State sales and income tax revenues received from businesses and residents of the primary study area. The exact amount of State and local sales tax revenue increases has not yet been calculated; however, this impact would be beneficial.

This impact is similar to but more beneficial than Impact Socio-6 (CP1). Because of the larger total personal income (direct, indirect, and induced) over the construction period expected to result from implementation of CP2, it is assumed that the short-term increase in local sales tax revenues generated by CP2 would be greater than that from CP1. Construction-related activities under CP2 are also expected to result in a temporary increase in State sales and income tax revenues received from businesses and residents of the primary study area. These additional revenues would likely be cycled back to local government coffers through statewide programs and policies. The increases in State sales and income taxes are expected to be larger under CP2 than under CP1. All of these increases are expected to be more beneficial for the relevant local jurisdictions. This impact would be beneficial. Mitigation for this impact is not needed, and thus not proposed.

Impact Socio-7 (CP2): Long-Term Reduction in the Adverse Economic Effects of Flooding in the Primary Study Area As a result of the added reservoir capacity created by CP2, the overall risk of flooding below Shasta Dam and its related consequences to the primary study area are expected to be reduced.

Although heavy-rain events would continue to occur in the region and locally, the project is intended to provide greater flexibility in flood control downstream because of the increased capacity of the reservoir. As a result, there would be less damage to existing structures and a smaller loss of potential future development; this, in turn, would reduce salary and wage losses for residents of the primary study area, as well as business and personal income losses from such damage. Therefore, this impact would be beneficial.

This impact is similar to but more beneficial than Impact Socio-7 (CP1). CP2 would increase the total storage capacity of Shasta Lake by 443,000 acre-feet. CP2 would therefore provide approximately 187,000 acre-feet more storage capacity in the reservoir than CP1. This additional capacity provided with the 12.5-foot dam raise would increase the flood control capabilities compared to both existing conditions and CP1 by further reducing the risk of flooding downstream from Shasta Dam. The overall risk of flooding and its associated adverse effects on property, housing, and businesses downstream from Shasta Dam and residents throughout the primary study area would therefore be further reduced.

The increased storage capacity proposed as a part of CP2 would also reduce the risk of job loss from flooding and its related effects to a greater extent than the capacity increase proposed under CP1. The increased storage capacity would further reduce the risk of flood-level conditions downstream from the dam. Related effects from flooding on the economic livelihood of residents of the primary study area would similarly be reduced.

Fewer flooding events would occur and less damage would be inflicted on property adjacent to downstream waterways during some flood events. This reduction in flood damage would also reduce residents' salary and wage losses resulting from these catastrophic events.

For the reasons described above, this impact would be beneficial. Mitigation for this impact is not needed, and thus not proposed.

Impact Socio-8 (CP2): Long-Term Increases in Direct Employment in the Primary Study Area Related to Project Operations In the long term, it is expected that implementation of CP2 would create at least two new maintenance-related positions for the Shasta Dam facilities. These two positions are expected to be permanent and would continue once the 48-month construction period is complete. This impact would be beneficial.

This impact would be the same as Impact Socio-8 (CP1) and would be beneficial. Mitigation for this impact is not needed, and thus not proposed.

Lower Sacramento River and Delta

Impact Socio-9 (CP2): Potential Temporary Increase in Indirect Employment in Construction-Related Businesses of the Lower Sacramento River and Delta
Construction activities associated with CP2 have the potential to result in a short-term increase in indirect employment within the lower Sacramento River and Delta portion of the extended study area. Depending on the location of construction material sourced outside of the primary study area, indirect increases in employment within construction-related businesses may result in the lower Sacramento River and Delta area. This impact would be beneficial.

This impact is similar to but more beneficial than Impact Socio-9 (CP1). A larger potential temporary increase in indirect employment in construction-related businesses of the lower Sacramento River and Delta area would be expected under CP2 than under CP1. Estimated total construction costs for CP2 are approximately 10.4 percent higher than costs for CP1. Therefore, it is expected more income would be allocated to indirect positions in construction-related businesses under CP2. This impact would be beneficial. Mitigation for this impact is not needed, and thus not proposed.

Impact Socio-10 (CP2): Short-Term Increases in Sales and Profits for Businesses in the Lower Sacramento River and Delta Area That Support the Construction Industry It is expected that a small amount of the construction materials used for CP2 are expected to be purchased within the extended study area. These purchases are predicted to increase sales and profits of businesses within the lower Sacramento River and Delta area over the 48-month construction period of CP1. This impact would be beneficial.

This impact is similar to but more beneficial than Impact Socio-10 (CP1). Because of the longer project duration and larger dam raise proposed under CP2, short-term increases in sales and profits for construction-related businesses in the lower Sacramento River and Delta area are expected to be larger than those under CP1. The size of these increases has not yet been quantified, but because additional time and materials would be required, implementing CP2 would likely generate more sales and profits for construction-related and service-oriented businesses. This impact would be beneficial. Mitigation for this impact is not needed, and thus not proposed.

Impact Socio-11 (CP2): Short-Term Increase in State Sales and Income Tax Revenues in the Lower Sacramento River and Delta Area from Construction-Related Personal Income and Purchases In addition to local tax revenues, CP2 is expected to increase short-term construction-related State sales and income tax revenues received from businesses and residents of the lower Sacramento River and Delta portion of the extended study area. These additional revenues are expected to be cycled back to local government coffers through statewide programs and policies. This impact would be beneficial.

This impact is similar to but more beneficial than Impact Socio-11 (CP1) because the construction period would be longer and more construction materials would be needed. The increased employment and personal incomes anticipated as a part of implementation of CP2 are expected to cause an increase in short-term construction-related State sales and income tax revenues received from businesses and residents of the lower Sacramento River and Delta portion of the extended study area. These additional revenues would likely be cycled back to local government coffers through statewide programs and policies. This impact would be beneficial. Mitigation for this impact is not needed, and thus not proposed.

Impact Socio-12 (CP2): Long-Term Reduction in the Adverse Economic Effects of Flooding in the Lower Sacramento River and Delta Area As a result of the added reservoir capacity under CP2, the overall risk of flooding and its related consequences below Shasta Dam is expected to be reduced. Although heavy-rain events would continue to occur in the region, CP2 is intended to provide greater flexibility in flood control in the lower Sacramento River and Delta area because of the increased capacity of the reservoir. As a result, less damage to existing structures and a smaller loss of potential future development would be expected; this, in turn, would reduce salary and wage losses for residents in or near the lower Sacramento River floodplain and the Delta resulting from these catastrophic events, as well as business and personal income losses from such damage. Therefore, this impact would be beneficial.

This impact is similar to but more beneficial than Impact Socio-12 (CP1). CP2 would provide approximately 187,000 acre-feet more storage capacity in the reservoir than CP1. This additional capacity would increase the flood control capabilities beyond the existing capabilities at Shasta Dam and the capabilities proposed under CP1, and would further reduce the risk of flooding downstream from the dam. The overall risk of flooding and its associated adverse effects on property, housing, businesses, and residents of the lower Sacramento River and Delta area would be reduced with implementation of CP2. Flood risk reduction effects identified earlier for CP1 would apply to CP2, but the positive effects would be greater because of the direct relationship between the proposed dam heights, corresponding capacity of the reservoir, and associated increase in flood control operations and management flexibility.

Increased storage capacity proposed as a part of CP2 would also reduce the risk of job loss from flooding and its related effects in the lower Sacramento River and Delta area, when compared to CP1. A reduction in the risk of flood-level conditions downstream from the dam would thus strengthen the economic livelihood of downstream residents in the lower Sacramento River and Delta area.

Fewer flooding events would occur and less damage would be inflicted on businesses located adjacent to downstream waterways during some flood

events. This reduction in flood damage would reduce residents' salary and wage losses resulting from these catastrophic events.

For the reasons described above, this impact would be beneficial. Mitigation for this impact is not needed, and thus not proposed.

CVP/SWP Service Areas

Impact Socio-13 (CP2): Short-Term Increases in Sales and Profits for Businesses in the CVP and SWP Service Areas That Support the Construction Industry A small amount of the construction materials used during construction under CP2 are expected to be purchased within the extended study area, including the CVP and SWP service areas. These purchases are predicted to increase sales and profits of businesses within the CVP and SWP service areas over the 48-month construction period of CP2. This impact would be beneficial.

This impact is similar to but more beneficial than Impact Socio-13 (CP1). Because of the longer project duration and larger dam raise proposed under CP2, short-term increases in sales and profits for construction-related businesses in the extended study area, including the CVP and SWP service areas, are expected to be larger than those for CP1. The size of these increases has not yet been quantified, but it is expected that the additional time and materials required to implement CP2 would generate more sales and profits for construction-related and service-oriented businesses. This impact would be beneficial. Mitigation for this impact is not needed, and thus not proposed.

Impact Socio-14 (CP2): Potential Temporary Reduction in Shasta Project Water or Hydropower Supplied to the CVP and SWP Service Areas During Construction Implementation of CP2 may require temporarily reducing the reservoir level either throughout the 48-month project duration or at critical times. This reduction in the reservoir level could temporarily reduce the amount of water or hydropower available from the dam and related hydropower infrastructure. Should this occur, sources of replacement water or hydropower would need to be secured. If these replacement resources were substantially more expensive, a minor negative effect on water or power customers may result. This impact would be potentially significant.

This impact is similar to Impact Socio-14 (CP1), except that the project construction period would be longer and reductions in reservoir levels could last longer under CP2. This impact would be potentially significant. Mitigation for this impact is proposed in Section 16.3.5.

Impact Socio-15 (CP2): Short-Term Increase in State Sales and Income Tax Revenues in the CVP and SWP Service Areas from Construction-Related Personal Income and Purchases In addition to local tax revenue, CP2 is expected to increase short-term construction-related State sales and income tax revenues received from businesses and residents of the CVP and SWP service

areas. These additional revenues are expected to be cycled back to local government coffers through statewide programs and policies. This impact would be beneficial.

This impact is similar to but more beneficial than Impact Socio-15 (CP1). Short-term increases in State sales and income taxes are expected to be larger under CP2 than under CP1. All of these increases are expected to be more beneficial for the relevant local jurisdictions. This impact would be beneficial. Mitigation for this impact is not needed, and thus not proposed.

Impact Socio-16 (CP2): Long-Term Increase in Agricultural Income and Jobs in the CVP and SWP Service Areas as a Result of Improved Water Availability and Reliability Based on CVPM modeling, improved water availability and reliability expected to result from implementation of CP2 would substantially increase agricultural net income in the CVP and SWP service areas and increase the number of agricultural positions in these areas. This increase in production and jobs would contribute substantially to the continuation of this already strong industry in California. This impact would be beneficial.

This impact is similar to Impact Socio-16 (CP1). Because of the increase in the availability and reliability of water associated with implementation of CP2, the long-term increase in indirect employment within the agricultural sector is expected to be larger than under CP1. Based on the outputs of CVPM modeling, CP2 is estimated to generate an additional $11.5 million in net income during dry years and $7.1 million in average years, when compared to existing conditions. In wet years, net income is projected to decrease slightly ($200,000). This overall increase in net income is expected to stimulate more employment opportunities in the agricultural sector to support the higher crop production that would likely be the result of additional irrigation deliveries under CP2 (compared to CP1). This impact would be beneficial. Mitigation for this impact is not needed, and thus not proposed.

Impact Socio-17 (CP2): Reduction in Risk of Potential Water and Power Shortages (and Related Economic Activity) in the CVP and SWP Service Areas as a Result of Long-Term Improvements to Water and Power Supply Reliability Implementation of CP2 would substantially increase Shasta Dam's storage capacity. As stated in Impact Socio-16 (CP2), this additional storage capacity would improve the long-term availability and reliability of water in the CVP and SWP service areas. Beyond increasing agricultural production, this improved availability and reliability would reduce the long-term risk of urban water and power shortages, and their related adverse economic consequences, in the future. This impact would be beneficial.

This impact would be the similar to Impact Socio-17 (CP1) and would be beneficial. Mitigation for this impact is not needed, and thus not proposed.

CP3 – 18.5-Foot Dam Raise, Anadromous Fish Survival and Water Supply

CP3 would increase the full pool capacity of Shasta Lake to 5,186 TAF and increase the surface area of the pool to 32,100 acres. It is expected that implementing CP3 would result in the replacement or modification of eight bridges and relocation of approximately 130 existing structures. The total construction cost associated with CP3 would be approximately $1,064 million and the annual operational cost would be $53.7 million. This alternative would generate approximately $26.7 million in annual water supply reliability benefits and $25.0 million average annual equivalent anadromous fish restoration benefits. CP3 would increase hydropower generation by approximately 96 GWh per year, equivalent to approximately $5.4 million in hydropower benefits.

Shasta Lake and Vicinity and Upper Sacramento River (Shasta Dam to Red Bluff)

Impact Socio-1 (CP3): Short-Term Increase in Population and Housing Demand in the Primary Study Area Resulting from Construction-Related Activities According to Reclamation estimates, approximately 350 new direct jobs would be created as a result of construction activities associated with CP3. All 350 construction workers are expected to come from the local labor force; therefore, a short-term population increase is not expected. This impact would be less than significant.

This impact is similar to Impacts Socio-1 (CP1) and Socio-1 (CP2). CP3 would add 191,000 acre-feet of storage capacity beyond the capacity anticipated in CP2, for a total increase of 634,000 acre-feet. As with the other two dam raise alternatives, approximately 350 new construction workers would be needed to complete the 18.5-foot raise proposed in CP3. Approximately 60 months of work (compared to the 48 months proposed under CP2) would be required to complete the construction activities proposed under CP3. Workers for this effort would also come from the local labor pool. This impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact Socio-2 (CP3): Short-Term Increases in Direct, Indirect, and Induced Employment in the Primary Study Area Related to Construction Activities
Construction activities associated with CP3 are assumed to generate approximately 350 new direct construction jobs, 450 indirect jobs in various construction-related support industries, and 610 induced jobs because of increased household spending in the primary study area. Individuals to fill these jobs are expected to be drawn from the local community. These new jobs are expected to provide important but temporary employment opportunities to many unemployed construction workers in the primary study area. This impact would be beneficial.

This impact is similar to Impact Socio-2 (CP1) and Socio-2 (CP2). Under CP3, approximately 350 new short-term, direct construction jobs would be created, in addition to 450 indirect jobs expected to be created in various construction-related support industries, and 610 induced jobs created because of increased

household spending near the project area. Total direct, indirect, and induced employment under CP3 would be less than CP1 and CP2; however, these positions would last approximately 60 months under CP3, compared to 36 months under CP1 and 48 months under CP2. This impact would be beneficial. Mitigation for this impact is not needed, and thus not proposed.

Impact Socio-3 (CP3): Potential for Temporary Reduction in the Labor Force of Related Industrial Sectors in the Primary Study Area as a Result of Direct Construction-Related Employment With the creation of 350 new construction jobs resulting from CP3, the potential exists for workers from other industries to move to jobs related to construction at Shasta Dam. Given the size of the construction industry in the primary study area, and the high unemployment rate in the area, this impact would be less than significant.

This impact would be similar to Impacts Socio-3 (CP1) and Socio-3 (CP2) and would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact Socio-4 (CP3): Short-Term Increases in Direct, Indirect, and Induced Personal Income Paid to Employees in the Primary Study Area Hired for Construction-Related Activities Based on calculations completed as a part of Reclamation's IMPLAN socioeconomic model process, it is estimated that more than $97.3 million in personal income would be directly paid to employees in the primary study area each year of the 60 month construction period under CP3. This amount of personal income is a more than 1.3 percent increase in income in the local economic study area. In addition, more than $44.3 million in indirect and induced income is expected to be generated in various construction-related and other industries in the primary study area each year of construction under CP3. This impact would be beneficial.

This impact is similar to Impacts Socio-4 (CP1) and Socio-4 (CP2). CP3 is estimated to generate $97.3 million in direct personal income each year of construction from the 350 direct construction-related jobs that would be created. This amount of personal income is roughly a 1.3 percent increase in annual income in the local economic study area. In addition, indirect and induced personal income totaling $44.3 million per year of construction is expected to be generated in various construction-related and other industries in the primary study area that would support construction under CP3.

Taken together, it is expected that direct, indirect, and induced personal income resulting from CP3 would be approximately $141.7 million per year of construction within the local economic study. Direct, indirect, and induced annual personal income under CP3 would be less than CP1 and CP2; however, this income would be generated over 60 months under CP2 (for a total of $708.4 million), compared to 36 months under CP1 (for a total of $550.7 million) and to 48 months under CP2 (for a total of $608.0 million). This impact

would be beneficial. Mitigation for this impact is not needed, and thus not proposed.

Impact Socio-5 (CP3): Short-Term Increases in Sales and Profits for Businesses in the Primary Study Area that Support the Construction Industry Most of the construction materials used for CP3 are expected to be purchased within the primary study area. These purchases would provide the local economy with increased sales and profits over the 60-month construction period. This impact would be beneficial.

This impact is similar to but more beneficial than Impacts Socio-5 (CP1) and Socio-5 (CP2). CP3 would require the largest dam height increase and therefore the greatest construction expenditures over the total construction period. As a result, CP3 is expected to generate more business sales and profits than CP1 and CP2 in construction-related and service-oriented businesses in the primary study area. This impact would be beneficial. Mitigation for this impact is not needed, and thus not proposed.

Impact Socio-6 (CP3): Short-Term Increase in State and Local Sales Tax Revenues in the Primary Study Area from Construction-Related Personal Income and Purchases As stated above, implementation of CP3 is expected to result in a substantial increase in total personal income (direct, indirect, and induced) over the 60-month construction period. This additional income, in combination with the construction-related purchases in the primary study area, would result in a substantial increase in local sales tax revenues from increased consumer spending in nearby cities and counties. Construction-related activities under CP3 would likely also result in a temporary increase in State sales and income tax revenues received from businesses and residents of the primary study area. The exact amount of State and local sales tax revenue increases has not yet been calculated: however, this impact would be beneficial.

This impact is similar to but more beneficial than Impacts Socio-6 (CP1) and Socio-6 (CP2). CP3 is estimated to generate more direct personal income than CP1 and CP2. This larger amount of personal income generated is expected to result in more local sales tax revenues in the primary study area than under the other two alternatives. Construction-related activities under CP3 are also expected to result in a temporary increase in State sales and income tax revenues received from businesses and residents of the primary study area. These additional revenues would likely be cycled back to local government coffers through statewide programs and policies. This impact would be beneficial. Mitigation for this impact is not needed, and thus not proposed.

Impact Socio-7 (CP3): Long-Term Reduction in the Adverse Economic Effects of Flooding in the Primary Study Area As a result of the added reservoir capacity created by CP3, the overall risk of flooding and its related consequences below Shasta Dam are expected to be reduced. Although heavy-rain events would continue to occur in the region and locally, the project is

intended to provide greater flexibility in flood control downstream because of the increased capacity of the reservoir. As a result, there would be less damage to existing structures and a smaller loss of potential future development; this, in turn, would reduce salary and wage losses for residents of the primary study area, as well as business and personal income losses from such damage. Therefore, this impact would be beneficial.

This impact is similar to but more beneficial than Impacts Socio-7 (CP1) and Socio-7 (CP2). CP3 would create 634,000 acre-feet more storage capacity than current capacity, more than 40 percent more than would be provided by CP2. CP3 would therefore provide substantially more flood protection than either CP1 or CP2. As a result, CP3 would result in a greater reduction than CP1 and CP2 in the risk of damage to property and structures from flooding along the upper Sacramento River.

The increased storage capacity proposed as a part of CP3 would result in a larger decrease in the risk of job loss from flooding and its related effects than would occur under CP1 or CP2. CP3 would increase storage space in Shasta Lake and provide approximately 191,000 more acre-feet of storage than either of the two previous alternatives. The increased storage capacity would create a greater reduction in the risk of flood-level conditions downstream from the dam. Related effects from flooding on the economic livelihood of residents of the primary study area would similarly be reduced. In addition, the reduction in flood damage would reduce residents' salary and wage losses resulting from these catastrophic events.

For the reasons described above, this impact would be beneficial. Mitigation for this impact is not needed, and thus not proposed.

Impact Socio-8 (CP3): Long-Term Increases in Direct Employment in the Primary Study Area Related to Project Operations In the long term, it is expected that implementation of CP3 would create at least two new maintenance-related positions for the Shasta Dam facilities. These two positions are expected to be permanent and would continue once the 60-month construction period is complete. This impact would be beneficial.

This impact would be the same as Impacts Socio-8 (CP1) and Socio-8 (CP2) and would be beneficial. Mitigation for this impact is not needed, and thus not proposed.

Lower Sacramento River and Delta

Impact Socio-9 (CP3): Potential Temporary Increase in Indirect Employment in Construction-Related Businesses of the Lower Sacramento River and Delta Construction activities associated with CP3 have the potential to result in a short-term increase in indirect employment within the lower Sacramento River and Delta portion of the extended study area. Depending on the location of construction materials sourced outside of the primary study area, indirect

increases in employment within construction-related businesses may result in the lower Sacramento River and Delta area. This impact would be beneficial.

This impact is similar to but more beneficial than Impact Socio-9 (CP2). A larger potential temporary increase in indirect employment in construction-related businesses of the lower Sacramento River and Delta area would be expected under CP3. Estimated total construction costs for CP3 are approximately 16.5 percent higher than costs for CP2. Therefore, it is expected more income would be allocated to indirect positions in construction-related businesses would be expected under CP3. This impact would be beneficial. Mitigation for this impact is not needed, and thus not proposed.

Impact Socio-10 (CP3): Short-Term Increases in Sales and Profits for Businesses in the Lower Sacramento River and Delta Area That Support the Construction Industry It is expected that a small amount of the construction materials used for CP3 are expected to be purchased within the extended study area. These purchases are predicted to increase sales and profits of businesses within the lower Sacramento River and Delta area over the 60-month construction period of CP3. This impact would be beneficial.

This impact is similar to but more beneficial than Impacts Socio-10 (CP1) and Socio-1 (CP2). Because of the longer project duration and greater construction expenditures associated with the larger dam raise proposed under CP3, short-term increases in sales and profits for construction-related businesses in the lower Sacramento River and Delta area are expected to be larger than those CP2. The size of these increases has not yet been quantified, but it is expected that because additional time and materials would be required, implementing CP3 would generate more sales and profits for construction-related and service-oriented businesses. This impact would be beneficial. Mitigation for this impact is not needed, and thus not proposed.

Impact Socio-11 (CP3): Short-Term Increase in State Sales and Income Tax Revenues in the Lower Sacramento River and Delta Area from Construction-Relate Personal Income and Purchases In addition to local tax revenues, CP3 is expected to increase short-term construction-related State sales and income tax revenues received from businesses and residents of the lower Sacramento River and Delta portion of the extended study area. These additional revenues are expected to be cycled back to local government coffers through statewide programs and policies. This impact would be beneficial.

This impact is similar to but more beneficial than Impacts Socio-11 (CP1) and Socio-11 (CP2) because the construction period would be longer and more construction materials would be needed. The increased employment and personal incomes anticipated as a part of implementation of CP3 are expected to cause an increase in short-term construction-related State sales and income tax revenues received from businesses and residents of the lower Sacramento River and Delta portion of the extended study area. These additional revenues would

likely be cycled back to local government coffers through statewide programs and policies. This impact would be beneficial. Mitigation for this impact is not needed, and thus not proposed.

Impact Socio-12 (CP3): Long-Term Reduction in the Adverse Economic Effects of Flooding in the Lower Sacramento River and Delta Area As a result of the added reservoir capacity under CP3, the overall risk of flooding and its related consequences below Shasta Dam is expected to be reduced. Although heavy-rain events would continue to occur in the region, CP3 is intended to provide greater flexibility in flood control in the lower Sacramento River and Delta area because of the increased capacity of the reservoir. As a result, less damage to existing structures and a smaller loss of potential future development would be expected; this, in turn, would reduce salary and wage losses for residents in and near the lower Sacramento River floodplain and the Delta resulting from these catastrophic events, as well as business and personal income losses from such damage. Therefore, this impact would be beneficial.

This impact is similar to but more beneficial than Impact Socio-12 (CP2). CP3 would provide approximately 191,000 acre-feet more storage capacity in the reservoir than CP2. This additional capacity would increase the flood control capabilities beyond the existing capabilities at Shasta Dam and the capabilities proposed under CP2, and would further reduce the risk of flooding downstream from the dam. The overall risk of flooding and its associated adverse effects on property, housing, businesses, and residents of the lower Sacramento River and Delta area would be reduced with implementation of CP3. Flood risk reduction effects identified earlier for CP2 would apply to CP3, but the positive effects would be greater because of the direct relationship between the proposed dam heights, corresponding capacity of the reservoir, and associated increase in flood control operations and management flexibility.

Increased storage capacity proposed as a part of CP3 would also reduce the risk of job loss from flooding and its related effects in the lower Sacramento River and Delta, when compared to CP2. A reduction in the risk of flood-level conditions downstream from the dam would thus strengthen the economic livelihood of downstream residents in the lower Sacramento River and Delta portion of the extended study area. This impact would be beneficial. Mitigation for this impact is not needed, and thus not proposed.

CVP/SWP Service Areas

Impact Socio-13 (CP3): Short-Term Increases in Sales and Profits for Businesses in the CVP and SWP Service Areas That Support the Construction Industry A small amount of the construction materials used during construction under CP3 are expected to be purchased within the extended study area. These purchases are predicted to increase sales and profits of businesses within the CVP and SWP service areas over the 60-month construction period of CP3. This impact would be beneficial.

This impact is similar to but more beneficial than Impacts Socio-13 (CP1) and Socio-13 (CP2) because the construction period would be longer and more construction materials would be needed. This impact would be beneficial. Mitigation for this impact is not needed, and thus not proposed.

Impact Socio-14 (CP3): Potential Temporary Reduction in Shasta Project Water or Hydropower Supplied to the CVP and SWP Service Areas During Construction Implementation of CP3 may require temporarily reducing the reservoir level either throughout the 60-month construction period or at critical times. This reduction in the reservoir level could temporarily reduce the amount of water or hydropower available from the dam and related hydropower infrastructure. Should this occur, sources of replacement water or hydropower would need to be secured. If these replacement resources were substantially more expensive, a minor negative effect on water or power customers may result. This impact would be potentially significant.

This impact is similar to Impacts Socio-14 (CP1) and Socio-14 (CP2), except that the project construction period would be longer. This impact would be potentially significant. Mitigation for this impact is proposed in Section 16.3.5.

Impact Socio-15 (CP3): Short-Term Increase in State Sales and Income Tax Revenues in the CVP and SWP Service Areas from Construction-Related Personal Income and Purchases In addition to local tax revenue, CP3 is expected to increase short-term construction-related State sales and income tax revenues received from businesses and residents of the CVP and SWP service areas. These additional revenues are expected to be cycled back to local government coffers through statewide programs and policies. This impact would be beneficial.

This impact is similar to but more beneficial than Impact Socio-15 (CP2). Short-term increases in State sales and income taxes are expected to be larger under CP3 than under CP2. All of these increases are expected to be more beneficial for the relevant local jurisdictions. This impact would be beneficial. Mitigation for this impact is not needed, and thus not proposed.

Impact Socio-16 (CP3): Long-Term Increase in Agricultural Income and Jobs in the CVP and SWP Service Areas as a Result of Improved Water Availability and Reliability Based on CVPM modeling, improved water availability and reliability expected to result from implementation of CP3 would substantially increase agricultural net income in the CVP and SWP service areas and increase the number of agricultural positions in these areas. This increase in production and jobs would contribute substantially to the continuation of this already strong industry in California. This impact would be beneficial.

This impact is similar to Impacts Socio-16 (CP1) and Socio-16 (CP2). Because of the increase in the availability and reliability of water associated with implementation of CP3, the long-term increase in indirect employment within

the agricultural sector is expected to be larger than under CP1 and CP2 (6.5-foot and 12.5-foot dam raise, respectively). Based on the outputs of CVPM modeling, CP3 is estimated to generate an additional $15.3 million in net income during dry years and $6.8 million in average years, when compared to existing conditions. In wet years, CP3 is expected to produce a $700,000 increase in net income. This increase is in contrast to the loss in net income projected for CP1 and CP2. The projected increase in net income under CP3 is expected to stimulate a greater number of employment opportunities in the agricultural sector than under CP1 and CP2, because this alternative would likely generate higher crop production. This impact would be beneficial. Mitigation for this impact is not needed, and thus not proposed.

Impact Socio-17 (CP3): Reduction in Risk of Potential Water and Power Shortages (and Related Economic Activity) in the CVP and SWP Service Areas as a Result of Long-Term Improvements to Water and Power Supply Reliability Implementation of CP3 would substantially increase Shasta Dam's storage capacity. As stated in Impact Socio-16 (CP3), this additional storage capacity would improve long-term water availability and reliability in the CVP and SWP service areas. Beyond increasing agricultural production, this improved availability and reliability would reduce the long-term risk of urban water and power shortages, and their related adverse economic consequences, in the future. This impact would be beneficial.

This impact would be the similar to the other CPs and would be beneficial. Mitigation for this impact is not needed, and thus not proposed.

CP4 – 18.5-Foot Dam Raise, Anadromous Fish Focus with Water Supply Reliability

CP4 would increase the full pool capacity of Shasta Lake to 5,186 TAF and increase the surface area of the pool to 32,100 acres. It is expected that implementing CP4 would result in the replacement or modification of eight bridges and relocation of approximately 130 existing structures. The total construction cost associated with CP4 would be approximately $1,070 million and the annual operational cost would be $54.0 million. This alternative would generate approximately $27.0 million in annual water supply reliability benefits and $49.2 million average annual equivalent anadromous fish restoration benefits. CP4 would generate approximately 138 GWh per year, equivalent to approximately $7.6 million in hydropower benefits.

Shasta Lake and Vicinity and Upper Sacramento River (Shasta Dam to Red Bluff)

Impact Socio-1 (CP4): Short-Term Increase in Population and Housing Demand in the Primary Study Area Resulting from Construction-Related Activities According to Reclamation estimates, approximately 350 new direct jobs would be created as a result of construction activities associated with CP4. All 350 construction workers are expected to come from the local labor force;

therefore, a short-term population increase is not expected. This impact would be less than significant.

This impact would be the same as Impact Socio-1 (CP3) and would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact Socio-2 (CP4): Short-Term Increases in Direct, Indirect, and Induced Employment in the Primary Study Area Related to Construction Activities Construction activities associated with CP4 are assumed to generate approximately 350 new construction jobs, 450 indirect jobs in various construction-related support industries, and 610 induced jobs because of increased household spending in the primary study area. Individuals to fill these jobs are expected to be drawn from the local community. These new jobs are expected to provide important but temporary employment opportunities to many unemployed construction workers in the primary study area. This impact would be beneficial.

This impact would be the same as Impact Socio-2 (CP3) and would be beneficial. Mitigation for this impact is not needed, and thus not proposed.

Impact Socio-3 (CP4): Potential for Temporary Reduction in the Labor Force of Related Industrial Sectors in the Primary Study Area as a Result of Direct Construction-Related Employment With the creation of 350 new construction jobs resulting from CP4, the potential exists for workers from other industries to move to jobs related to construction at Shasta Dam. Given the size of the construction industry in the primary study area, and the high unemployment rate in the area, this impact would be less than significant.

This impact would be the same as Impact Socio-3 (CP3) and would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact Socio-4 (CP4): Short-Term Increases in Direct, Indirect, and Induced Personal Income Paid to Employees in the Primary Study Area Hired for Construction-Related Activities Construction activities for CP4 would last 60 months, compared to 36 and 48 months for CP1 and CP2, respectively (but gravel augmentation would continue for 120 months). Based on calculations completed as a part of Reclamation's IMPLAN socioeconomic model process, it is estimated that more than $97.9 million in personal income would be directly paid to employees in the primary study area each year of construction. This amount of personal income is a more than 1.3 percent increase in income in the local economic study area. In addition, more than $44.5 million in indirect and induced income is expected to be generated in various construction-related and other industries in the primary study area each year of construction under CP4. This impact would be beneficial.

This impact would be very similar to Impact Socio-4 (CP3), varying only with relatively minor construction activities associated with downstream restoration,

and would be beneficial. Mitigation for this impact is not needed, and thus not proposed.

Impact Socio-5 (CP4): Short-Term Increases in Sales and Profits for Businesses in the Primary Study Area that Support the Construction Industry Most of the construction materials used for CP4 are expected to be purchased within the primary study area. These purchases would provide the local economy with increased sales and profits over the 60-month construction period. This impact would be beneficial.

This impact would be very similar to Impact Socio-5 (CP3) and would be beneficial. Mitigation for this impact is not needed, and thus not proposed.

Impact Socio-6 (CP4): Short-Term Increase in State and Local Sales Tax Revenues in the Primary Study Area from Construction-Related Personal Income and Purchases As stated above, implementation of CP4 is expected to result in a substantial increase in total personal income (direct, indirect, and induced) over the 60-month construction period. This additional income, in combination with the construction-related purchases in the primary study area, would result in a substantial increase in local sales tax revenues from increased consumer spending in nearby cities and counties. Construction-related activities under CP4 would likely also result in a temporary increase in State sales and income tax revenues received from businesses and residents of the primary study area. The exact amount of State and local sales tax revenue increases has not yet been calculated; however, this impact would be beneficial.

This impact would be very similar to Impact Socio-6 (CP3) and would be beneficial. Mitigation for this impact is not needed, and thus not proposed.

Impact Socio-7 (CP4): Long-Term Reduction in the Adverse Economic Effects of Flooding in the Primary Study Area As a result of the added reservoir capacity created by CP4, the overall risk of flooding and its related consequences below Shasta Dam are expected to be reduced. Although heavy-rain events would continue to occur in the region and locally, the project is intended to provide greater flexibility in flood control downstream because of the increased capacity of the reservoir. As a result, there would be less damage to existing structures and a smaller loss of potential future development; this, in turn, would reduce salary and wage losses for residents of the primary study area, as well as business and personal income losses from such damage. Therefore, this impact would be beneficial.

This impact would be the same as Impact Socio-7 (CP3) and would be beneficial. Mitigation for this impact is not needed, and thus not proposed.

Impact Socio-8 (CP4): Long-Term Increases in Direct Employment in the Primary Study Area Related to Project Operations In the long term, it is expected that implementation of CP4 would create at least two new

maintenance-related positions for the Shasta Dam facilities. These two positions are expected to be permanent and would continue once the 60-month construction period is complete. This impact would be beneficial.

This impact would be the same as Impact Socio-8 (CP3) and would be beneficial. Mitigation for this impact is not needed, and thus not proposed.

Lower Sacramento River and Delta

Impact Socio-9 (CP4): Potential Temporary Increase in Indirect Employment in Construction-Related Businesses of the Lower Sacramento River and Delta
Construction activities associated with CP4 have the potential to result in a short-term increase in indirect employment within the lower Sacramento River and Delta portion of the extended study area. Depending on the location of construction material sourced outside of the primary study area, indirect increases in employment within construction-related businesses may result in the lower Sacramento River and Delta area. This impact would be beneficial.

This impact would be very similar to Impact Socio-9 (CP3) and would be beneficial. Mitigation for this impact is not needed, and thus not proposed.

Impact Socio-10 (CP4): Short-Term Increases in Sales and Profits for Businesses in the Lower Sacramento River and Delta Area That Support the Construction Industry It is expected that a small amount of the construction materials used for CP4 are expected to be purchased within the extended study area. These purchases are predicted to increase sales and profits of businesses within the lower Sacramento River and Delta area over the 60-month construction period of CP4. This impact would be beneficial.

This impact would be very similar to Impact Socio-10 (CP3) and would be beneficial. Mitigation for this impact is not needed, and thus not proposed.

Impact Socio-11 (CP4): Short-Term Increase in State Sales and Income Tax Revenues in the Lower Sacramento River and Delta Area from Construction-Related Personal Income and Purchases In addition to local tax revenues, CP4 is expected to increase short-term construction-related State sales and income tax revenues received from businesses and residents of the lower Sacramento River and Delta portion of the extended study area. These additional revenues are expected to be cycled back to local government coffers through statewide programs and policies. This impact would be beneficial.

This impact would be very similar to Impact Socio-11 (CP3) and would be beneficial. Mitigation for this impact is not needed, and thus not proposed.

Impact Socio-12 (CP4): Long-Term Reduction in the Adverse Economic Effects of Flooding in the Lower Sacramento River and Delta Area As a result of the added reservoir capacity under CP4, the overall risk of flooding and its related consequences below Shasta Dam is expected to be reduced. Although heavy-rain events would continue to occur in the region, CP4 is intended to provide

greater flexibility in flood control in the lower Sacramento River and Delta area because of the increased capacity of the reservoir. As a result, less damage to existing structures and a smaller loss of potential future development would be expected; this, in turn, would reduce salary and wage losses for residents in and near the lower Sacramento River floodplain and the Delta resulting from these catastrophic events, as well as business and personal income losses from such damage. Therefore, this impact would be beneficial.

This impact would be the same as Impact Socio-12 (CP3) and would be beneficial. Mitigation for this impact is not needed, and thus not proposed.

CVP/SWP Service Areas

Impact Socio-13 (CP4): Short-Term Increases in Sales and Profits for Businesses in the CVP and SWP Service Aras That Support the Construction Industry A small amount of the construction materials used during construction under CP4 are expected to be purchased within the extended study area. These purchases are predicted to increase sales and profits of businesses within the CVP and SWP service areas over the 60-month construction period of CP4. This impact would be beneficial.

This impact would be very similar to Impact Socio-13 (CP3) and would be beneficial. Mitigation for this impact is not needed, and thus not proposed.

Impact Socio-14 (CP4): Potential Temporary Reduction in Shasta Project Water or Hydropower Supplied to the CVP and SWP Service Areas During Construction Implementation of CP4 may require temporarily reducing the reservoir level either throughout the 60-month project duration or at critical times. This reduction in the reservoir level could temporarily reduce the amount of water or hydropower available from the dam and related hydropower infrastructure. Should this occur, sources of replacement water or hydropower would need to be secured. If these replacement resources were substantially more expensive, a minor negative effect on water or power customers may result. This impact would be potentially significant.

This impact is similar to Impact Socio-14 (CP3), except that the project construction period would be longer. This impact would be potentially significant. Mitigation for this impact is proposed in Section 16.3.5.

Impact Socio-15 (CP4): Short-Term Increase in State Sales and Income Tax Revenues in the CVP and SWP Service Areas from Construction-Related Personal Income and Purchases In addition to local tax revenue, CP4 is expected to increase short-term construction-related State sales and income tax revenues received from businesses and residents of the CVP and SWP service areas. These additional revenues are expected to be cycled back to local government coffers through statewide programs and policies. This impact would be beneficial.

This impact would be very similar to Impact Socio-15 (CP3) and would be beneficial. Mitigation for this impact is not needed, and thus not proposed.

Impact Socio-16 (CP4): Long-Term Increase in Agricultural Income and Jobs within the CVP and SWP Service Areas as a Result of Improved Water Availability and Reliability Based on CVPM modeling, improved water availability and reliability expected to result from implementation of CP4 would substantially increase agricultural net income in the CVP and SWP service areas. This increase in production would contribute substantially to the continuation of this already strong industry in California. This impact would be beneficial.

This impact would be the same as Impact Socio-16 (CP1) and would be beneficial. Mitigation for this impact is not needed, and thus not proposed.

Impact Socio-17 (CP4): Reduction in Risk of Potential Water and Power Shortages (and Related Economic Activity) in the CVP and SWP Service Areas as a Result of Long-Term Improvements to Water and Power Supply Reliability Implementation of CP4 would substantially increase Shasta Dam's storage capacity. As stated in Impact Socio-16 (CP4), this additional storage capacity would improve long-term water availability and reliability in the CVP and SWP service areas. Beyond increasing agricultural production, this improved availability and reliability would reduce the long-term risk of urban water and power shortages, and their related adverse economic consequences, in the future. This impact would be beneficial.

This impact would be the similar to the other CPs and would be beneficial. Mitigation for this impact is not needed, and thus not proposed.

CP5 – 18.5-Foot Dam Raise, Combination Plan

CP5 would increase the full pool capacity of Shasta Lake to 5,186 TAF and increase the surface area of the pool to 32,100 acres. It is expected that implementing CP5 would result in the replacement or modification of eight bridges and relocation of approximately 130 existing structures. The total construction cost associated with CP5 would be approximately $1,073 million and the annual operational cost would be $54.1 million. This alternative would generate approximately $26.7 million in annual water supply reliability benefits and $25.0 million average annual equivalent anadromous fish restoration benefits. CP5 would generate approximately 96 GWh per year, equivalent to approximately $5.4 million in hydropower benefits.

Shasta Lake and Vicinity and Upper Sacramento River (Shasta Dam to Red Bluff)

Impact Socio-1 (CP5): Short-Term Increase in Population and Housing Demand in the Primary Study Area Resulting from Construction-Related Activities According to Reclamation estimates, approximately 350 new direct jobs would be created as a result of construction activities associated with CP5.

All 350 construction workers are expected to come from the local labor force; therefore, a short-term population increase is not expected. This impact would be less than significant.

This impact would be the same as Impact Socio-1 (CP3) and would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact Socio-2 (CP5): Short-Term Increases in Direct, Indirect, and Induced Employment in the Primary Study Area Related to Construction Activities Construction activities associated with CP5 are assumed to generate approximately 350 new direct construction jobs, 450 indirect jobs in various construction-related support industries, and 620 induced jobs because of increased household spending in the primary study area. Individuals to fill these jobs are expected to be drawn from the local community. These new jobs are expected to provide important but temporary employment opportunities to many unemployed construction workers in the primary study area. This impact would be beneficial.

This impact would be very similar to Impact Socio-2 (CP3), varying only with relatively minor construction activities associated with shoreline and tributary restoration, and would be beneficial. Mitigation for this impact is not needed, and thus not proposed.

Impact Socio-3 (CP5): Potential for Temporary Reduction in the Labor Force of Related Industrial Sectors in the Primary Study Area as a Result of Direct Construction-Related Employment With the creation of 350 new construction jobs resulting from CP5, the potential exists for workers from other industries to move to jobs related to construction at Shasta Dam. Given the size of the construction industry in the primary study area, and the high unemployment rate in the area, this impact would be less than significant.

This impact would be the same as Impact Socio-3 (CP3) and would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact Socio-4 (CP5): Short-Term Increases in Direct, Indirect, and Induced Personal Income Paid to Employees in the Primary Study Area Hired for Construction-Related Activities Construction activities for CP5 would last 60 months, compared to 36 and 48 months for CP1 and CP2, respectively. (Gravel augmentation activities would last 120 months, however.) Based on calculations completed as a part of Reclamation's IMPLAN socioeconomic model process, it is estimated that more than $98.2 million in personal income would be directly paid to employees in the primary study area each year of construction. This amount of personal income is a more than 1.3 percent increase in income in the local economic study area. In addition, more than $44.7 million in indirect and induced income is expected to be generated in various construction-related and other industries in the primary study area each year of construction under CP5. This impact would be beneficial.

This impact would be very similar to Impact Socio-4 (CP3), varying only with relatively minor construction activities associated with downstream, shoreline, and tributary restoration, and would be beneficial. Mitigation for this impact is not needed, and thus not proposed.

Impact Socio-5 (CP5): Short-Term Increases in Sales and Profits for Businesses in the Primary Study Area that Support the Construction Industry Most of the construction materials used for CP5 are expected to be purchased within the primary study area. These purchases would provide the local economy with increased sales and profits over the 60-month construction period. This impact would be beneficial.

This impact would be very similar to Impact Socio-5 (CP3) and would be beneficial. Mitigation for this impact is not needed, and thus not proposed.

Impact Socio-6 (CP5): Short-Term Increase in State and Local Sales Tax Revenues in the Primary Study Area from Construction-Related Personal Income and Purchases As stated above, implementation of CP5 is expected to result in a substantial increase in total personal income (direct, indirect, and induced) over the 60-month construction period. This additional income, in combination with the construction-related purchases in the primary study area, would result in a substantial increase in local sales tax revenues from increased consumer spending in nearby cities and counties. Construction-related activities under CP5 would likely also result in a temporary increase in State sales and income tax revenues received from businesses and residents of the primary study area. The exact amount of State and local sales tax revenue increases has not yet been calculated; however, this impact would be beneficial.

This impact would be very similar to Impact Socio-6 (CP3) and would be beneficial. Mitigation for this impact is not needed, and thus not proposed.

Impact Socio-7 (CP5): Long-Term Reduction in the Adverse Economic Effects of Flooding in the Primary Study Area As a result of the added reservoir capacity created by CP5, the overall risk of flooding and its related consequences below Shasta Dam are expected to be reduced. Although heavy-rain events would continue to occur in the region and locally, the project is intended to provide greater flexibility in flood control downstream because of the increased capacity of the reservoir. As a result, there would be less damage to existing structures and a smaller loss of potential future development; this, in turn, would reduce salary and wage losses for residents of the primary study area, as well as business and personal income losses from such damage. Therefore, this impact would be beneficial.

This impact would be the same as Impact Socio-7 (CP3) and would be beneficial. Mitigation for this impact is not needed, and thus not proposed.

Impact Socio-8 (CP5): Long-Term Increases in Direct Employment in the Primary Study Area Related to Project Operations In the long term, it is expected that implementation of CP5 would create at least two new maintenance-related positions for the Shasta Dam facilities. These two positions are expected to be permanent and would continue once the 60-month construction period is complete. This impact would be beneficial.

This impact would be the same as Impact Socio-8 (CP3) and would be beneficial. Mitigation for this impact is not needed, and thus not proposed.

Lower Sacramento River and Delta

Impact Socio-9 (CP5): Potential Temporary Increase in Indirect Employment in Construction-Related Businesses of the Lower Sacramento River and Delta Construction activities associated with CP5 have the potential to result in a short-term increase in indirect employment within the lower Sacramento River and Delta portion of the extended study area. Depending on the location of construction materials sourced outside of the primary study area, indirect increases in employment within construction-related businesses may result in the lower Sacramento River and Delta area. This impact would be beneficial.

This impact would be very similar to Impact Socio-9 (CP3) and would be beneficial. Mitigation for this impact is not needed, and thus not proposed.

Impact Socio-10 (CP5): Short-Term Increases in Sales and Profits for Businesses in the Lower Sacramento River and Delta Area That Support the Construction Industry It is expected that a small amount of the construction materials used for CP5 are expected to be purchased within the extended study area. These purchases are predicted to increase sales and profits of businesses within the lower Sacramento River and Delta area over the 60-month construction period of CP5. This impact would be beneficial.

This impact would be very similar to Impact Socio-10 (CP3) and would be beneficial. Mitigation for this impact is not needed, and thus not proposed.

Impact Socio-11 (CP5): Short-Term Increase in State Sales and Income Tax Revenues in the Lower Sacramento River and Delta Area from Construction-Related Personal Income and Purchases In addition to local tax revenues, CP5 is expected to increase short-term construction-related State sales and income tax revenues received from businesses and residents of the lower Sacramento River and Delta portion of the extended study area. These additional revenues are expected to be cycled back to local government coffers through statewide programs and policies. This impact would be beneficial.

This impact would be very similar to Impact Socio-11 (CP3) and would be beneficial. Mitigation for this impact is not needed, and thus not proposed.

Impact Socio-12 (CP5): Long-Term Reduction in the Adverse Economic Effects of Flooding in the Lower Sacramento River and Delta Area *As* a result of the

added reservoir capacity under CP5, the overall risk of flooding and its related consequences below Shasta Dam is expected to be reduced. Although heavy-rain events would continue to occur in the region, CP5 is intended to provide greater flexibility in flood control in the lower Sacramento River and Delta area because of the increased capacity of the reservoir. As a result, less damage to existing structures and a smaller loss of potential future development would be expected; this, in turn, would reduce salary and wage losses for residents in and near the lower Sacramento River floodplain and the Delta resulting from these catastrophic events, as well as business and personal income losses from such damage. Therefore, this impact would be beneficial.

This impact would be the same as Impact Socio-12 (CP3) and would be beneficial. Mitigation for this impact is not needed, and thus not proposed.

CVP/SWP Service Areas

Impact Socio-13 (CP5): Short-Term Increases in Sales and Profits for Businesses in the CVP and SWP Service Areas That Support the Construction Industry A small amount of the construction materials used during construction under CP5 are expected to be purchased within the extended study area, including the CVP and SWP service areas. These purchases are predicted to increase sales and profits of businesses within the CVP and SWP service areas over the 60-month construction period of CP5. This impact would be beneficial.

This impact would be very similar to Impact Socio-13 (CP3) and would be beneficial. Mitigation for this impact is not needed, and thus not proposed.

Impact Socio-14 (CP5): Potential Temporary Reduction in Shasta Project Water or Hydropower Supplied to the CVP and SWP Service Areas During Construction Implementation of CP5 may require temporarily reducing the reservoir level either throughout the 60-month project duration or at critical times. This reduction in the reservoir level could temporarily reduce the amount of water or hydropower available from the dam and related hydropower infrastructure. Should this occur, sources of replacement water or hydropower would need to be secured. If these replacement resources were substantially more expensive, a minor negative effect on water or power customers may result. This impact would be potentially significant.

This impact would be the same as Impact Socio-14 (CP3) and would be potentially significant. Mitigation for this impact is proposed in Section 16.3.5.

Impact Socio-15 (CP5): Short-Term Increase in State Sales and Income Tax Revenues in the CVP and SWP Service Areas from Construction-Related Personal Income and Purchases In addition to local tax revenue, CP5 is expected to increase short-term construction-related State sales and income tax revenues received from businesses and residents of the CVP and SWP service areas. These additional revenues are expected to be cycled back to local

government coffers through statewide programs and policies. This impact would be beneficial.

This impact would be very similar to Impact Socio-15 (CP3) and would be beneficial. Mitigation for this impact is not needed, and thus not proposed.

Impact Socio-16 (CP5): Long-Term Increase in Agricultural Income and Jobs in the CVP and SWP Service Areas as a Result of Improved Water Availability and Reliability Based on CVPM modeling, improved water availability and reliability expected to result from implementation of CP5 would substantially increase agricultural net income in the CVP and SWP service areas. This increase in production would contribute substantially to the continuation of this already strong industry in California. This impact would be beneficial.

This impact would be the same as Impact Socio-16 (CP3) and would be beneficial. Mitigation for this impact is not needed, and thus not proposed.

Impact Socio-17 (CP5): Reduction in Risk of Potential Water and Power Shortages (and Related Economic Activity) in the CVP and SWP Service Areas as a Result of Long-Term Improvements to Water and Power Supply Reliability Implementation of CP5 would substantially increase Shasta Dam's storage capacity. As stated in Impact Socio-16 (CP5), this additional storage capacity would improve long-term water availability and reliability in the CVP and SWP service areas. Beyond increasing agricultural production, this improved availability and reliability would reduce the long-term risk of urban water and power shortages, and their related adverse economic consequences, in the future. This impact would be beneficial.

This impact would be the similar to the other CPs and would be beneficial. Mitigation for this impact is not needed, and thus not proposed.

16.3.5 Mitigation Measures

Table 16-1 presents a summary of mitigation measures for socioeconomics, population, and housing.

Table 16-1. Summary of Mitigation Measures for Socioeconomics, Population, and Housing

Impact		No-Action Alternative	CP1	CP2	CP3	CP4	CP5
Impact Socio-1 (No-Action): Potential for Reduced Employment Opportunities for Lower Sacramento River and Delta Area Residents	LOS before Mitigation	PS	LTS	LTS	LTS	LTS	LTS
	Mitigation Measure	None required.	None needed; thus, none proposed.				
Impact Socio-1 (CP1–CP5): Short-Term Increase in Population and Housing Demand in the Primary Study Area Resulting from Construction-Related Activities	LOS after Mitigation	PS	LTS	LTS	LTS	LTS	LTS
Impact Socio-2 (No-Action): Potential for Temporary Disruptions in Business and Industrial Activity in the Lower Sacramento River and Delta Area	LOS before Mitigation	PS	B	B	B	B	B
	Mitigation Measure	None required.	None needed; thus, none proposed.				
Impact Socio-2 (CP1–CP5): Short-Term Increases in Direct, Indirect, and Induced Employment in the Primary Study Area Related to Construction Activities	LOS after Mitigation	PS	B	B	B	B	B
Impact Socio-3 (No-Action): Potential for Reduced Employment Opportunities for Residents Within the CVP and SWP Service Areas	LOS before Mitigation	PS	LTS	LTS	LTS	LTS	LTS
	Mitigation Measure	None required.	None needed; thus, none proposed.				
Impact Socio-3 (CP1–CP5): Potential for Temporary Reduction in the Labor Force of Related Industrial Sectors in the Primary Study Area as a Result of Direct Construction-Related Employment	LOS after Mitigation	PS	LTS	LTS	LTS	LTS	LTS
Impact Socio-4 (No-Action): Potential for Temporary Disruptions in Business and Industrial Activity in the CVP and SWP Service Areas	LOS before Mitigation	PS	B	B	B	B	B
	Mitigation Measure	None required.	None needed; thus, none proposed.				
Impact Socio-4 (CP1–CP5): Short-Term Increases in Direct, Indirect, and Induced Personal Income Paid to Employees in the Primary Study Area Hired for Construction-Related Activities	LOS after Mitigation	PS	B	B	B	B	B

Table 16-1. Summary of Mitigation Measures for Socioeconomics, Population, and Housing (contd.)

Impact		No-Action Alternative	CP1	CP2	CP3	CP4	CP5
Impact Socio-5: Short-Term Increases in Sales and Profits for Businesses in the Primary Study Area that Support the Construction Industry	LOS before Mitigation	NA	B	B	B	B	B
	Mitigation Measure	None required.	None needed; thus, none proposed.				
	LOS after Mitigation	NA	B	B	B	B	B
Impact Socio-6: Short-Term Increase in State and Local Sales Tax Revenues in the Primary Study Area from Construction-Related Personal Income and Purchases	LOS before Mitigation	NA	B	B	B	B	B
	Mitigation Measure	None required.	None needed; thus, none proposed.				
	LOS after Mitigation	NA	B	B	B	B	B
Impact Socio-7: Long-Term Reduction in the Adverse Economic Effects of Flooding in the Primary Study Area	LOS before Mitigation	NA	B	B	B	B	B
	Mitigation Measure	None required.	None needed; thus, none proposed.				
	LOS after Mitigation	NA	B	B	B	B	B
Impact Socio-8: Long-Term Increases in Direct Employment in the Primary Study Area Related to Project Operations	LOS before Mitigation	NA	B	B	B	B	B
	Mitigation Measure	None required.	None needed; thus, none proposed.				
	LOS after Mitigation	NA	B	B	B	B	B
Impact Socio-9: Potential Temporary Increase in Indirect Employment in Construction-Related Businesses of the Lower Sacramento River and Delta	LOS before Mitigation	NA	B	B	B	B	B
	Mitigation Measure	None required.	None needed; thus, none proposed.				
	LOS after Mitigation	NA	B	B	B	B	B
Impact Socio-10: Short-Term Increases in Sales and Profits for Businesses in the Lower Sacramento River and Delta Area That Support the Construction Industry	LOS before Mitigation	NA	B	B	B	B	B
	Mitigation Measure	None required.	None needed; thus, none proposed.				
	LOS after Mitigation	NA	B	B	B	B	B
Impact Socio-11: Short-Term Increase in State Sales and Income Tax Revenues in the Lower Sacramento River and Delta Area from Construction-Related Personal Income and Purchases	LOS before Mitigation	NA	B	B	B	B	B
	Mitigation Measure	None required.	None needed; thus, none proposed.				
	LOS after Mitigation	NA	B	B	B	B	B
Impact Socio-12: Long-Term Reduction in the Adverse Economic Effects of Flooding in the Lower Sacramento River and Delta Area	LOS before Mitigation	NA	B	B	B	B	B
	Mitigation Measure	None required.	None needed; thus, none proposed.				
	LOS after Mitigation	NA	B	B	B	B	B
Impact Socio-13: Short-Term Increases in Sales and Profits for Businesses in the CVP and SWP Service Areas That Support the Construction Industry	LOS before Mitigation	NA	B	B	B	B	B
	Mitigation Measure	None required.	None needed; thus, none proposed.				
	LOS after Mitigation	NA	B	B	B	B	B

Table 16-1. Summary of Mitigation Measures for Socioeconomics, Population, and Housing (contd.)

Impact		No-Action Alternative	CP1	CP2	CP3	CP4	CP5
Impact Socio-14: Potential Temporary Reduction in Shasta Project Water or Hydropower Supplied to the CVP and SWP Service Areas During Construction	LOS before Mitigation	NA	PS	PS	PS	PS	PS
	Mitigation Measure	None required.	Mitigation Measure Socio-14 (CP1–CP5): Secure Replacement Water or Hydropower During Project Construction.				
	LOS after Mitigation	NA	LTS	LTS	LTS	LTS	LTS
Impact Socio-15: Short-Term Increase in State Sales and Income Tax Revenues in the CVP and SWP Service Areas from Construction-Related Personal Income and Purchases	LOS before Mitigation	NA	B	B	B	B	B
	Mitigation Measure	None required.	None needed; thus, none proposed.				
	LOS after Mitigation	NA	B	B	B	B	B
Impact Socio-16: Long-Term Increase in Agricultural Income and Jobs in the CVP and SWP Service Areas as a Result of Improved Water Availability and Reliability	LOS before Mitigation	NA	B	B	B	B	B
	Mitigation Measure	None required.	None needed; thus, none proposed.				
	LOS after Mitigation	NA	B	B	B	B	B
Impact Socio-17: Reduction in Risk of Potential Water and Power Shortages (and Related Economic Activity) in the CVP and SWP Service Areas as a Result of Long-Term Improvements to Water and Power Supply Reliability	LOS before Mitigation	NA	B	B	B	B	B
	Mitigation Measure	None required.	None needed; thus, none proposed.				
	LOS after Mitigation	NA	B	B	B	B	B

Key:
B = beneficial
LOS = level of significance
LTS = less than significant
NA = not applicable
PS = potentially significant

No-Action Alternative

No mitigation measures are needed for this alternative.

CP1 – 6.5-Foot Dam Raise, Anadromous Fish Survival and Water Supply Reliability

No mitigation is needed for Impacts Socio-1 (CP1) through Socio-13 (CP1) and Impacts Socio-15 (CP1) through Socio-17 (CP1). Mitigation is provided below for the other impact of CP1.

Mitigation Measure Socio-14 (CP1): Secure Replacement Water or Hydropower During Project Construction To address potential temporary shortages in water or hydropower caused by reduced availability at Shasta Dam during construction, replacement water or hydropower supplies would need to be sourced elsewhere to maintain current service needs. Depending on the conditions of the water or energy markets at the time of need, these replacement resources could be more expensive than water or hydropower obtained from Shasta Dam. The additional expense of obtaining water or hydropower resources could potentially produce a minor negative effect on water and power customers if replacement of these resources is substantially more expensive.

To eliminate the potential impact of project construction on water and/or hydropower purchases, Reclamation will identify the need for replacement water or hydropower early in project implementation and will secure such resources at the lowest cost possible. Reclamation will provide these replacement resources to business and industry in the CVP and SWP service areas at costs comparable to water or hydropower obtained from Shasta Dam.

Implementation of this mitigation measure would reduce Impact Socio-14 (CP1) to a less than significant level.

CP2 – 12.5-Foot Dam Raise, Anadromous Fish Survival and Water Supply Reliability

No mitigation is needed for Impacts Socio-1 (CP2) through Socio-13 (CP2) and Impacts Socio-15 (CP2) through Socio-17 (CP2). Mitigation is provided below for the other impact of CP2.

Mitigation Measure Socio-14 (CP2): Secure Replacement Water or Hydropower During Project Construction This mitigation measure is identical to Mitigation Measure Socio-14 (CP1). Implementation of this mitigation measure would reduce Impact Socio-14 (CP2) to a less than significant level.

CP3 – 18.5-Foot Dam Raise, Anadromous Fish Survival and Water Supply

No mitigation is needed for Impacts Socio-1 (CP3) through Socio-13 (CP3) and Impacts Socio-15 (CP3) through Socio-17 (CP3). Mitigation is provided below for the other impact of CP3.

Mitigation Measure Socio-14 (CP3): Secure Replacement Water or Hydropower During Project Construction This mitigation measure is identical to Mitigation Measure Socio-14 (CP1). Implementation of this mitigation measure would reduce Impact Socio-14 (CP3) to a less than significant level.

CP4 – 18.5-Foot Dam Raise, Anadromous Fish Focus with Water Supply Reliability

No mitigation is needed for Impacts Socio-1 (CP4) through Socio-13 (CP4) and Impacts Socio-15 (CP4) through Socio-17 (CP4). Mitigation is provided below for the other impact of CP4.

Mitigation Measure Socio-14 (CP4): Secure Replacement Water or Hydropower During Project Construction This mitigation measure is identical to Mitigation Measure Socio-14 (CP1). Implementation of this mitigation measure would reduce Impact Socio-14 (CP4) to a less than significant level.

CP5 – 18.5-Foot Dam Raise, Combination Plan

No mitigation is needed for Impacts Socio-1 (CP5) through Socio-13 (CP5) and Impacts Socio-15 (CP5) through Socio-17 (CP5). Mitigation is provided below for the other impact of CP5.

Mitigation Measure Socio-14 (CP5): Secure Replacement Water or Hydropower During Project Construction This mitigation measure is identical to Mitigation Measure Socio-14 (CP1). Implementation of this mitigation measure would reduce Impact Socio-14 (CP5) to a less than significant level.

16.3.6 Cumulative Effects

Water reliability and electrical demand are expected to become increasingly important issues as demand for water and electricity increases to meet the needs of California's growing population. Over time, water conservation and reuse efforts will increase and water provision is expected to shift from such areas as agricultural production to urban uses. Environmental restoration, flood control, and hydropower generation are expected to continue in a manner similar to existing conditions.

CP1 – 6.5-Foot Dam Raise, Anadromous Fish Survival and Water Supply Reliability

Primary Study Area In the primary study area, effects related to increases in population and housing during construction under CP1 would be less than significant. In combination with past, present, and reasonably foreseeable future projects, this incremental contribution to increases in population and housing demand would not be significant. The combined effect of these projects and the SLWRI would not induce substantial growth in population, produce a substantial burden on the existing housing stock within the local community, or

require sizeable numbers of new workers from outside the local area. Implementing CP1 would result in beneficial effects on employment and the labor force, business and industrial activity, and government and finance. Thus, the project would not result in a cumulatively considerable incremental contribution to cumulative effects on socioeconomic resources.

Extended Study Area Without mitigation, CP1 could cause a potentially significant adverse effect on business and industrial activity in the CVP and SWP service areas. This adverse effect would be a potential temporary reduction in Shasta project water or hydropower supplied to CVP and SWP service areas during construction. With implementation of Mitigation Measure Socio-14 (CP1), adverse effects from CP1 would be fully mitigated because Reclamation would secure replacement water or hydropower during project construction. Therefore, the project would not contribute to a cumulatively considerable incremental contribution to cumulative effects related to the temporary reduction in water or hydropower supplies to the CVP and SWP service areas.

Implementing CP1 would also result in beneficial effects on employment and the labor force, business and industrial activity, and government and finance. Thus, the project would not result in a cumulatively considerable incremental contribution to cumulative effects on socioeconomic resources.

CP2 – 12.5-Foot Dam Raise, Anadromous Fish Survival and Water Supply Reliability

Primary Study Area In the primary study area, effects related to increases in population and housing during construction under CP2 would be less than significant. In combination with past, present, and reasonably foreseeable future projects, this incremental contribution to increases in population and housing demand would not be significant. The combined effect of these projects and the SLWRI would not induce substantial growth in population, produce a substantial burden on the existing housing stock within the local community, or require sizeable numbers of new workers from outside the local area. Implementing CP2 would cause beneficial effects on employment and the labor force, business and industrial activity, and government and finance. Overall, the beneficial effects of CP2 in the primary study area would be greater than those of CP1. Thus, the project would not result in a cumulatively considerable incremental contribution to cumulative effects on socioeconomic resources.

Extended Study Area The adverse effects of CP2 would be the same as those of CP1. With implementation of Mitigation Measure Socio-14 (CP2), adverse effects from CP2 would be fully mitigated because Reclamation would secure replacement water or hydropower during project construction. Therefore, the project would not contribute to a cumulatively considerable incremental contribution to cumulative effects related to the temporary reduction in water or hydropower supplies to the CVP and SWP service areas.

Implementing CP2 would result in less than significant effects on population and housing and also cause beneficial effects on employment and the labor force, business and industrial activity, and government and finance. Overall, the beneficial effects of CP2 in the extended study area would be greater than those of CP1. Thus, the project would not result in a cumulatively considerable incremental contribution to cumulative effects on socioeconomic resources.

CP3 – 18.5-Foot Dam Raise, Anadromous Fish Survival and Water Supply

Primary Study Area In the primary study area, effects related to increases in population and housing during construction under CP3 would be less than significant. In combination with past, present, and reasonably foreseeable future projects, this incremental contribution to increases in population and housing demand would not be significant. The combined effect of these projects and the SLWRI would not induce substantial growth in population, produce a substantial burden on the existing housing stock within the local community, or require sizeable numbers of new workers from outside the local area. CP3 would cause beneficial effects on employment and the labor force, business and industrial activity, and government and finance. Overall, the beneficial effects of CP3 in the primary study area would be greater than those of CP1 and CP2. Thus, the project would not result in a cumulatively considerable incremental contribution to cumulative effects on socioeconomic resources.

Extended Study Area The adverse effects of CP3 would be the same as those of CP1. With implementation of Mitigation Measure Socio-14 (CP3), adverse effects from CP3 would be fully mitigated because Reclamation would secure replacement water or hydropower during project construction. Therefore, the project would not contribute to a cumulatively considerable incremental contribution to cumulative effects related to the temporary reduction in water or hydropower supplies to the CVP and SWP service areas.

Implementing CP3 would result in less than significant effects on population and housing and also cause beneficial effects on employment and the labor force, business and industrial activity, and government and finance. Overall, the beneficial effects of CP3 in the extended study area would be greater than those of CP1 and CP2. Thus, the project would not result in a cumulatively considerable incremental contribution to cumulative effects on socioeconomic resources.

CP4 – 18.5-Foot Dam Raise, Anadromous Fish Focus with Water Supply Reliability

Primary Study Area In the primary study area, effects related to increases in population and housing during construction in CP4 would be less than significant. In combination with past, present, and reasonably foreseeable future projects, this incremental contribution to increases in population and housing demand would not be significant. The combined effect of these projects and the SLWRI would not induce substantial growth in population, produce a substantial burden on the existing housing stock within the local community, or

require sizeable numbers of new workers from outside the local area. CP4 would cause beneficial effects on employment and the labor force, business and industrial activity, and government and finance. Overall, in the primary study area, the beneficial effects of CP4 would be the same as those of CP3. Thus, the project would not result in a cumulatively considerable incremental contribution to cumulative effects on socioeconomic resources.

Extended Study Area The adverse effects of CP4 would be the same as those of CP1. With implementation of Mitigation Measure Socio-14 (CP4), adverse effects from CP4 would be fully mitigated because Reclamation would secure replacement water or hydropower during project construction. Therefore, the project would not contribute to a cumulatively considerable incremental contribution to cumulative effects related to the temporary reduction in water or hydropower supplies to the CVP and SWP service areas.

Implementing CP4 would result in less than significant effects on population and housing and also cause beneficial effects on employment and the labor force, business and industrial activity, and government and finance. In the extended study area, the beneficial effects of CP4 for population and housing, employment, and the labor force would be the same as those of CP3. For business and industrial activity, CP4 would be more beneficial than CP3. Thus, the project would not result in a cumulatively considerable incremental contribution to cumulative effects on socioeconomic resources.

CP5 – 18.5-Foot Dam Raise, Combination Plan

Primary Study Area In the primary study area, effects related to increases in population and housing during construction under CP5 would be less than significant. In combination with past, present, and reasonably foreseeable future projects, this incremental contribution to increases in population and housing demand would not be significant. The combined effect of these projects and the SLWRI would not induce substantial growth in population, produce a substantial burden on the existing housing stock within the local community, or require sizeable numbers of new workers from outside the local area. CP5 would cause beneficial effects on employment and the labor force, business and industrial activity, and government and finance. Overall, in the primary study area, the beneficial effects of CP5 would be the same as those of CP3. Thus, the project would not result in a cumulatively considerable incremental contribution to cumulative effects on socioeconomic resources.

Extended Study Area The adverse effects of CP5 would be the same as those of CP1. With implementation of Mitigation Measure Socio-14 (CP5), adverse effects from CP5 would be fully mitigated because Reclamation would secure replacement water or hydropower during project construction. Therefore, the project would not contribute to a cumulatively considerable incremental contribution to cumulative effects related to the temporary reduction in water or hydropower supplies to the CVP and SWP service areas.

Implementing CP5 would result in less than significant effects on population and housing and also cause beneficial effects on employment and the labor force, business and industrial activity, and government and finance. Overall, in the extended study area, the beneficial effects of CP3 would be the same as those of CP3. Thus, the project would not result in a cumulatively considerable incremental contribution to cumulative effects on socioeconomic resources.

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Chapter 17
Land Use and Planning

17.1 Affected Environment

This chapter describes the affected environment related to land uses and planning for the dam and reservoir modifications proposed under the SLWRI.

Because of the potential influence of the proposed modification of Shasta Dam and water deliveries over a large geographic area, the SLWRI includes both a primary study area and an extended study area. The primary study area has been further divided into Shasta Lake and vicinity and the upper Sacramento River (Shasta Dam to Red Bluff). The extended study area has been further divided into the lower Sacramento River and Delta and the CVP/SWP service areas.

The setting for land uses and planning in the Shasta Lake and vicinity portion of the primary study area consists of the portion of Shasta County north of Shasta Dam. This area encompasses Shasta Lake, lands surrounding the lake, and parts of the Pit River, Squaw Creek, McCloud River, and Sacramento River watersheds. Land use and planning in this area are influenced by land ownership, the presence of rural lakeside communities, and topography.

The setting for land uses and planning in the upper Sacramento River portion of the primary study area consists of the portion of Shasta County south of Shasta Dam and Tehama County. The incorporated cities of Shasta Lake, Redding, Anderson, and Red Bluff, all located along the Interstate 5 (I-5) corridor, establish urban settings in the otherwise rural upper Sacramento Valley. The upper Sacramento Valley is characterized by rolling hills with mountains to the north, east, and west. Land use and planning in this area are influenced by land ownership, historic land use patterns, topography, and population densities.

The land use and planning setting for the extended study area consists of 24 counties downstream from the Red Bluff Diversion Dam and encompasses all areas served by the CVP and the SWP. Land use and planning in the extended study area are influenced by the same factors identified for the upper Sacramento River study area. The type and focus of land use and planning may vary, however, in the large urban areas located in the extended study area.

17.1.1 Land Use

Shasta Lake and Vicinity

Land uses in the Shasta Lake and vicinity portion of the primary study area consist primarily of open space and other land uses that support recreational

activities in the Shasta Unit of the Whiskeytown-Shasta-Trinity National Recreation Area (NRA). The USFS manages the Shasta Unit of the NRA. Federally owned lands in the NRA total 235,740 acres, including Shasta Lake; lands held in private ownership total 10,347 acres. A small area around Shasta Dam is administered by Reclamation. In addition, the California Department of Transportation manages the I-5 corridor, and the Union Pacific Railroad (UPRR) manages the rail corridor that crosses the primary study area (Figure 17-1).

The following land use designations are applied to lands managed by the Shasta Unit of the NRA. Riparian Reserves, the largest land use designation in the NRA, are located in areas along rivers, streams, lakes, and wetlands, including the area inundated by Shasta Lake. Riparian Reserves were established to provide natural corridors throughout the NRA. Approximately 25 percent of the land in the NRA is designated Matrix and Adaptive Management; these areas generally emphasize recreation and visual quality. Late Successional Reserves (LSR) and Administratively Withdrawn Areas each account for 20 percent of the land use designations in the NRA. LSRs are characterized by large blocks of land reserved for northern spotted owl and other species that are dependent on late successional old-growth forest. Lands with this designation are scattered throughout the NRA; these lands have a natural appearance, with much of the land area covered with late successional forest vegetation.

The Shasta Unit of the NRA is not managed for timber harvest. Vegetation removal is permitted for fuel breaks, hazard tree removal, protection of life and property, prevention of significant losses caused by insects or disease, and wildlife habitat management.

Recreational and commercial land uses occupy 2 percent of the land managed by the Shasta-Trinity National Forest (STNF) within the Shasta Unit of the NRA. Recreational use in the NRA exceeds 2 million visitor days annually. Water-oriented activities, such as boating, fishing, waterskiing, and house-boating, are the main attractions. Marinas that currently operate on Shasta Lake include Antlers, Sugarloaf, Shasta, Lakeview, Holiday Harbor, Packers Bay, Bridge Bay, Silverthorn, Jones Valley, and Digger Bay. Other recreational land uses include hiking, camping, picnicking, and off-highway vehicle activities. A planning permit has been issued by the STNF to decommission Digger Bay and construct a new marina at Turntable Bay, but the permit was not exercised and has since been revoked.

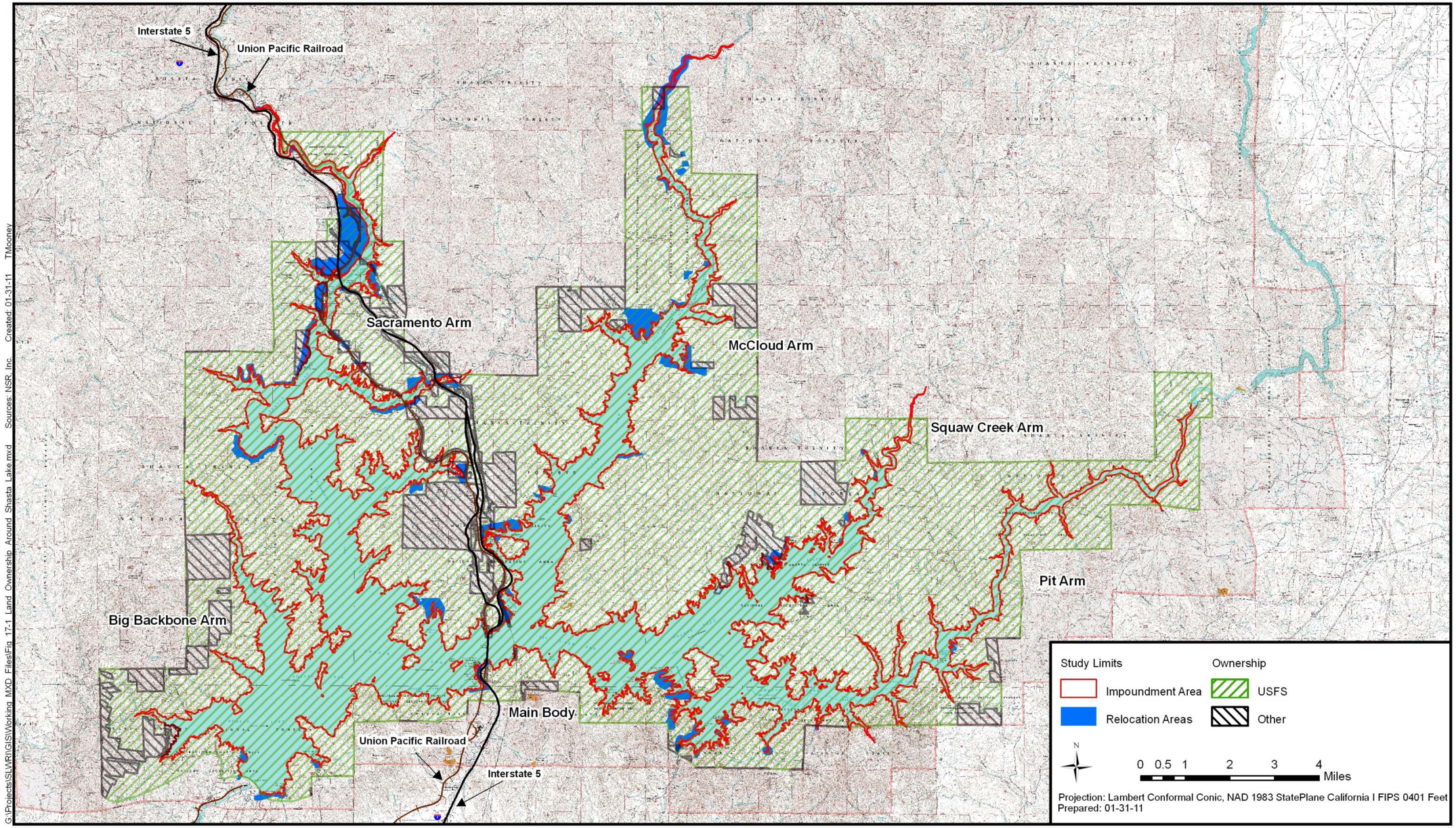


Figure 17-1. Land Ownership Around Shasta Lake

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Commercial land uses in the NRA include resorts, marinas, campgrounds, restaurants, motels, grocery stores, and service stations. Resorts typically operate in conjunction with marinas and include Sugarloaf Resort, Lakeview Resort, Bridge Bay Resort, Jones Valley Resort, Shasta Marina Resort, Silverthorn Resort, and Antlers Resort and Marina. Some resorts on Shasta Lake must move their docks substantial distances from their land-based facilities during periods of low water levels.

The USFS operates recreation residential tracts at Salt Creek, Silverthorn, Campbell Creek, and Didallas Creek; these tracts combined contain 160 privately owned cabins on National Forest System lands. USFS policy is to manage these tracts and residences for individual recreational use and to keep the areas as close as possible to their natural state. Only minimal improvements are permitted, and structures must blend into the natural environment.

Mining and grazing do not take place in the NRA. There are no grazing permits authorized for the Shasta Unit of the NRA, primarily because of a lack of suitable range. Federal lands in the NRA, except those with valid existing rights, were withdrawn from mineral entry by the legislation that created the NRA. Reclamation and USFS conducted validity determinations on most of the claims existing at that time and contested the majority of them based on the absence of a valid discovery. There are five claims in the NRA that predate the withdrawal. The lands covered by these claims remain open to mineral leasing, but there are no approved operating plans for these claims. Hard rock minerals in the NRA are available for prospecting, exploration, and development under solid mineral leasing regulations (36 Code of Federal Regulations (CFR) Subpart 3583). Authorization for this land use requires permits and leases subject to USFS terms and conditions to protect the values of the NRA.

Land uses on privately owned lands in the NRA generally consist of commercial, recreational, and residential land uses associated with the NRA. Approximately 20 percent of the privately held lands in the NRA are developed. Commercial development consists primarily of service industries supporting residents and recreational visitors.

Residential land uses are typically characterized as low density and rural. Established small communities along Shasta Lake include Lamoine, Lakehead, Lakeshore, and Sugarloaf, which are located on the Sacramento Arm of Shasta Lake. Farther south is the residential community of O’Brien, which is located between the Sacramento and McCloud arms near I-5.

The McCloud River, a portion of which is located in the Shasta Lake and vicinity portion of the primary study area, is eligible for listing as Wild and Scenic under the Federal Wild and Scenic Rivers Act (WSRA). In addition, although it is not state-listed as Wild and Scenic, the McCloud River receives certain protections under the California Public Resources Code (PRC), Section 5093.542, established through enactment of the California Wild and Scenic

Rivers Act, as amended (Sections 5093.50 – 5093.70). The effects of the proposed enlargement of Shasta Lake on the McCloud River are discussed in Chapter 25 of this EIS.

Upper Sacramento River (Shasta Dam to Red Bluff)

Land uses in the upper Sacramento River area consist of urban, residential, municipal and industrial, and agricultural uses. Urban development is located in the valley and is concentrated along the transportation corridors provided by I-5, State Route 273, and the UPRR. Incorporated cities located in the valley along I-5 in the upper Sacramento River study area are the cities of Shasta Lake, Redding, Anderson, and Red Bluff. Cottonwood, an unincorporated community located along the I-5 corridor, also has residential and commercial development.

Small rural communities characterize development patterns 5 to 8 miles east and west of the I-5 corridor. Many of these communities have their origins in the early settlement of Shasta County and Tehama County, as evidenced by the agriculture, grazing, and timber operations typical of the upland areas. These communities usually consist of small community centers surrounded by vast tracts of fields and forest that are dotted with home sites (Shasta County 2004).

The northern, western, and eastern portions of Shasta County are relatively uninhabited because the lands in these areas are managed by USFS for timber, wildlife, and wilderness uses. Lands managed by USFS in the western and southeastern portions of Tehama County are also relatively uninhabited.

The National Park Service manages lands in the upper Sacramento River study area, including the Whiskeytown Unit of the NRA, west of Keswick, and Lassen Volcanic National Park, in the northeastern corner of Tehama County. The U.S. Bureau of Land Management (BLM) manages the 12,194-acre Sacramento River Bend Management Area on the east side of the Sacramento River northeast of Red Bluff.

Lower Sacramento River and Delta

Land uses in the extended study area vary greatly because of differences in population, economy, and environment. Land uses in the Sacramento River valley are principally agricultural and open space, with urban development focused around the state capital in the Sacramento metropolitan area. The primary private land use in the region is agriculture. As of 1997, the Sacramento Valley area contained more than 11,000 farms on about 4.3 million acres. Urban development has occurred along major highway corridors, primarily in Sacramento, Placer, El Dorado, Yolo, Solano, and Sutter counties, and has caused some agricultural land to be taken out of production. For those lands that remain agricultural, soil conditions allow a wide variation in crop mix.

The American River is in the lower Sacramento River and Delta portion of the extended study area. Two sections of the American River, the North Fork American River from its source in the Sierra Nevada to the Iowa Hill Bridge

near Colfax, and the lower American River from Nimbus Dam to the river's confluence with the Sacramento River in the city of Sacramento, are listed as Wild and Scenic under the Federal WSRA and State PRC.

The listed segment of the North Fork American River is designated as a wild river under the Federal WSRA and State PRC. The listed segment is above any regulated reaches and is not under the control of the Central Valley Project or the State Water Project. The downstream end of the listed segment is more than 70 river miles and 50 air miles upstream from the confluence with the Sacramento River and is thus too far away to be affected by any hydraulic changes in the Sacramento River.

The lower American River is regulated by Folsom Dam, which is approximately 7 miles upstream from Nimbus Dam. Both Shasta Dam and Folsom Dam release water in accordance with their operational requirements, including releases to maintain water quality for fisheries, municipal use, and agricultural use, and for exports to the San Joaquin Valley. Both dams have operational requirements for the sections of the Sacramento and lower American rivers above their confluence, and they also have shared operational requirements for the Sacramento River and Delta below the confluence. Therefore, operational changes at one dam could require operational changes at the other. For example, reduced releases from Shasta Dam could require increased releases from Folsom Dam to meet flow requirements in the lower Sacramento River and Delta.

The lower American River is designated as a recreational river under the Federal WSRA and State PRC. Fishing and boating, including rafting and canoeing, are the primary recreational activities on the river. In addition, much of the lower American River's south shore is part of the American River Parkway. Joggers, bicyclists, walkers, and families use the riverside trails and beaches of this extensive park system.

CVP/SWP Service Areas

The CVP, operated by Reclamation, is the largest water storage and delivery system in California, covering 29 of the state's 58 counties. Most of the CVP service area is in the Central Valley, and about 90 percent of the south-of-Delta contractual delivery is for agricultural uses (Reclamation 2007).

Most of the population of the CVP service area is concentrated within urban areas. The CVP service area includes various municipal and industrial water contractors and water districts that serve portions of the Sacramento and Stockton metropolitan areas and the San Francisco Bay Area. Outside these population centers, most of the CVP service area is rural, with irrigated agriculture the predominant land use and economic driver (Reclamation 2007).

SWP water is delivered to contracting agencies in Northern California, the San Francisco Bay Area, the Central Coast, San Joaquin Valley, and Southern California.

Land uses in the CVP/SWP service areas vary and include agricultural, municipal and industrial, commercial, open space, grazing, and timber production.

17.1.2 Planning

Shasta Lake and Vicinity

Federal Land Use Planning Federal lands are not subject to county or city general plans. Land use planning direction for the NRA is guided by Federal legislation (including 36 CFR part 292 subpart B), regional forest directives, and forest-specific management directives found in the STNF Land and Resource Management Plan (LRMP).

The STNF LRMP is based on three broad management strategies: preservation, biodiversity, and sustainable development for people. Resources are categorized by type (e.g., air resources, fisheries, lands) and assigned management goals, standards, and guidelines. The following goals describe the desired future condition of the STNF:

- Lands
  - Plan for long-range land ownership adjustments that support resource objectives.
  - Provide for continued use and new development of hydroelectric facilities.

The six broad categories of land use that apply to the STNF are Congressionally Reserved Areas, LSRs, Administratively Withdrawn Areas, Riparian Reserves, Matrix, and Adaptive Management Areas (USFS 1995). The LRMP requires each type of land use to be managed in accordance with specific standards and guidelines pertaining to each resource type. Lands designated as Riparian Reserve, for example, have specific management standards and guidelines for air quality, biological diversity, fire and fuels, etc. The following describes each type of land use in the STNF:

- **Late Successional Reserves** – LSRs have been established to protect and enhance conditions of late-successional and old-growth forest ecosystems and to ensure the support of related species, including the northern spotted owl. The applicable management prescription is:
  - Provide special management for LSRs and threatened and endangered species. The management prescription includes special,

selected sensitive wildlife species that are primarily dependent on late seral stage conditions.

- **Administratively Withdrawn Areas** – These areas are identified in the LRMP and include recreation and visual areas, backcountry, and other areas where management emphasis precludes scheduled timber harvesting. The applicable management prescriptions are:

  - **Unroaded Non-Motorized Recreation** – Provide for semi-primitive non-motorized recreation opportunities in unroaded areas outside existing wilderness areas while maintaining predominantly natural-appearing areas with only subtle modifications.

  - **Limited Roaded Motorized Recreation** – Provide for semi-primitive motorized recreation opportunities while maintaining predominantly natural-appearing areas with some modifications.

  - **Roaded, High Density Recreation** – Provide areas that are characterized by a substantially modified natural environment.

  - **Special Area Management** – Provide for protection and management of special interest areas and research natural areas.

  - **Heritage Resource Management** – The primary theme of this prescription is to protect designated cultural resource values, interpret significant archaeological and historical values for the public, and encourage scientific research of these selected properties.

- **Riparian Reserves** – Provide an area along streams, wetlands, ponds, lakes, and unstable and potentially unstable areas where riparian-dependent resources receive primary emphasis. The applicable management prescription is:

  - Maintain or enhance riparian areas, wildlife and fisheries habitat, and water quality by emphasizing streamside and wetland management.

- **Matrix** – Includes Federal lands outside the categories of the designated areas listed above. Matrix lands are where most timber harvest would occur and where standards and guidelines are in place to ensure appropriate conservation of ecosystems as well as provide habitat for rare and lesser known species. The applicable management prescriptions are:

  - **Roaded Recreation** – Provide for an area where there are moderate evidences of the sights and sounds of humans.

  - **Wildlife Habitat Management** – The primary purpose of this prescription is to maintain and enhance big game, small game, upland game bird, and nongame habitat to provide adequate hunting and viewing opportunities.

- **Adaptive Management Areas** – Manage lands on an ecosystem basis in terms of both technical and social challenges, and in a manner consistent with applicable laws. There are no management prescriptions associated with Adaptive Management Areas.

The LRMP provides another more specific layer of land use planning guidance for the NRA in the Management Guide: Shasta and Trinity Units of the Whiskeytown-Shasta-Trinity NRA (USFS 1996). This document provides the following land use guidance:

- Those private lands that would enhance outdoor recreation opportunities and/or the conservation of scenic, scientific, historic, and other values contributing to the public enjoyment of the NRA should be acquired as opportunities arise.

- Land exchanges will be pursued in accordance with the Forest Land Adjustment Guide. Lands directly adjacent to the shoreline will have the highest priority.

- Lands with significant known pollution sources arising from a history of mining discharge will not be acquired.

- Coordination will take place with Shasta County to allow those private land developments and resource production proposals that will maintain or enhance NRA values, and to disallow or phase out private land uses that detract from those values.

- Coordination will take place with county, State, and other Federal agencies on development, management, and regulatory oversight of recreation opportunities and facilities to ensure consistency with NRA objectives.

- Planning will take place with owners and managers of travel and utility corridors through the NRA (railroad, highway, and major power lines) to minimize the visual impacts of these corridors on the aesthetic value of the NRA.

The STNF coordinates with Shasta County to ensure that private development in the NRA maintains or enhances NRA values through local zoning regulations.

County Land Use Planning Land-use planning on non-Federal land is the province of local governments in California. All cities and counties in California are required by the State to adopt a general plan establishing goals and policies for long-term development, protection from environmental hazards, and conservation of identified natural resources (California Government Code 65300). General plans lay out the pattern of future residential, commercial, industrial, agricultural, open-space, and recreational land uses on non-Federal land within a community. To facilitate implementation of planned growth patterns, general plans identify goals and/or policies to establish land use patterns.

Local governments implement general plans by adopting zoning, subdivision, grading, and other ordinances. Zoning ordinances identify specific types of land uses that may be allowed on a given site and establish specific development standards. Zoning regulations vary from jurisdiction to jurisdiction. However, typical standards promulgated in zoning ordinances include the siting of structures relative to parcel boundaries, architectural design (including height limitations), and the percentage of building coverage allowed relative to the overall square footage of a parcel.

The *Shasta County General Plan* (Shasta County 2004) provides planning guidance for privately owned land in Shasta County. Land use directives are provided in the form of goals, policies, objectives, standards, and guidelines. The following land uses described in the general plan are present in the Shasta Lake and vicinity portion of the primary study area:

- **Rural Residential** – Encompasses areas that receive minimal urban services, usually in or near a rural community center and areas with no urban services that are located in areas of the county characterized by one or more of the following conditions:
    - Severe limitations on septic tank use
    - Uncertain long-term availability of water
    - Proximity to lands categorized as timber, grazing, or crop lands
    - Remoteness from urban, town, and rural community centers
    - Extreme wildland fire hazard
    - Inaccessibility via county-maintained roads
- **Existing Residential** – This designation may be applied to residential areas that existed before 1984 and that do not fit the land use designation or density applied to surrounding properties.

- **Mixed Use** – This category recognizes that in a rural setting the strict segregation of different land use types, which is typically found in urban environments, is neither necessary nor practical. At this scale, conflicts that may result from the intermixing of land uses may be addressed by County zoning and development standards related to screening setbacks and architectural design.

- **Commercial Recreational** – This designation provides opportunities for the development of privately owned lands characterized by the natural environment for the purpose of providing commercial recreation activities that use and provide for the enjoyment of the natural environment. Examples of commercial recreation include campgrounds, fishing and hunting clubs, dude ranches, boating facilities, and recreational vehicle parks. Other uses such as a restaurant or small grocery store may be permitted when accessory to, supportive of, and compatible with the recreation activity.

- **Natural Resources Protection**

  - **Community Parks** – Provides for large-scale community recreation facilities

  - **Habitat** – Provides for protection of significant wildlife habitat resources

Shasta County land use actions and decisions on non-Federal land in the NRA are subject to STNF review and approval pursuant to 36 CFR part 292 subpart B.

Upper Sacramento River (Shasta Dam to Red Bluff)

Land use planning in the upper Sacramento River area consists of general plans adopted by Shasta and Tehama counties and the cities of Shasta Lake, Redding, Anderson, and Red Bluff. BLM lands in this area are managed in accordance with the Redding Resource Management Plan (RMP), discussed in the Regulatory Framework section below.

Local Land Use Planning

Shasta County The *Shasta County General Plan* (2004) designates the following land uses along the Sacramento River from Shasta Dam south to the Tehama County line:

- Rural residential
- Greenway
- Habitat resource
- Natural habitat

- **Agricultural** – cropland
- **Agricultural** – small-scale crops, grazing
- Mineral resources

Tehama County Tehama County is currently updating its general plan. The *Draft Plan and Background Report* were circulated to the public in May 2007. The associated Environmental Impact Report has not been completed. The current *Tehama County General Plan* (1983) designates the following land uses along the Sacramento River from the Shasta County line in the north to Red Bluff:

- Habitat resource, resource lands, and public/wilderness
- Cropland and grazing
- General commercial
- Scenic easement and open space
- Commercial recreation
- Urban and city
- Rural small lot, rural large lot, and suburban

City of Shasta Lake The *City of Shasta Lake General Plan* was adopted in 1999. The general Plan designates the following land uses along Shasta Dam Boulevard, the primary roadway leading up to Shasta Dam:

- Community park
- 100-year floodplain
- Public facilities
- Commercial
- Mixed use
- Rural residential (1 unit/2 acres, 1 unit/5 acres)
- Suburban residential (3 units/acre)
- Urban residential (10 units/acre)
- **Urban residential** – High (20 units/acre)

City of Redding The City of Redding adopted an updated general plan in 2000 (City of Redding 2000). The general plan designates the following land uses along the Sacramento River within the city limits and sphere of influence:

- Greenway
- Park, Park-Golf

- Public Facility; Public Facility-School
- Recreational
- General Office
- General Commercial
- Neighborhood Commercial
- Residential (2–3.5, 3.5–6, 6–10 units/acre)
- Critical Mineral Resource Overlay
- Mixed Use Neighborhood Overlay

City of Anderson The City of Anderson released its updated general plan in May 2007 (City of Anderson 2007). The general plan designates the following land uses along the Sacramento River within the city limits and sphere of influence:

- Commercial
- Industrial
- Public/Quasi-Public
- Medium-Density Residential
- Rural Residential/Rural Estate

City of Red Bluff The City of Red Bluff most recently amended its General Plan Land Use Element in 1993. The general plan designates the following land uses along the Sacramento River within the city limits and sphere of influence:

- Primary Floodplain
- Exclusive Agriculture
- General Commercial
- Central Business Districts
- Single-Family Residential
- General and Neighborhood Apartment Districts
- General Industrial
- Public Agency District
- Park

Lower Sacramento River and Delta

The lower Sacramento River and Delta are within the planning jurisdiction of Butte, Colusa, Contra Costa, Glenn, Sacramento, Solano, Sutter, Yolo, and Yuba counties. The largest cities in this region are Antioch, Chico, Davis, Fairfield, Martinez, Marysville, Pittsburgh, Sacramento, Vacaville, Vallejo, West Sacramento, and Woodland. Each of these entities currently has adopted general plans and zoning ordinances. Land use planning documents are adopted by Federal agencies for Federally managed lands in the lower Sacramento River and Delta areas.

CVP/SWP Service Areas

The CVP extends from the Cascade Range near Redding in the north to the Tehachapi Mountains near Bakersfield in the south. The CVP serves farms, homes, and industry in California's Central Valley as well as major urban centers in the San Francisco Bay Area. SWP contractors are in the southern San Joaquin Valley, Central Coastal area, and Southern California. CVP and SWP service areas include portions of the primary and extended study area. CVP water irrigates more than 3 million acres of farmland and provides drinking water to nearly 2 million consumers. SWP deliveries are 70 percent urban and 30 percent agriculture, serving 20 million Californians and more than 600,000 irrigated acres, respectively. Each of the counties and incorporated cities in the CVP and SWP service areas has adopted general plans and zoning ordinances. Federally managed lands in the service areas are managed in accordance with land use and planning documents similar to the STNF LRMP and the BLM's RMP, and military installations located in the service areas have their own planning processes.

17.2 Regulatory Framework

17.2.1 Federal

Federal land use policies apply only to actions on, or affecting the uses of, Federal lands. Federal lands in the primary study area consist of the following:

- National Forest lands managed by the STNF around Shasta Lake
- Lands along the Sacramento River just south of Shasta Dam managed by Reclamation
- Lands managed by BLM along the Sacramento River south of Shasta Dam as far downstream as Red Bluff

Entry upon or use of these Federally administered lands would require approval from the appropriate Federal entity(ies).

Federal Land Policy and Management Act

The Federal Land Policy and Management Act was enacted to change the Federal public lands policy from disposal to retention. The act directs Federal agencies to apply land use principles that emphasize conservation; these include the principles of multiple use and sustained yield land management policies. The Federal Land Policy and Management Act consolidated and articulated BLM's management responsibilities and applies primarily to this Federal land management agency. Title V of the Federal Land Policy and Management Act also granted the Secretary of the Interior and the Secretary of Agriculture the authority to issue rights-of-way for various uses, including reservoirs.

Code of Federal Regulations

USFS personnel administer their responsibilities for regulating use and protecting National Forest lands under Title 36 of the CFR and sections of titles 16, 18, and 21. Public services directives from the code are integrated into the STNF LRMP and include the following topics: fire and fuels management, facilities management, law enforcement, and land management.

Shasta-Trinity National Forest Land and Resource Management Plan

The STNF LRMP is a forestwide land use plan developed to guide resource management on the STNF. Six broad categories are used to define management strategies. The management strategies (known as land allocations) are implemented through management prescriptions that provide specific standards and guidelines for forest resource management (USFS 1995).

Management Guide for the Shasta and Trinity Units of the Whiskeytown-Shasta-Trinity National Recreation Area

The Management Guide for the NRA contains management strategies intended to achieve or maintain desired conditions for the NRA. The document supplements the STNF LRMP by providing specific information about current conditions in the NRA, desired future conditions for the NRA, and management recommendations for the NRA. The STNF is responsible for administering the Shasta and Trinity units of the NRA.

BLM's Redding Resource Management Plan

BLM's Redding RMP (BLM 1994) provides guidance for the management of cultural resources, fire, grazing, minerals, vegetation, water quality, wildlife and fish habitats, and other resources and issues in Shasta County. The RMP governs land use on BLM lands, including lands in the Sacramento River Management Area. Planning issues addressed in the RMP include land tenure adjustments, such as land acquisition, exchange, and sale; recreation management; access; and forest management, including harvesting, herbicide use, and special-status species.

The RMP was amended by the 1994 Record of Decision for the *Northwest Forest Plan* (Final Supplemental Environmental Impact Statement for Amendments to Forest Service and Bureau of Land Management Planning

Documents within the Range of the Northern Spotted Owl). This amendment required preparation of Watershed Analysis prior to initiating BLM activities. As a party to the *Northwest Forest Plan,* BLM, like USFS, is also required to ensure that projects are consistent with the Aquatic Conservation Strategy.

Federal Wild and Scenic Rivers Act

The Federal WSRA, enacted in 1968, established the National Wild and Scenic Rivers System "to preserve rivers with outstanding natural, cultural, and recreational values in a free-flowing condition for the enjoyment of present and future generations." To be eligible for inclusion in the system, a river must be free-flowing and exhibit outstandingly remarkable values. Free-flowing means "existing or flowing in a natural condition without impoundment, diversion, straightening, rip-rapping, or other modification of the waterway" (16 U.S. Code Sec. 1286). outstandingly remarkable values are scenic, recreational, geologic, fish and wildlife, historic, cultural, or other similar values (16 USC Sec. 1271). Depending on the specific attributes of a river, it may be designated as "wild," "scenic," or "recreation." Different segments of a single river can receive different designations; in other words, some segments can be designated wild, some scenic, and some recreation or combinations of these designations. Recreation rivers are defined as "rivers or sections of rivers that are readily accessible by road or railroad, that may have some development along their shorelines, and that may have undergone some impoundment or diversion in the past" (16 USC Sec. 1286).

State-designated rivers may be added to the Federal system upon the request of the state's governor and the approval of the Secretary of the Interior (16 USC Sec. 1286). Two sections of the American River were added to the federal system in 1981 under this method. These sections are the lower American River from Nimbus Dam to the river's confluence with the Sacramento River and the North Fork American River from its source to the Iowa Hill Bridge. The North Fork section is located above Nimbus, Folsom, and Lake Clementine dams many miles upstream from the confluence with Sacramento River. The North Fork is not regulated by Folsom Dam and would not be affected by hydraulic changes in the Sacramento River. The lower American River is designated as a recreational river.

17.2.2 State

California Public Resource Code, Division 6

The California Public Resource Code, Division 6, grants the State Lands Commission (SLC) jurisdiction over 4.5 million acres of land held in trust for Californians. The SLC's jurisdiction includes a 3-mile-wide section of tidal and submerged land adjacent to the coast and offshore islands, including bays, estuaries, and lagoons. It also includes the waters and beds of more than 120 rivers, lakes, streams, and sloughs. The State holds these lands for the public trust purposes of water-related commerce, navigation, fisheries, recreation, and open space. The SLC may grant dredging permits and issue land use leases for

activities within its jurisdiction. The SLC does not have a comprehensive use plan for these lands but manages them according to State and Federal laws and regulations. In the primary study area, the SLC's jurisdiction includes areas along the Sacramento River north of Red Bluff.

California Fire Plan

The *California Fire Plan* was prepared by the State Board of Forestry and the California Department of Forestry and Fire Protection to provide a comprehensive strategy for wildland fire protection and prevention in California. The plan provides recommendations for fire-safe land use planning. Preventive measures include using fire-resistant building materials, maintaining a defensible space around structures, vegetation management, and infrastructure planning.

Water Quality Control Plan

The *Water Quality Control Plan for the Sacramento River and San Joaquin River Basins* provides water quality objectives to protect beneficial uses of designated rivers and streams. *Water Quality Control Plan for the Sacramento River and San Joaquin River Basins* objectives are incorporated into county and city general plans, zoning ordinances, and subdivision ordinances.

California Public Resources Code, Sections 5093.50–5093.70

The California PRC Sections 5093.50 – 5093.70 were established through 1972 enactment of the Wild and Scenic Rivers Act, which was subsequently amended on several occasions, to preserve certain rivers that possess extraordinary scenic, recreational, fishery, or wildlife values in their free-flowing state. The State PRC identifies, classifies, and provides protection for specific rivers or river segments, as approved by the legislature. Rivers or river segments that are specifically identified and classified in the PRC comprise the State Wild and Scenic Rivers System. As described in PRC Section 5093.50, rivers or river segments included in the State system must possess "extraordinary scenic, recreational, fishery, or wildlife values"; however, the PRC does not define what constitutes "extraordinary."

Depending on the specific conditions of a river, it may be designated as "wild," "scenic," or "recreation." Different segments of a single river can receive different designations; in other words, some segments can be designated wild, some scenic, and some recreation or combinations of these designations. Recreation river segments are readily accessible by road or railroad, may have some development along their shorelines, and may have been impounded or diverted in the past (PRC Section 5093.53).

With its initial passage, the state system protected segments of eight rivers, including two sections of the American River. These sections include the lower American from Nimbus Dam to its confluence with the Sacramento River and the North Fork from its source to the Iowa Hill Bridge. The North Fork section is located above Nimbus, Folsom, and Lake Clementine dams many miles

upstream from the confluence with Sacramento River. The North Fork is not regulated by Folsom Dam and would not be affected by hydraulic changes in the Sacramento River. The lower American is designated as a recreational river.

17.2.3 Regional and Local

Shasta County General Plan

The *Shasta County General Plan* (2004) guides land use planning on non-Federal land for Shasta County through 2025. The Community Organization and Development Pattern element of the *Shasta County General Plan* establishes policies related to the organization and relationships of the community types present in Shasta County, the living environments these communities offer, and the locations of development in relation to these communities. These policies were developed to maintain and enhance the quality of their environments. The Community Organization and Development Pattern element includes several objectives that influence land use decisions in the project study area:

- To promote a development pattern that will accommodate, consistent with the other objectives of the plan, the growth that will be experienced by Shasta County
- To guide development in a pattern that will provide opportunities for present and future county residents to enjoy the variety of living environments that currently exist within the county
- To guide development in a pattern that will respect the natural resource values of county lands and their contributions to the county's economic base
- To guide development in a pattern that will minimize land use conflicts between adjacent land users
- To recognize that the major economic resources for achieving the development pattern will come from the private sector, rather than government, and that the general plan, as the expression of community values, will guide the use of these resources

Tehama County General Plan

The *Tehama County General Plan* is used to guide future development in unincorporated areas of the county. The county's current general plan was adopted in 1983 and is currently being updated. The updated *Draft General Plan and Background Report* were circulated to the public in May 2007. The Land Use element of the *Draft General Plan* establishes the goals, policies, and implementation measures that will help guide the growth and development of Tehama County for the next 20 years. This element also contains the General Plan Land Use Diagram, which delineates those areas of the county where

future residential development of varying densities and nonresidential growth is anticipated or will be directed (Tehama County 2007a and 2007b).

City of Shasta Lake General Plan

The planning boundaries for the *City of Shasta Lake General Plan* are within the Shasta Lake and vicinity study area, north of Keswick Dam, east of the Sacramento River, and west of I-5. This general plan was adopted in 1999 and is intended to guide land use planning within the city through the Year 2020 (City of Shasta Lake 1999). The following statement from the Land Use element of the general plan identifies some of the concerns surrounding land use decisions within the City of Shasta Lake:

> *The Land Use Element and the Land Use and Circulation Map constitute the physical framework for the general plan, which designates the proposed location, distribution, and extent of land uses. Land use was a specific area of concern identified as being key to the development of the City of Shasta Lake. Some of the major issues identified included an evaluation and establishment of urban, rural, and urban reserve boundaries. This was accomplished by identifying areas that currently lack infrastructure that would be required to develop in an orderly manner through the development of Area Plans.*

City of Redding General Plan

The planning boundaries for the *City of Redding General Plan* encompass areas within the city limits and the urban growth boundary. This plan was adopted in 2000 and is intended to guide land use planning through the year 2020 (City of Redding 2000). The Community Development and Design element of the general plan states the following about the role and effects of land use policies:

> *Land use policies and the General Plan Diagram affect every property in the City. They determine how people can use/develop their land and what they can reasonably expect to develop next door, down the street, or across town. They provide for overall consistency and compatibility between land uses and can be a determining factor in quality of life. The policies … also have a direct bearing on traffic, the feasibility of public transportation, and the quality of the air.*

City of Anderson General Plan

The planning boundaries of the *City of Anderson General Pla*n encompass areas within the city limits and the urban growth boundary. The City of Anderson released its updated general plan in May 2007 (City of Anderson 2007). The general plan is intended to guide land use planning within the city through the Year 2027. The following statement from the Land Use element of the general plan identifies some of the concerns surrounding land use decisions within the City of Anderson:

> *The Land Use Element describes the pattern of land development within the City of Anderson and the proposed expansion area and provides direction for the future development envisioned for the City. Also included in this Element are descriptions of geographic areas that are anticipated to be developed over the term of this General Plan and goals and policies to guide the City's decision makers in their review of development proposals. This Element also defines land use categories and provides supporting detail for the uses depicted upon the Anderson General Plan Land Use Diagram.*

Red Bluff General Plan

The planning boundaries for the *City of Red Bluff General Plan* encompass areas within the city limits and the urban growth boundary. The adopted General Plan elements are as follows: Circulation element (1991), Housing element (2004), and Land Use, Natural Environment, Noise, and Safety Elements (1993). The following statement from the Land Use element summarizes concerns relative to land use decisions in Red Bluff (City of Red Bluff 1993):

> *The land use element identifies the spatial arrangement of existing and proposed uses of land including public lands and facilities. It lays out the distribution of classes of land use, the intensity of those uses, and proposes a strategy of goals, objectives, policies and implementation measures to promote a wise use of land to promote the welfare of the community.*

17.3 Environmental Consequences and Mitigation Measures

17.3.1 Methods and Assumptions

To characterize existing land uses in the primary study area, pertinent planning documents were reviewed to identify objectives for the level, type, location, density, and intensity of development and to determine whether the alternatives would be in conflict with current plans and policies. Planning documents that were reviewed include the STNF LRMP (USFS 1995), the Management Guide for the NRA, and the general plans for the cities of Shasta Lake, Redding, Anderson, and Red Bluff and Shasta and Tehama counties. Land use maps and zoning maps were consulted to identify planned land uses. The analysis also included a review of aerial photography to determine existing land uses in the primary study area.

The impacts of each alternative are analyzed separately, starting with the analysis of the No-Action Alternative, followed by each of the action alternatives. The impact analysis includes a discussion of both direct and indirect impacts associated with each alternative.

17.3.2 Criteria for Determining Significance of Effects

An environmental document prepared to comply with NEPA must consider the context and intensity of the environmental effects that would be caused by, or result from, the proposed action. Under NEPA, the significance of an effect is used solely to determine whether an EIS must be prepared. An environmental document prepared to comply with CEQA must identify the potentially significant environmental effects of a proposed project. A "[s]ignificant effect on the environment" means a substantial, or potentially substantial, adverse change in any of the physical conditions within the area affected by the project" (CEQA Guidelines, Section 15382). CEQA also requires that the environmental document propose feasible measures to avoid or substantially reduce significant environmental effects (CEQA Guidelines, Section 15126.4(a)).

The following significance criteria were developed based on guidance provided by the State CEQA Guidelines and consider the context and intensity of the environmental effects as required under NEPA. An alternative was determined to result in a significant effect related to land use and planning if it would do any of the following:

- Create land uses that are incompatible with existing and planned land uses adjacent to actions described as part of the project
- Introduce substantial nuisance effects on sensitive land uses that would disrupt use over an extended time period
- Conflict with any applicable land use plan, policy, ordinance, or regulation of an agency with jurisdiction over the project (including general plans, specific plans, and zoning ordinances) adopted for the purpose of avoiding or mitigating an environmental effect
- Disrupt or divide the physical arrangement of an established community
- Conflict with any applicable habitat conservation or natural community conservation plan

17.3.3 Topics Eliminated from Further Consideration

Effects of the proposed enlargement of Shasta Lake on the listed segments of the American River have been eliminated from further consideration in this EIS. The listed segment of the North Fork American River has been eliminated because it is above any regulated reaches and is many miles from the confluence of the American and Sacramento rivers. The lower American River has been eliminated because none of the alternatives would adversely affect its designation as a recreational river under the Federal WSRA or State PRC. Under each of the action alternatives, releases from Shasta Dam would increase from late spring through early autumn. Increased releases from Shasta Dam during this period would reduce the volume of water released from Folsom Dam

during the primary recreation season on the lower American River (late spring through early autumn). Flow volumes and water levels within the lower American River would, however, remain substantially similar to existing conditions and would remain within the river's typical range of variation during the primary recreation season. During the secondary recreation season (autumn through spring), precipitation is greater, flows in the Sacramento River and Delta are higher, and releases from Shasta Dam would be reduced to increase storage in Shasta Lake. Reclamation may need to occasionally increase releases from Folsom Dam to accommodate demand and offset decreased releases from Shasta Dam. Flow volumes and water levels in the lower American River would, however, remain substantially similar to existing conditions and within the river's typical range of variation during the secondary recreation season.

17.3.4 Direct and Indirect Effects

No-Action Alternative

Shasta Lake and Vicinity, Upper Sacramento River (Shasta Dam to Red Bluff), Lower Sacramento River and Delta, and CVP/SWP Service Areas
The impact discussion for the No-Action Alternative addresses all three study areas together, because this alternative would not impact land use in either of the three study areas.

Impact LU-1 (No-Action): Disrupt Existing Land Uses No new facilities would be constructed and no existing facilities would be altered, expanded, or demolished. Therefore, there would be no impact. Mitigation is not required for the No-Action Alternative.

Impact LU-2 (No-Action): Conflict with Existing Land Use Goals and Policies of Affected Jurisdictions No new facilities would be constructed and no existing facilities would be altered, expanded, or demolished. Therefore, there would be no impact. Mitigation is not required for the No-Action Alternative.

CP1 – 6.5-Foot Dam Raise, Anadromous Fish Survival and Water Supply Reliability

Shasta Lake and Vicinity and Upper Sacramento River (Shasta Dam to Red Bluff) The impact discussion for CP1 addresses the Shasta Lake and Vicinity and Upper Sacramento River study areas together, because impacts from construction activities would affect both study areas.

Impact LU-1 (CP1): Disrupt Existing Land Uses Project construction activities associated with enlarging Shasta Dam and relocating utilities, infrastructure, and public service and recreational facilities could result in short-term and long-term disruptions to land uses by interfering with the ability to use certain lands and interfering with access to certain lands. Construction activities that could disrupt land uses include the transport of project materials to and from project construction sites and the demolition and relocation of some utilities. This impact would be potentially significant.

It is anticipated that construction activities would be limited to the Shasta Lake and vicinity study area; therefore, no impacts associated with disruption of existing land uses would be expected to occur downstream from Shasta Dam.

Construction activities specific to enlarging Shasta Dam would be limited to the existing footprint of the Shasta Dam facilities and areas immediately adjacent. The project construction site would be accessed by existing roadways (I-5, Shasta Dam Boulevard, and Lake Boulevard). The access roads allow commercial truck use and are capable of supporting project-generated traffic. Road modifications would be necessary to accommodate project traffic en route to the construction sites and access restrictions would occur. Noise, air quality, and traffic impacts along these local roadways are evaluated in separate sections of the PDEIS. Equipment staging areas would be sited to avoid affecting or conflicting with existing land uses.

Project construction activities associated with relocating utilities, infrastructure, and public service and recreational facilities could result in temporary and localized disruptions of existing land uses. Lake inundation resulting from future dam operations could result in long-term disruptions of land uses in the primary study area. The Utilities and Miscellaneous Minor Infrastructure Technical Memorandum provides descriptions and detailed maps of the utilities and minor infrastructure that would be demolished or relocated in the ancillary areas near Shasta Lake (Reclamation 2007). Chapter 21 (Utilities and Service Systems) of this PDEIS evaluates the project's impacts on utilities and service systems, and the environmental impacts of utilities demolition and relocation are evaluated in the pertinent technical chapters of the EIS (e.g., Water Quality, Air Quality and Climate, and Noise and Vibration).

Construction activities would affect major features around Shasta Lake and vicinity and would require demolition, relocation, modification, or reconstruction to prevent inundation of the features caused by an increased reservoir elevation. The major features affected would include:

- Major roads and road segments (Lakeshore Drive realignment)
- Vehicle bridges (Charlie Creek, Doney Creek, McCloud River, Didallas Creek, and Second Creek)
- Railroad bridge
- Utilities and service systems infrastructure
- Campgrounds and picnic areas
- Buildings (resort/marina, residential, USFS facilities)

The communities of Lakeshore and Sugarloaf would be affected the most by transportation infrastructure relocation activities. Seventy-five small road segments (both paved and unpaved) would need to be modified. CP1 would result in the inundation of Lakeshore Drive at numerous locations south of Charlie Creek Bridge and in two locations between Charlie Creek and Doney Creek bridges. Relocation of Lakeshore Drive and the UPRR would occur near existing residences and businesses. Road construction activity could result in temporary and localized increases in dust, noise, and construction truck traffic and potential disruption of access.

Seven bridges would need to be replaced. Construction activities associated with bridge modifications and relocations, particularly in areas with existing development such as Bridge Bay Marina and the communities of Lakeshore and Sugarloaf, could result in short-term disruptions of nearby residential, commercial, and industrial land uses. Bridge construction activity could result in temporary and localized increases in dust, noise, and construction truck traffic and potential disruption of access.

Approximately 66,000 feet of power and telecommunications lines would need to be demolished and reconstructed in areas around Shasta Lake. Utilities infrastructure relocation activities could result in short-term disruptions of land uses in communities and recreation areas around Shasta Lake. Relocation activities could require partial or full road closures and other access restrictions to ensure public safety. Utilities relocation activities could also result in temporary and localized increases in dust, noise, heavy equipment traffic, and other project traffic.

An estimated 45 buildings would be affected under a 6.5-foot dam raise. The buildings have been categorized as residential (cottages, homes, etc.), commercial (resorts, marinas, stores, etc.), and USFS sites (work stations, campground buildings, recreation site restrooms, etc.). Buildings within the inundation area would be removed, and some would be relocated. Utilities associated with the removed buildings (water systems, septic systems, telecommunications and power facilities) would also require demolition or abandonment. Construction activity related to removal and/or relocation of buildings would result in temporary and localized increases in dust, noise, and construction truck traffic and potential disruption of access. Some existing marinas would need to be modified or relocated, which would disrupt existing commercial and recreational land uses. See the *Recreation and Public Access Technical Report* for details concerning marina relocations.

Reservoir dikes would be required in the areas of Antlers/Lakeshore and at the UPRR track at the south end of Bridge Bay for protection of existing infrastructure from increased full pool elevations. Additional sites for dike construction could be added in the future. Dike construction could serve to lessen long-term land use impacts resulting from the project by eliminating the need to remove and relocate a number of structures. Construction activities

associated with dike construction would result in temporary and localized increases in dust, noise, and construction truck traffic and potential disruption of access.

Project implementation could result in short-term disruptions of land uses of parcels around Shasta Lake and vicinity during construction and relocation activities; long-term disruptions of land use could also result from project operations. This impact would be potentially significant. Mitigation for this impact is proposed in Section 17.3.5.

Impact LU-2 (CP1): Conflict with Existing Land Use Goals and Policies of Affected Jurisdictions Project implementation would result in inundating land around Shasta Lake, which could conflict with land use goals and policies of affected jurisdictions. Relocation of utilities and service systems resulting from project implementation could also conflict with existing land use goals and policies. This impact would be potentially significant.

It is anticipated that construction activities would be limited to the Shasta Lake and vicinity study area; therefore, no conflicts with existing land use goals and policies would be expected to occur in planning jurisdictions downstream from Shasta Dam.

Project implementation would result in an increase in reservoir pool elevation during extreme storm events, which could result in the flooding of approximately 1,200 acres in the lower elevations around Shasta Lake. To prevent utilities and infrastructure damage, Reclamation would relocate roads, utilities and service systems, marinas, and other structures and would modify a number of bridges. Relocation plans are based on broad assumptions regarding optimum construction, operation, and environmental conditions. Areas planned for relocation activities could have land use designations that conflict with the land use proposed by the project. It is anticipated that some relocation activities would conflict with land use designations. Specific relocation sites are needed before a detailed analysis can be made. Once relocation sites are known, the proposed land use would be compared to the existing land uses and land use designations to determine consistency with the USFS LRMP and the *Shasta County General Plan* and the Shasta County Zoning Ordinance.

Areas that would be most affected by project implementation are located on the Sacramento Arm of Shasta Lake and include the communities of Sugarloaf and Lakeshore. A number of existing residential land uses would be inundated by a higher full pool elevation in Shasta Lake. Residences within 20 feet of the new full pool elevation will be demolished and most will be relocated.

Most recreation facilities that could be inundated by project implementation would be relocated; some recreation facilities would be relocated adjacent to existing recreation facilities. Sites proposed for the relocation of recreational facilities could be inconsistent with the current land use designations.

Reclamation would cooperate with USFS to find the most suitable relocation sites that would be consistent with the STNF LRMP and the NRA Management Guide.

Open space lands would be inundated. STNF LRMP land allocations that would be inundated include Riparian Reserve allocations. Loss of the use of NRA lands would be inconsistent with LRMP and NRA goals and policies. Reclamation would coordinate mitigation measures with USFS to minimize the impacts from losing the ability to use lands around Shasta Lake.

Vegetation clearing required for the relocation of structures, marinas, recreation facilities, and utilities could be inconsistent with the STNF LRMP, the *Shasta County General Plan*, and the Shasta County Zoning Ordinance. Many relocation activities would require vegetation clearing prior to construction. Specific clearing sites would be dependent on the sites chosen for utilities, building, and infrastructure relocation. The sites have not been determined at this time. Once specific relocation sites are known and the areas requiring vegetation clearance are determined, an analysis would be performed to determine whether the proposed action would be inconsistent with the STNF LRMP, the NRA Management Guide, the *Shasta County General Plan*, and the Shasta County Zoning Ordinance. Reclamation would obtain authorization and/or use permits from USFS for actions within the jurisdiction of USFS; Reclamation would also obtain authorization and/or use permits from Shasta County and the California Department of Forestry and Fire Protection for vegetation clearing activities within the jurisdiction of Shasta County.

It should be noted that even where site-specific land use designations in the NRA conflict with proposed relocation activities, the STNF LRMP identifies the following overarching goal for the STNF: “provide for continued use and new development of hydroelectric facilities.” This implies that specific USFS land allocations that may be inconsistent with relocation activities could be revised or amended for project purposes. However, Reclamation would cooperate with USFS to amend site-specific land use designations, which could require additional NEPA review.

Site-specific information is needed for all infrastructure, building, and utilities relocation plans to review completely for consistency with existing land use planning documents, primarily the STNF LRMP and the *Shasta County General Plan*. Given the magnitude of facilities that might be relocated, including existing marinas, it is anticipated that there would be some inconsistencies with existing planning policies. This impact would be potentially significant. Mitigation for this impact is proposed in Section 17.3.5.

Lower Sacramento River and Delta and CVP/SWP Service Areas
Impact LU-3 (CP1): Disrupt Existing Land Uses Construction activities would be limited to the primary study area; therefore, there would be no disruption of

existing land uses in the extended study area. There would be no impact. Mitigation for this impact is not needed, and thus not proposed.

Impact LU-4 (CP1): Conflict with Existing Land Use Goals and Policies of Affected Jurisdictions Construction activities would be limited to the primary study area; therefore, no conflicts with existing land use goals and policies would occur in the extended study area. There would be no impact. Mitigation for this impact is not needed, and thus not proposed.

CP2 – 12.5-Foot Dam Raise, Anadromous Fish Survival and Water Supply Reliability

Shasta Lake and Vicinity and Upper Sacramento River (Shasta Dam to Red Bluff) The impact discussion for CP2 addresses the Shasta Lake and Vicinity and Upper Sacramento River study areas together, because impacts from construction activities would affect both study areas.

Impact LU-1 (CP2): Disrupt Existing Land Uses Project construction activities associated with enlarging the Shasta Dam facilities and relocating utilities and infrastructure could result in short-term and long-term disruptions to land uses by interfering with the ability to use certain lands and interfering with access to land. Construction activities that could disrupt land uses include the transport of project materials to and from project construction sites. This impact would be potentially significant.

This impact would be similar to Impact LU-1 (CP1). A dam raise of 12.5 feet would result in a larger area of inundation than CP1, which would, in turn, result in additional relocation of existing structures, infrastructure, and utilities and a longer duration for the impact. Reclamation estimates the construction of CP2 would take 44 months, which would be 8 months longer than for CP1. CP2 would, therefore, result in longer term disruptions of land use than would CP1. Approximately 500 additional acres would be inundated by CP2, totaling 1,734 acres of land that would be inundated by Shasta Dam operations. Specific information regarding the location and number of structures that would permanently lost will be incorporated into the land use impact analysis.

Project implementation could result in short-term and long-term disruptions of existing land uses. Therefore, this impact would be potentially significant. Mitigation for this impact is proposed in Section 17.3.5.

Impact LU-2 (CP2): Conflict with Existing Land Use Goals and Policies of Affected Jurisdictions Project implementation could result in a permanent loss of inundated land around Shasta Lake, which could conflict with land use goals and policies of affected jurisdictions. Relocation of utilities and service systems resulting from project implementation could also conflict with existing land use goals and policies. This impact would be potentially significant.

This impact would be similar to LU-2 (CP1). A dam raise of 12.5 feet would create a larger area of inundation than CP1, which, compared to CP1, would result in additional relocation of structures and infrastructure that would be subject to USFS and Shasta County land use goals and policies. A site-specific analysis would be conducted to determine where relocation activities and permanent land base losses resulting from project implementation would be inconsistent with the STNF LRMP, the NRA Management Guide, the *Shasta County General Plan*, and the Shasta County Zoning Ordinance.

Project implementation could result in short-term and long-term impacts that could conflict with existing land use goals and policies. Therefore, this impact would be potentially significant. Mitigation for this impact is proposed in Section 17.3.5.

Lower Sacramento River and Delta and CVP/SWP Service Areas
Impact LU-3 (CP2): Disrupt Existing Land Uses Construction activities would be limited to the primary study area; therefore, there would be no disruption of existing land uses in the extended study area. There would be no impact. Mitigation for this impact is not needed, and thus not proposed.

Impact LU-4 (CP2): Conflict with Existing Land Use Goals and Policies of Affected Jurisdictions Construction activities would be limited to the primary study area; therefore, no conflicts with existing land use goals and policies would occur in the extended study area. There would be no impact. Mitigation for this impact is not needed, and thus not proposed.

CP3 – 18.5-Foot Dam Raise, Anadromous Fish Survival and Water Supply
Shasta Lake and Vicinity and Upper Sacramento River (Shasta Dam to Red Bluff) The impact discussion for CP3 addresses the Shasta Lake and Vicinity and Upper Sacramento River study areas together, because impacts from construction activities would affect both study areas.

Impact LU-1 (CP3): Disrupt Existing Land Uses Project construction activities associated with enlarging the Shasta Dam facilities and relocating utilities and infrastructure could result in short- and long-term disruptions to land uses by interfering with the ability to use certain lands and interfering with access to land. Construction activities that could disrupt land uses include the transport of project materials to and from project construction sites. This impact would be potentially significant.

This impact would be similar to LU-1 (CP1). A dam raise of 18.5 feet would result in a larger area of inundation than CP1, which would result in additional relocation of existing structures and infrastructure compared to CP1 and a longer duration for the impact. Reclamation estimates that construction of CP3 would take 46 months, which would be 10 months longer than for CP1. Approximately 2,500 acres of land would be inundated by CP3 and, according to the 2003 infrastructure inventory at Shasta Lake, an estimated 130 buildings

would be inundated under an 18.5-foot dam raise (Shasta County 2003). Specific information regarding the location and number of structures that would be permanently lost would be incorporated into the land use impact analysis. CP3 would require a more extensive (longer and wider) system of reservoir dikes than CP1 to accommodate increased Shasta Lake elevations resulting from Shasta Dam operations. A dam raise of 18.5 feet would result in the encroachment of 100 road segments. Lakeshore Drive could be inundated for nearly its entire length between Charlie Creek and Doney Creek.

Project implementation could result in short- and long-term disruptions of existing land uses. Therefore, this impact would be potentially significant. Mitigation for this impact is proposed in Section 17.3.5.

Impact LU-2 (CP3): Conflict with Existing Land Use Goals and Policies of Affected Jurisdictions Project implementation could result in a permanent loss of inundated land around Shasta Lake, which could conflict with land use goals and policies of affected jurisdictions. Relocation of utilities and service systems resulting from project implementation could also conflict with existing land use goals and policies. This impact would be potentially significant.

This impact would be similar to LU-2 (CP1). A dam raise of 18.5 feet would result in a larger area of inundation than CP1, which, compared to CP1, would result in additional relocation of existing structures and infrastructure that would be subject to existing USFS and Shasta County land use goals and policies. A site-specific analysis would be conducted to determine where relocation activities and permanent land base losses resulting from project implementation would be inconsistent with the STNF LRMP, the NRA Management Guide, the *Shasta County General Plan*, and the Shasta County Zoning Ordinance.

Project implementation could result in short-term and long-term impacts that could conflict with existing land use goals and policies. Therefore, this impact would be potentially significant. Mitigation for this impact is proposed in Section 17.3.5.

Lower Sacramento River and Delta and CVP/SWP Service Areas

Impact LU-3 (CP3): Disrupt Existing Land Uses Construction activities would be limited to the primary study area; therefore, there would be no disruption of existing land uses in the extended study area. There would be no impact. Mitigation for this impact is not needed, and thus not proposed.

Impact LU-4 (CP3): Conflict with Existing Land Use Goals and Policies of Affected Jurisdictions Construction activities would be limited to the primary study area; therefore, no conflicts with existing land use goals and policies would occur in the extended study area. There would be no impact. Mitigation for this impact is not needed, and thus not proposed.

CP4 – 18.5-Foot Dam Raise, Anadromous Fish Focus with Water Supply Reliability

Shasta Lake and Vicinity and Upper Sacramento River (Shasta Dam to Red Bluff) The impact discussion for CP4 addresses the Shasta Lake and Vicinity and Upper Sacramento River study areas together, because impacts from construction activities would affect both study areas.

Impact LU-1 (CP4): Disrupt Existing Land Uses Project construction activities associated with enlarging the Shasta Dam facilities and relocating utilities and infrastructure could result in short-term and long-term disruptions to land uses by interfering with the ability to use certain lands and interfering with access to land. Construction activities that could disrupt land uses include the transport of project materials to and from project construction sites. This impact would be potentially significant.

This impact would be similar to LU-1 (CP1). Therefore, this impact would be potentially significant. Mitigation for this impact is proposed in Section 17.3.5.

Impact LU-2 (CP4): Conflict with Existing Land Use Goals and Policies of Affected Jurisdictions Project implementation could result in a permanent loss of inundated land around Shasta Lake, which could conflict with land use goals and policies of affected jurisdictions. Relocation of utilities and service systems resulting from project implementation could also conflict with existing land use goals and policies. This impact would be potentially significant.

This impact would be similar to LU-2 (CP1). Therefore, this impact would be potentially significant. Mitigation for this impact is proposed in Section 17.3.5.

Lower Sacramento River and Delta and CVP/SWP Service Areas

Impact LU-3 (CP4): Disrupt Existing Land Uses Construction activities would be limited to the primary study area. Gravel augmentation and the Reading Island habitat restoration along the upper Sacramento River could cause minor disruptions of existing land uses in the extended study area. This impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact LU-4 (CP4): Conflict with Existing Land Use Goals and Policies of Affected Jurisdictions Construction activities would be limited to the primary study area. Gravel augmentation and the Reading Island habitat restoration along the upper Sacramento River would not alter land uses and would not be expected to conflict with existing land use goals and policies. This impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

CP5 – 18.5-Foot Dam Raise, Combination Plan

Shasta Lake and Vicinity and Upper Sacramento River (Shasta Dam to Red Bluff) The impact discussion for CP5 addresses the Shasta Lake and

Vicinity and Upper Sacramento River study areas together, because impacts from construction activities would affect both study areas.

Impact LU-1 (CP5): Disrupt Existing Land Uses Project construction activities associated with enlarging the Shasta Dam facilities and relocating utilities and infrastructure could result in short-term and long-term disruptions to land uses by interfering with the ability to use certain lands and interfering with access to land. Construction activities that could disrupt land uses include the transport of project materials to and from project construction sites. This impact would be potentially significant.

This impact would be similar to LU-1 (CP1). Therefore, this impact would be potentially significant. Mitigation for this impact is proposed in Section 17.3.5.

Impact LU-2 (CP5): Conflict with Existing Land Use Goals and Policies of Affected Jurisdictions Project implementation could result in a permanent loss of inundated land around Shasta Lake, which could conflict with land use goals and policies of affected jurisdictions. Relocation of utilities and service systems resulting from project implementation could also conflict with existing land use goals and policies. This impact would be potentially significant.

This impact would be similar to LU-2 (CP-1). Therefore, this impact would be potentially significant. Mitigation for this impact is proposed in Section 17.3.5.

Lower Sacramento River and Delta and CVP/SWP Service Areas
Impact LU-3 (CP5): Disrupt Existing Land Uses Construction activities would be limited to the primary study area. Gravel augmentation and the Reading Island habitat restoration along the upper Sacramento River could cause minor disruptions of existing land uses in the extended study area. This impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact LU-4 (CP5): Conflict with Existing Land Use Goals and Policies of Affected Jurisdictions Construction activities would be limited to the primary study area. Gravel augmentation and the Reading Island habitat restoration along the upper Sacramento River would not alter land uses and would not be expected to conflict with existing land use goals and policies. This impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

17.3.5 Mitigation Measures

Table 17-1 presents a summary of mitigation measures for land use.

Table 17-1. Summary of Mitigation Measures for Land Use

Impact		No-Action Alternative	CP1	CP2	CP3	CP4	CP5
Impact LU-1: Disrupt Existing Land Uses (Shasta Lake and Vicinity and Upper Sacramento River)	LOS before Mitigation	NI	PS	PS	PS	PS	PS
	Mitigation Measure	None required.	LU-1: Minimize and/or Avoid Temporary Disruptions to Local Communities.				
	LOS after Mitigation	NI	SU	SU	SU	SU	SU
Impact LU-2: Conflict with Existing Land Use Goals and Policies of Affected Jurisdictions (Shasta Lake and Vicinity and Upper Sacramento River)	LOS before Mitigation	NI	PS	PS	PS	PS	PS
	Mitigation Measure	None required.	LU-2: Minimize and/or Avoid Conflicts with Land Use Goals and Policies.				
	LOS after Mitigation	NI	SU	SU	SU	SU	SU
Impact LU-3: Disrupt Existing Land Uses (Lower Sacramento River, Delta, CVP/SWP Service Areas)	LOS before Mitigation	NI	NI	NI	NI	LTS	LTS
	Mitigation Measure	None required.	None needed; thus, none proposed.				
	LOS after Mitigation	NI	NI	NI	NI	LTS	LTS
Impact LU-4: Conflict with Existing Land Use Goals and Policies of Affected Jurisdictions (Lower Sacramento River, Delta, CVP/SWP Service Areas)	LOS before Mitigation	NI	NI	NI	NI	LTS	LTS
	Mitigation Measure	None required.	None needed; thus, none proposed.				
	LOS after Mitigation	NI	NI	NI	NI	LTS	LTS

Notes:
LOS = level of significance
LTS = less than significant
NI = no impact
PS = potentially significant
SU = significant and unavoidable

No-Action Alternative

No mitigation measures are required for this alternative.

CP1 – 6.5-Foot Dam Raise, Anadromous Fish Survival and Water Supply Reliability

No mitigation is required for Impacts LU-3 and LU-4 for the extended study area. Mitigation is provided below for Impacts of CP1 on land uses in the primary study area.

Mitigation Measure LU-1 (CP1): Minimize and/or Avoid Temporary Disruptions to Local Communities To minimize and/or avoid temporary

disruption to local communities, the following measures will be implemented during project construction:

- Prior to construction, Reclamation and its contractor will develop a construction plan for each affected community (i.e., Lakeshore, Sugarloaf), consisting of the following:
  - Alternate access routes will be identified for local residences and businesses affected by project construction activities.
  - Construction and staging areas will be fenced, secured, and clearly marked. Security will be provided to ensure public safety.
  - Public parking areas outside of the construction staging areas will be kept clear of construction-related equipment of materials at all times.
  - Any open trenches will be covered or secured after daily activities to protect worker and public safety.
  - Construction activities near noise-sensitive land uses (e.g., near residences, campgrounds) or land uses that experience high levels of public activity (e.g., boat ramps, marinas) will be restricted to days and hours that minimize land use conflicts to the extent feasible.
- The contractor will provide advance notice of the construction activities schedule to the affected community members (e.g., residences, property owners, business owners, and public facilities operators), including posting of signs in the project area.
- The contractor will provide a phone number and community contact for inquiries about the project throughout the construction period.
- Reclamation and its contractor will coordinate with local jurisdictions and obtain all necessary permits (e.g., encroachment permit, utility excavation permit), will comply with permit conditions established to minimize construction impacts, and will assign an inspector to the project to oversee construction activities.

Implementing this mitigation measure would substantially reduce land use capability impacts generated by short-term construction activities, but might not reduce all impacts to a less than significant level. As a result, this impact would remain significant and unavoidable.

Mitigation Measure LU-2 (CP1): Minimize and/or Avoid Conflicts with Land Use Goals and Policies To reduce conflicts with land use goals and

policies of affected jurisdictions, Reclamation will implement the following measures:

- Reclamation will coordinate with USFS to find the most suitable relocation sites for recreation facilities with respect to consistency with the STNF LRMP and the NRA Management Guide.

- Reclamation will coordinate with USFS to identify measures to minimize the impacts of the loss of use of USFS lands around Shasta Lake (including open space and Riparian Reserve allocations) caused by inundation, and measures to offset inconsistencies with the LRMP and NRA goals and policies related to the loss of use of NRA lands.

- As utility and facility relocation sites are being refined, Reclamation will evaluate consistency of the relocated land uses with the USFS LRMP, the NRA Management Guide, the Shasta County General Plan, and the county zoning ordinance. To the degree possible, Reclamation will design the relocated utilities and facilities to comply with these plans and ordinances. If needed, Reclamation would seek permits, easements, and or plan amendments.

Implementing this mitigation measure would substantially reduce land use plan consistency impacts, but might not reduce all impacts to a less than significant level. As a result, this impact would remain significant and unavoidable.

CP2 – 12.5-Foot Dam Raise, Anadromous Fish Survival and Water Supply Reliability

No mitigation is required for Impacts LU-3 and LU-4 for the extended study area. Mitigation is provided below for the impacts of CP2 on land uses in the primary study area.

Mitigation Measure LU-1 (CP2): Minimize and/or Avoid Temporary Disruptions to Local Communities This mitigation measure is identical to Mitigation Measure LU-1 (CP1).

Mitigation Measure LU-2 (CP2): Minimize and/or Avoid Conflicts with Land Use Goals and Policies This mitigation measure is identical to Mitigation Measure LU-2 (CP1).

CP3 – 18.5-Foot Dam Raise, Anadromous Fish Survival and Water Supply

No mitigation is required for impacts LU-3 and LU-4. Mitigation is provided below for the impacts of CP3 on land uses in the primary study area.

Mitigation Measure LU-1 (CP3): Minimize and/or Avoid Temporary Disruptions to Local Communities This mitigation measure is identical to Mitigation Measure LU-1 (CP1).

Mitigation Measure LU-2 (CP3): Minimize and/or Avoid Conflicts with Land Use Goals and Policies This mitigation measure is identical to Mitigation Measure LU-2 (CP1).

CP4 – 18.5-Foot Dam Raise, Anadromous Fish Focus with Water Supply Reliability

No mitigation is required for impacts LU-3 and LU-4 in the extended study area. Mitigation is provided below for the impacts of CP4 on land uses in the primary study area.

Mitigation Measure LU-1 (CP4): Minimize and/or Avoid Temporary Disruptions to Local Communities This mitigation measure is identical to Mitigation Measure LU-1 (CP1).

Mitigation Measure LU-2 (CP4): Minimize and/or Avoid Conflicts with Land Use Goals and Policies This mitigation measure is identical to Mitigation Measure LU-2 (CP1).

CP5 – 18.5-Foot Dam Raise, Combination Plan

No mitigation is required for impacts LU-3 and LU-4 for the extended study area. Mitigation is provided below for the impacts of CP5 on land uses in the primary study area.

Mitigation Measure LU-1 (CP5): Minimize and/or Avoid Temporary Disruptions to Local Communities This mitigation measure is identical to Mitigation Measure LU-1 (CP1).

Mitigation Measure LU-2 (CP5): Minimize and/or Avoid Conflicts with Land Use Goals and Policies This mitigation measure is identical to Mitigation Measure LU-2 (CP1).

17.3.6 Cumulative Effects

The action alternatives could temporarily affect land use in the Shasta Lake and vicinity portion of the project area during construction, and some components might be inconsistent with the USFS LRMP, the NRA Management Guide, the Shasta County General Plan, and the county zoning ordinance. Only a few of the present or reasonably foreseeable future actions are located in the vicinity of Shasta Lake and have the potential to conflict with land uses that might also be affected by construction of the action alternatives. These actions include Antlers Bridge replacement, the Turntable Bay Master Development Plan, and the Iron Mountain Mine Restoration Plan. The Antlers Bridge replacement is currently under construction and would be completed before any of the action alternatives would begin. With respect to the Turntable Bay Master Development Plan and the Iron Mountain Mine Restoration Plan, it is unlikely these activities would occur simultaneously with the action alternatives, or would considerably and adversely affect use of the same land. Therefore, construction activities related to implementation of the proposed SLWRI alternatives would not contribute

considerably to significant cumulative impacts related to temporary land use impacts.

A few of the present or reasonably foreseeable future actions are located in the STNF, the NRA, or Shasta County. As with the action alternatives, some of these actions might not be consistent with the USFS LRMP, the NRA Management Guide, the Shasta County General Plan, and the county zoning ordinance. The cumulative effects of these actions on resources protected by these land use plans are addressed in other the pertinent technical chapters of the PDEIS.

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Chapter 18
Recreation and Public Access

18.1 Affected Environment

This section describes recreational facilities and opportunities and public access in the primary and extended study areas.

18.1.1 Recreation

Shasta Lake and Vicinity

Shasta Lake is the centerpiece of the Shasta Unit of the Shasta-Trinity National Recreation Area (NRA), which is administered by the USFS Shasta-Trinity National Forest, headquartered in Redding. The Shasta Unit has a total area of approximately 125,500 acres, of which 29,500 acres are currently inundated by Shasta Lake at full pool, leaving approximately 96,000 acres of land area (USFS 1996). Figure 18-1 shows the recreation facilities in the Shasta Unit of the NRA.

Recreation Setting and Activities The Shasta-Trinity National Forest manages the Shasta Unit of the NRA to be a showcase recreational area. Environmental factors such as a hot summer season, steep terrain, and sparse forest cover in some areas favor water-oriented recreation as the main attraction. The focal point of recreation in the Shasta Unit is Shasta Lake itself, with its large surface area and 370 miles of shoreline (USFS 1996). The lake has four major arms; three of the arms are more than 12 miles long at full pool, and all are a mile or more wide at their downstream ends. The main basin of the lake near the dam is about 2 miles across.

Because boating is the predominant recreation activity at Shasta Lake, the lake attracts all types and sizes of powerboats, including personal watercraft (jet skis); runabouts, ski boats, and fishing boats; and larger cabin cruisers, pontoon boats, deck boats, and houseboats (Graefe et al. 2005).

Most fishing at Shasta Lake is done by boat rather than from the shoreline. The summer stratification of the lake into an upper warm layer above a deep cold-water pool provides opportunities for anglers to catch both warmwater and cold-water fish species year-round (USFS 1996).

Because of the steep terrain around the lake, there are no suitable sites for developed beach facilities (USFS 1996), and most swimming is associated with boating. Shasta Lake is also a very popular camping destination.

The primary recreation season at Shasta Lake is the period of approximately 100 days from Memorial Day weekend to Labor Day weekend, although recreation uses occur year-round. Daytime high temperatures during the summer average in the mid to high 90s and in midwinter average in the mid 50s. Nearly all of the 30 to 70 inches of precipitation received by the lake area, mostly in the form of rain but occasionally as snowfall, occurs during late fall, winter, and spring (USFS 1996).

The Shasta Unit is bisected by Interstate 5, which provides easy access in 4 hours or less for more than five million residents of southern Oregon and Northern California (USFS 1996). The population of Shasta County was estimated to be about 181,000 in 2009 (U.S. Census Bureau 2011).

This combination of large size and plentiful water-based recreation opportunities, favorable climate, and easy access make Shasta Lake one of the most visited recreation destinations in the state and region. The Shasta Unit of the Shasta-Trinity NRA received approximately 2.4 million recreation visitor days of use in 1994 (USFS 1996). Use levels are reduced during low-water years. Boating use levels as high as 1,400 boats have been recorded on summer weekends in recent years. Houseboats have been found to compose 30–40 percent of boat traffic on summer weekends (Graefe et al. 2005).

Recreation Facilities The boating, fishing, camping, and other recreation activities enjoyed at Shasta Lake are supported by a diverse range of public, commercial, and private facilities. Table 18-1 summarizes the major types of recreation facilities present.

Recreational boating on Shasta Lake is dependent on access to the water via shoreline facilities such as boat ramps and marinas. Six USFS public boat ramps are dispersed around the lake (USFS 2010a). Total parking capacity at the six ramps is about 600 vehicles (USFS 2007). The three largest ramps also offer accessible boat loading platforms for use by disabled persons (USFS 2010a).

A two-lane low-water ramp is used only when the reservoir is at least 75 feet below full pool, making the other public ramp in that area unusable (USFS 2010a). Parking is on the lake bed, and vault toilets are provided when the ramp is in use.

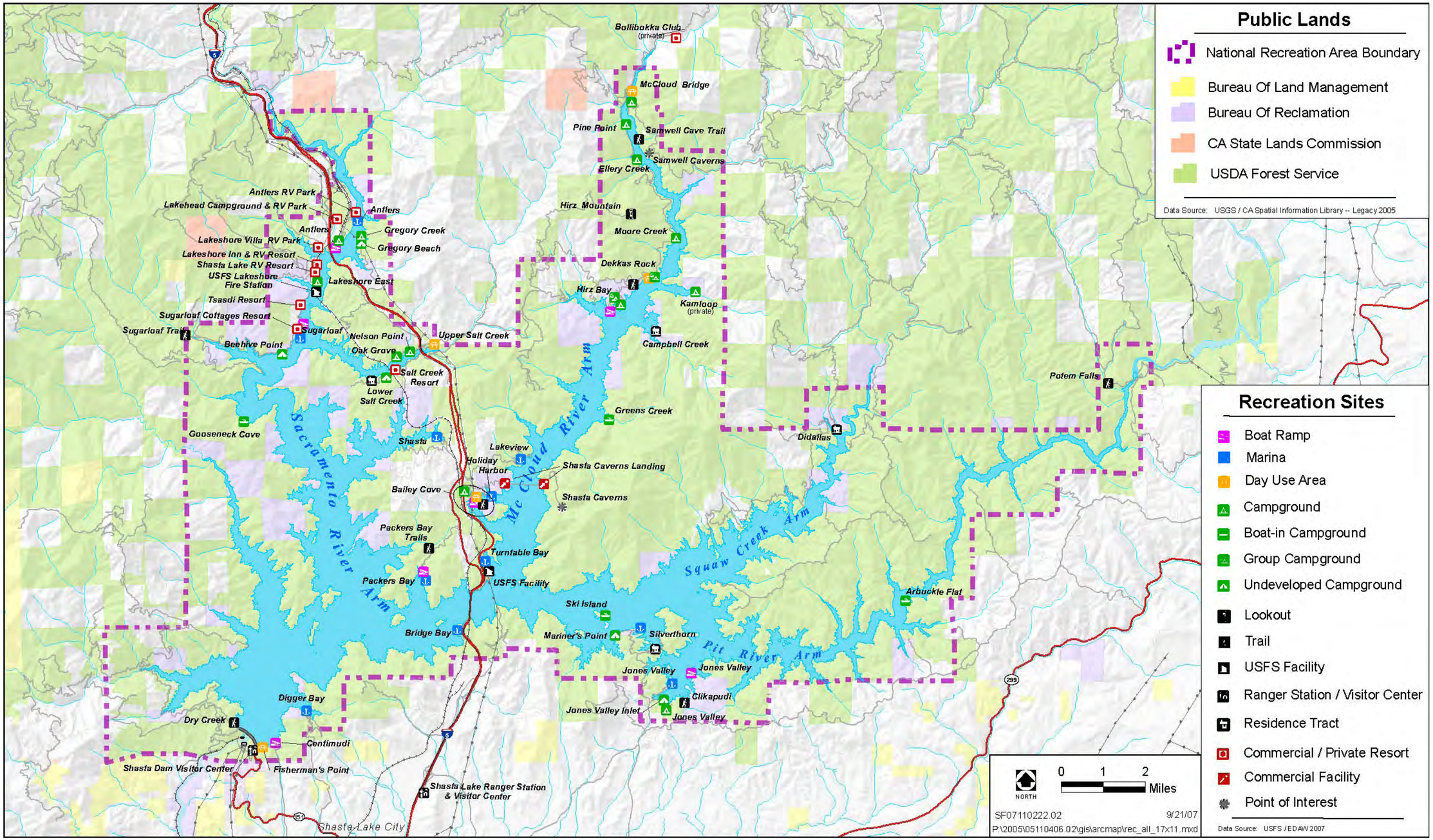


Figure 18-1. Recreation Facilities in the Shasta Unit of the NRA

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Ten commercial marinas and marina resorts, all of which operate under USFS special-use permits, are distributed around Shasta Lake. All of the marinas offer houseboats for rent, providing a combined rental fleet of several hundred houseboats. Some marinas also rent other types of powerboats, personal watercraft, and nonpowered boats. The other primary service offered by most of the marinas is short- and long-term moorage for private boats. In addition to the rental fleets, several hundred private houseboats are moored at these marinas, along with many other powerboats. Additional commercial services are offered at most marinas/marina resorts, such as boat launching, gas sales, stores, and restaurants. Some have tent and recreational vehicle (RV) campsites and cabin or motel accommodations (ShastaLake.com 2011).

Table 18-1. Summary of Public, Commercial, and Private Recreation Facilities on Shasta Lake

Type of Facility	Number	Description
Public Facilities		
Boat ramp	6	Each provides parking, restrooms, and two to four paved launch lanes at full pool; there is also a two-lane low-water ramp with parking on the lake bed.
Day-use area	4	Each provides parking, picnic sites with tables and grills, and restrooms.
Family or group campground	15	Twelve family campgrounds with eight to 59 sites per campground; all have flush and/or vault toilets, most have piped water. Three group campgrounds have water and vault toilets.
Shoreline camping area	5	No designated campsites; all are provided with vault toilets, some with piped water.
Boat access campground	4	Eight to 23 sites per campground, accessible only by boat; vault toilets are provided.
Trail/trailhead	12	Twelve trails from one-third mile to 8 miles in length; several trailheads are incorporated into boat ramp or day-use parking areas, while others are stand-alone facilities.

Table 18-1. Summary of Public, Commercial, and Private Recreation Facilities on Shasta Lake (contd.)

Type of Facility	Number	Description
Commercial Facilities		
Marina/marina resort	10	Wide range of sizes and services; most provide boat rentals, moorage, gas, groceries, etc.; some provide campsites and/or cabins.
Nonmarina resort/ RV park	7	Most provide cabins and/or RV and tent sites, moorage, and groceries/sundries. (Note: Five of these have shoreline infrastructure other than floating docks, two do not; additional resorts are nearby but not on the lake shoreline.)
Organization campground	1	Operated for members and the general public by California Kamloops, Inc.; tent camping, accessible only by boat, and boat dock/moorage provided for campers.
Other commercial facility	2	Shasta Lake Cavern tour; provides ferry and bus transport to caverns, moorage for private boats, and a gift shop.
		Bollibokka Club; offers lodging, meals, and guided trout fishing trips on the McCloud River upstream from the lake. (Note: this facility is not within the NRA, but is accessed via a USFS road)
Private Facilities		
Private cabin	~160	Located in four tracts, managed by USFS for individual recreation use with restrictions on improvements.

Source: USFS 1996

Key:
NRA = National Recreation Area
RV = recreational vehicle
USFS = U.S. Forest Service

Sixteen nonmarina resorts and RV parks are located on or near Shasta Lake. These typically provide some combination of tent and/or RV campsites and cabins with other ancillary amenities such as stores, game rooms, restaurants, and swimming pools (ShastaLake.com 2011). Some of the resorts have special-use permits from USFS for use of a segment of shoreline land and/or installation of a boat dock. Other resorts are situated a short distance from the shoreline but do not provide direct access to the lake.

Thirteen USFS-constructed and concessionaire-operated and maintained family and group campgrounds are located on the lake. These range in size from 8 to 59 sites and generally provide flush and/or vault restrooms and drinking water. Several of the campgrounds are adjacent to a public boat ramp or are served by a nearby ramp. Also available to campers are five shoreline camping areas with vault toilets but no designated sites; boaters may use one of four boat-access campgrounds ranging in size from eight to 23 sites, each with fire rings, picnic tables, and vault toilets (USFS 2010b). Four USFS day-use sites with views of the lake provide five to nine picnic sites each, along with restrooms and drinking water (USFS 2011). An additional day-use and swim area is at the upstream end of the Salt Creek inlet, but is not currently operational.

Twelve USFS hiking and mountain biking trails, totaling about 25 miles in length, are located on or near the shoreline of Shasta Lake. Several of these trails are accessed via trailheads located at boat ramp and day-use parking areas, while others are served by stand-alone trailheads (USFS 2010c).

A unique commercial recreation service offered at Shasta Lake is the Shasta Caverns Tour. The tour operator uses a parking area, gift shop, and ferry boarding facility on the west shore of the McCloud River Arm, and a similar staging area on the opposite shore, where visitors board buses for the short drive to the caverns.

Four USFS-managed "recreation residence" tracts are located on Shasta Lake, with numerous private cabins near the shoreline. USFS policy is to manage these facilities for the individual recreation use of the owners and to keep the areas in a primarily natural state (USFS 1996).

Reservoir Operations and Effects on Recreation Reclamation manages Shasta Lake primarily to provide water supply, which results in an annual cycle of major water level fluctuations at the lake. Such fluctuations affect access to water-based recreation facilities and services. In the typical annual cycle, the reservoir will reach its highest elevation for the year during late spring, then will be gradually drawn down through the summer peak recreation season and into fall. Refilling begins with the arrival of substantial winter rains in the watershed and continues through spring with additional rain and snowmelt. The highest annual reservoir pool level usually occurs between mid-April and mid-May. As the reservoir is drawn down during summer and fall, the lowest elevations are typically reached in November or December (DWR 2011a).

Boating facilities on the lake are generally designed to accommodate these expected and normal fluctuations in reservoir pool levels. All but one of the six primary public boat ramps extend to at least 75 feet below full pool; four extend from 95 feet to more than 200 feet below full pool (USFS 2010a).

Certain boating safety issues are related to pool level fluctuations. Reservoir drawdown places rocks, shoals, and islands just below the water surface where they may be struck by boats. Conversely, rising water levels may put obstacles that were easily seen and avoided one day just beneath the surface the next. Because the lake level varies considerably on a seasonal basis, the pattern of submerged obstacles varies as well.

Rising water levels may also increase the amount of floating debris in the lake, primarily woody debris that may include large tree limbs and logs. The larger debris can present a hazard to boating; even smaller debris can damage props or clog water intake ports in boat-engine cooling systems.

Campers are affected to some degree by falling pool levels because the distance from the campsites to the shoreline increases as the pool level decreases. The

sites nearest the shoreline at most public campgrounds will be within a few hundred feet of the water through most summers when the pool level is generally high, but they may be considerably farther from the water during the off-peak seasons or during the latter portion of the peak season in dry years. Because the shoreline terrain is steep in most areas, the drawdown zone is difficult for visitors to use. Drawdown of the reservoir also has aesthetic effects for lake users, with an expanding band of mostly bare earth and rock exposed as the pool level declines.

Upper Sacramento River (Shasta Dam to Red Bluff)

The Sacramento River corridor is an important recreation resource for the northern California region. Access and facilities are found on both public and private land. This section describes existing recreation and public access resources in the primary study area, beginning at and including the downstream side of Shasta Dam and extending to Lake Red Bluff/Red Bluff Diversion Dam (RBDD) that could be affected by the project. Figure 18-2 shows the recreation facilities in the upper Sacramento River portion of the primary study area.

Shasta Dam Reclamation controls public access at Shasta Dam. For security reasons, access was by permit only for several years; since 2010 visitors have been allowed to drive across the dam between 6 a.m. and 10 p.m. after producing a valid driver's license and vehicle registration and subjecting their vehicle and any trailer to inspection (Reclamation 2010).

The area immediately below the dam, where the Shasta Powerplant and associated infrastructure is located and where water is released from Shasta Dam and the powerplant, is closed to public use for safety and security reasons.

Shasta Dam to Keswick Dam Recreation facilities provided along this portion of the Sacramento River include the Chappie-Shasta Off Highway Vehicle (OHV) Area, Sacramento River Rail Trail and other trails, Shasta Campground, and Keswick Reservoir Boat Ramp.

Keswick Reservoir occupies nearly the full length of the narrow river gorge that stretches 9 miles from Keswick Dam to Shasta Dam. The reservoir has a healthy population of wild trout, including German browns and rainbows, and fish are occasionally planted by the DFG.

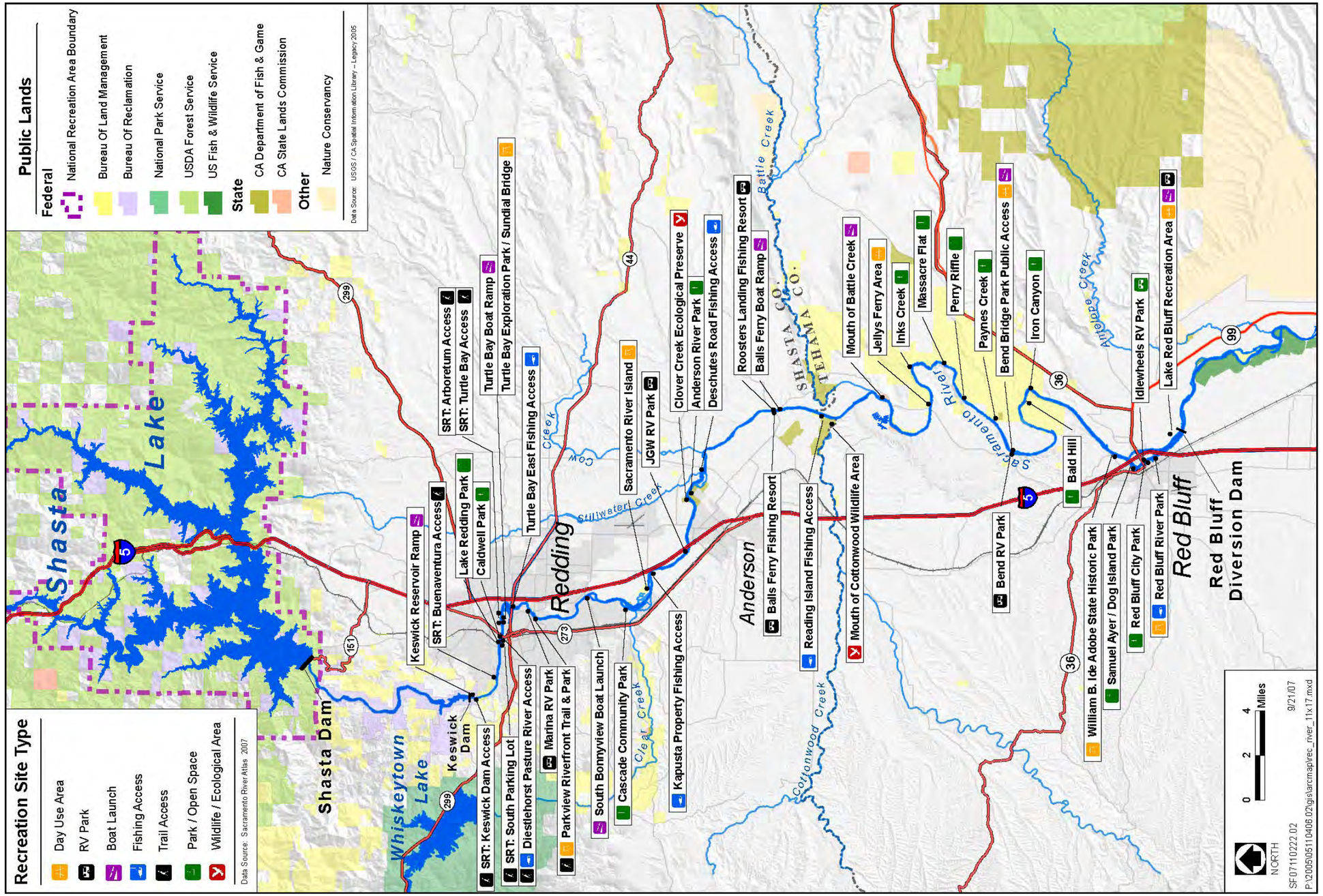


Figure 18-2. Recreation Facilities in the Upper Sacramento River Portion of the Primary Study Area

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The Chappie-Shasta OHV Area, managed by the U.S. Bureau of Land Management (BLM) Redding Field Office, provides opportunities for OHV use on 200 miles of roads throughout 52,000 acres of land. Two staging areas provide access to OHV roads and trails that are rated difficult and moderate, and that are open to two-wheeled motorcycles, all-terrain vehicles, and four-wheel-drive high-clearance vehicles (BLM 2006). The Shasta staging area and campground are situated close to the river about 1 mile below Shasta Dam. The campground has 30 campsites for tents and RVs. No water or electricity hook-ups are available (USFS 2010b).

The Sacramento River Rail Trail, a nonmotorized-use National Recreation Trail, extends more than 10 miles along an old railroad line and closely follows the west side of the river and of the shoreline of Keswick Reservoir. The wide and generally flat gravel-surface trail is open year-round to equestrians, hikers, and bicyclists. Trailheads are located at the Chappie-Shasta OHV Area, at Keswick Boat Ramp and Rock Creek, at the southern terminus of the trail, and at a location near the midpoint of the trail. The BLM lands above the east side of Keswick Reservoir have more than 20 miles of trails, primarily single-track nonmotorized trails with a dirt surface, connecting at the north end to Shasta Dam (Healthy Shasta 2009).

Keswick Dam to Red Bluff Diversion Dam This area encompasses about 60 miles of the Sacramento River and contains the majority of recreation resources and public access sites within the primary study area. Recreational activities are numerous within this area and include fishing, boating, hiking, horseback riding, biking, hunting, camping, picnicking, wildlife viewing/nature observation, viewing historic sites, and enjoying developed urban recreational activities such as soccer and baseball. The discussion below provides a brief overview of the activities supported by the Sacramento River and riverside recreation facilities, followed by additional details about recreation facilities.

Recreational Setting and Activities The Sacramento River between Keswick Dam and RBDD flows past cities and towns and both private and public lands. The riparian forests along the river, the oak woodlands and grasslands on higher ground, and riverside bluffs provide a scenic setting for river users at riverside recreation facilities and for boaters and anglers on the river. The riparian landscape between Redding and Red Bluff is described as the most unspoiled of the entire 375-mile river (DBW 2011a). BLM owns and manages much of the riverside lands between Balls Ferry and Red Bluff (approximately River Mile (RM) 250 to RM 276).

The climate of the northern Sacramento River valley is hot and dry during the summer, with daily high temperatures averaging in the upper 90s Fahrenheit and little or no precipitation. Winter climate can be described as moderate but wet, with average daily high temperatures in the mid 50s during December and January and an average of 4 to 8 inches of rain per month between November and March.

River use and the recreation opportunities available vary throughout the year with the highly variable flow of the river. During the winter and spring, the river may have short-term peak flows of 80,000 to 90,000 cubic feet per second (cfs) and is usually flowing above 20,000 to 30,000 cfs. Flows are less variable during the summer and fall, with typical summer flows of 10,000 to 15,000 cfs and typical fall flows of 5,000 to 10,000 cfs (DWR 2011b). BLM identifies flows of 6,000 to 12,000 cfs as optimal for boating (BLM no date). River temperature is cold year-round because of the release of water from the deep cold-water layers of Keswick Reservoir, and Shasta Lake upstream. Winter water temperatures are in the 40s Fahrenheit and summer water temperatures do not rise above the mid 50s.

The Sacramento River is known for good fishing opportunities. Species such as salmon, steelhead, rainbow trout, sunfish, largemouth bass, and striped bass can be found within the river. Fly fishing is popular, especially when flows are 5,000 to 8,000 cfs, which typically occurs during fall and early winter (Fly Fishing Connection 2003).

Boating opportunities are abundant along the Sacramento River from Keswick Dam to the seasonal Lake Red Bluff. Eight sites along the river provide public boat ramps and two additional sites permit car-top launch and retrieval. (Lake Red Bluff will no longer exist after 2012, when RBDD operations cease and are replaced by operation of a pumping plant that is currently under construction.)

Although the Sacramento River is not generally considered a whitewater river, there are two easy whitewater runs on this section of the river. The first is from Keswick Dam to the Anderson-Cottonwood Irrigation District Diversion Dam in Redding. The second run is from Anderson River Park to William B. Ide Adobe State Historic Park. This run is 22 miles long and rated Class I to Class II. The Class II China Rapid is a few miles upstream from Red Bluff (Tuthill 2005).

Opportunities for trail activities such as walking, jogging, bicycling, and horseback riding are available throughout this stretch of the river. There are 21 sites with trails or access to trails. The most notable trails along this section of river are the Sacramento River Trail and the trails that connect BLM lands below Balls Ferry.

Hunting opportunities are located primarily on BLM land along the Sacramento River. The main hunting areas along the river are Inks Creek, Massacre Flat, Perry Riffle, Paynes Creek, Bald Hill, and Iron Canyon. Hunting is permitted on BLM land unless posted as closed (e.g., along hiking trails and at developed recreation areas). Game species found on BLM lands include quail, dove, waterfowl, deer, pig, bear, and turkey (BLM 1992).

Opportunities for developed camping along or near the river are located mainly at privately operated RV parks and fishing resorts, and are also provided at the

public Lake Red Bluff Recreation Area. Most camping opportunities are for RVs, but a few tent and group camping sites are available. Primitive camping is available at five sites within the BLM Sacramento River Area, between about Battle Creek and Payne's Creek, about 10 miles upstream from RBDD. River visitors may also camp on undeveloped BLM land within the area. The mouth of Inks Creek and 0.75 mile above and below the mouth is closed to camping (BLM 1992).

The Sacramento River corridor provides a beautiful setting for picnickers. A total of 21 sites along this river reach provide picnicking facilities; these sites include municipal parks, RV parks and fishing resorts (private facilities), William B. Ide Adobe State Historic Park, boat ramps, and fishing access sites. Generally, facilities include picnic tables, shade structures (or trees), and barbeque pits.

Another recreation opportunity available along the Sacramento River is viewing historic sites. Historic sites or historical markers exist at a handful of sites.

The Sacramento River meanders through the small cities of Redding, Anderson, and Red Bluff. These cities' municipal parks along this section of the river provide developed urban recreation opportunities such as horseshoes, soccer, and baseball, as well as playgrounds and a swimming pool.

Recreational Facilities More than 40 recreation/public access sites are available along the Sacramento River between Keswick Dam and RBDD. For this analysis, these sites have been categorized by primary use as municipal parks, fishing access/day-use areas, boat launches, trail accesses, RV parks, wildlife areas, and undeveloped open space areas. Table 18-2 describes these facilities by type.

Municipal Parks Municipal parks in this river section include Lake Redding Park, Caldwell Park, Cascade Community Park (City of Redding); Anderson River Park (City of Anderson); and Samuel Ayer/Dog Island Park and Red Bluff City Park (City of Red Bluff) (CSUC 2006; City of Redding 2004; City of Anderson 2007). Most of the municipal parks provide facilities such as trails or trail access, restrooms, playgrounds, ball fields, swimming pools, horseshoe pits, and picnic sites. Lake Redding Park (Lake Redding is created by the Anderson-Cottonwood Irrigation District Diversion Dam) provides boating facilities, trails, picnic facilities, horseshoe pits, and restrooms. Anderson River Park provides a similar range of amenities, including a boat ramp.

Table 18-2. Summary of Recreation Sites along the Sacramento River between Keswick Dam and Red Bluff Diversion Dam

Type of Facility	Number	Description
Public Facilities		
Municipal park	6	Managed by the Cities of Redding, Anderson, and Red Bluff. All sites provide parking and picnic sites. Most have restrooms and trails. Several also have boat ramps and two sites have hand launching. Other amenities include horseshoe pits, sports fields, swimming pools, playgrounds, a skateboard park, a fish viewing area, and a bike riding area.
Boat launch	6	Managed by the City of Redding, Shasta County, Tehama County, the State Lands Commission, and the City of Red Bluff. All provide parking and most provide restrooms. One site is a Point of Historical Interest and one site provides raft rentals.
Trail access	6	Managed by Reclamation and the City of Redding. Primarily provide access to Sacramento River Trail. All provide parking, two provide picnic sites, and one provides restrooms. One site has a historical marker and one has a historic powerhouse.
Fishing access/ day-use area	7	Managed by the City of Redding, BLM, and Shasta County. Most provide parking and access to trails. Other amenities include ponds, boat ramps, day-use facilities, group camping, and a community garden.
Wildlife area/ ecological reserve	2	Both managed by DFG. Mouth of Cottonwood Creek Wildlife Area has parking facilities. Clover Creek Ecological Preserve has no facilities.
Open space area	6	All are managed by BLM. Most have trails, three have parking, and two have restrooms. Other amenities include hand launching, picnic sites, walk-in camping, fishing pond, and beaches. Three are trail or boat access only.
Other public park	2	Lake Red Bluff Recreation Area, administered by USFS, provides river access, day-use, and camping facilities; also includes the Sacramento River Discovery Center. William B. Ide Adobe State Historic Park is a small State Parks unit focused on a historic adobe and related structures.
Subtotal	35	
Private/Commercial Facilities		
Educational/nature Park	1	Turtle Bay Exploration Park; includes a museum, butterfly house, live animals, and parking, with access to a scenic pedestrian bridge over the river and the Sacramento River Trail.
RV park	7	The largest facility provides 174 RV sites, four other facilities provide from 44 to 85 RV sites; two “fishing resorts” provide 12 and 20 RV sites. Most provide a boat ramp and showers; other amenities include tent sites, restaurants, swimming pools, a store, a bar, and a group campground.
Subtotal	8	
Total – All Facilities	43	

Key:
BLM = U.S. Bureau of Land Management
DFG = California Department of Fish and Game
Reclamation = U.S. Department of the Interior, Bureau of Reclamation
RV = recreational vehicle
State Parks = California Department of Parks and Recreation
USFS = U.S. Forest Service

Fishing Access and Day-Use Sites There are four public fishing accesses in this reach of the Sacramento River: Turtle Bay East Fishing Access, Kapusta Property Fishing Access, Deschutes Road Fishing Access, and Reading Island Fishing Access. All of the fishing accesses provide parking and most provide trails as well. The sites are managed by the City of Redding, Shasta County, and BLM (CSUC 2006). Reading Island provides a cement boat ramp along a slough leading to the river, but sedimentation and dense aquatic vegetation limit use to small car-top boats. Primitive group camping is also available at Reading Island, under a special-use permit issued by BLM (BLM no date).

Three day-use sites are available on this stretch of the Sacramento River. These sites may provide both fishing and trail access, like that found at Diestlehorst Pasture River Access, managed by the City of Redding. Two BLM-managed day-use sites, Jellys Ferry and Sacramento River Island, are also available (CSUC 2006).

Boat Launch Facilities There are six sites on this river reach that are primarily for boat launching: Turtle Bay Boat Ramp and South Bonnyview Boat Launch, operated by the City of Redding; Balls Ferry Boat Ramp, operated by Shasta County; Mouth of Battle Creek Boat Launch, owned by the State Lands Commission; Bend Bridge Park Public Access, operated by Tehama County; and Red Bluff River Park, operated by the City of Red Bluff.

Trails and Trail Access Facilities The Sacramento River Trail is a 13-mile paved urban trail system along the riparian corridor on both sides of the river from Keswick Dam to Turtle Bay Park in Redding. Two pedestrian bridges cross the river to create a loop of about 5 miles. At least six sites provide primary access to the trail and a few other sites provide connections to the trail (Healthy Shasta 2008).

Unlike the boating and day-use facilities that occur throughout this river reach, the trail access sites are primarily on the portion of the river that flows through Redding. Six specific Sacramento River Trail access sites and five other sites, all provided by the City of Redding, also provide access to the Sacramento River Trail.

RV Parks There are seven privately operated RV parks along this reach: one in Redding (Marina RV Park), three in the Anderson area (JGW RV Park, Balls Ferry Fishing Resort, and Roosters Landing Fishing Resort), one near the community of Bend (Bend RV Park), and two in Red Bluff (Idlewheels RV Park and Durango RV Resort). The two largest parks offer 85 and 174 RV sites. Two of the parks also offer tent camping, and two parks offer group camping. All of the RV parks offer picnic facilities and most offer showers. Three of the parks offer boat launches. Two of the parks offer a restaurant and one offers a bar, swimming pool, and store. The largest park, a new facility in Red Bluff, offers a lap pool and spa, a lodge, two clubhouses for meetings, and 45 acres of surrounding land with walking trails (CSUC 2006).

Wildlife Areas There is one DFG-owned and managed area along this river reach, the Mouth of Cottonwood Creek Wildlife Area. A parking area is the only improvement at the site. The area is excellent habitat for Swainson's hawk, bald eagle, ringtail, and river otter and provides good wildlife viewing, birding, and photography opportunities (DFG 2011).

Undeveloped Public Lands There are six areas between Inks Creek and Iron Canyon that, for this analysis, are considered undeveloped open space areas: Inks Creek, Massacre Flat, Perry Riffle, Paynes Creek, Bald Hill, and Iron Canyon. All six areas are managed by the BLM Redding Field Office. Other than parking areas, few facilities are available at most of these areas; they are mainly large open areas available for general public use and enjoyment (CSUC 2006).

Other Public and Private Parks Turtle Bay Exploration Park in Redding is a privately operated facility that contains a museum, butterfly house, forest camp replica, arboretum, and gardens. The park provides access to the scenic Sundial pedestrian bridge over the river, and access to the Sacramento River Trail (Turtle Bay Exploration Park 2011). The 3-acre William B. Ide Adobe State Historic Park in Red Bluff focuses on several historical elements and provides parking, trails, picnic facilities, and restrooms (State Parks 1990).

Lower Sacramento River and Delta

Recreation opportunities on the Sacramento River downstream from RBDD include hunting, fishing, boating, RV/tent/group camping, birding, wildlife viewing, picnicking, hiking, and sports activities (softball, soccer, tennis, basketball, horseshoes). The 100-mile stretch of river down to Colusa includes many parcels of public conservation and recreation lands, as well as a few privately owned commercial recreation sites. Primary landowners on the river include the U.S. Fish and Wildlife Service, with more than two dozen units of the Sacramento River National Wildlife Refuge totaling more than 10,300 acres (many of which are closed to the public) (USFWS 2005), and DFG, with more than 15 units of the Sacramento River Wildlife Area totaling more than 3,700 acres (most open to the public but accessible only by boat) (DFG 2004). The California Department of Parks and Recreation (State Parks) operates three park units (one State park and two State recreation areas) on the river between Red Bluff and Colusa – one each near Corning (RM 218), Hamilton City (RM 193 – RM 200), and Colusa (RM 145) (CSUC 2006). An additional State recreation area is located on the Sacramento River in the Delta.

Recreation facilities are located primarily between Red Bluff and the Bidwell-Sacramento River State Park near Hamilton City, about 50 river miles downstream, because of the availability of the State park facilities and privately owned RV parks and resorts. Downstream from Bidwell–Sacramento River State Park, the variety and density of facilities are reduced. Facilities vary from boat ramps and marinas to campgrounds, picnic sites, and trails (CSUC 2006). Beyond Lake Red Bluff and RBDD, it is not expected that recreation or public

access would be affected with implementation of the project; therefore, an in-depth review of recreation activities and facilities south of Lake Red Bluff is not presented in this analysis.

CVP/SWP Service Areas

CVP and SWP facilities and service areas are widespread throughout much of California. Facilities include multiple dams, reservoirs, and canals that provide substantial water-based recreational activities. Releases from dams on major tributaries to the Sacramento River provide numerous recreational opportunities, especially boating and fishing. Reservoirs such as Folsom, Oroville, and New Melones provide boating, fishing, camping, and other recreational activities.

18.2 Regulatory Framework

18.2.1 Federal

U.S. Forest Service

Shasta Lake and the surrounding Federal lands compose the Shasta Unit of the Whiskeytown-Shasta-Trinity NRA, established by Congress in November 1965 to provide for public outdoor recreation use and enjoyment, among other purposes. Both the Shasta and Trinity units of the NRA are within the Shasta-Trinity National Forest and are administered by USFS as the Shasta-Trinity NRA. The act establishing the NRA specified that it was to be administered in a manner coordinated with other purposes of the CVP. Reclamation retained management of lands and waters needed for operating the CVP, and controls operation of Shasta Dam and reservoir pool levels. The lake surface and surrounding lands are administered by USFS (an exception is the area in the immediate vicinity of the dam, which is administered by Reclamation).

USFS management of recreation within the Shasta Unit occurs under the authority of the 1987 Master Interagency Agreement between Reclamation and USFS. Administration of the Shasta Unit of the NRA is coordinated with the administration and purposes of the CVP through a memorandum of agreement between Reclamation and USFS established December 31, 1986. The management of Shasta Lake is guided by the 1995 *Shasta-Trinity National Forest Land and Resource Management Plan* (Shasta-Trinity LRMP) and the 1996 *Shasta-Trinity NRA Management Plan*. The NRA Management Plan is currently being updated through a series of amendments.

Shasta-Trinity National Forest Land and Resource Management Plan (1995) The Shasta-Trinity LRMP (USFS 1995a) guides management of both the Shasta and Trinity national forests with the goals of integrating a mixture of management activities that protect forest resources and allow use, fulfill guiding legislation, and address local, regional, and national issues. The project is located within two management units—the Shasta Unit of the NRA, which

includes Shasta Lake and surrounding lands, and the Front Unit, which includes USFS lands south of the lake. As stated in the Shasta-Trinity LRMP, the Shasta Unit is managed according to the current NRA Management Plan. The portion of the Front Unit located within the primary study area (south of the lake) is managed under Matrix Prescription III, Roaded Recreation. This prescription "emphasizes recreational opportunities associated with developed road systems and dispersed and developed campsites" (USFS 1995a). The Shasta-Trinity LRMP states that this prescription is also the primary prescription for the Shasta Unit of the NRA. The plan provides relevant recreation-related standards and guidelines to ensure road, trail, and facility development and management activities consistent with a Roaded Natural setting.

Shasta-Trinity National Recreation Area Management Guide (1996) The *Shasta-Trinity National Recreation Area Management Guide* (USFS 1996) integrates management of the NRA with and implements the direction in the LRMP. The guide addresses key management concerns related to recreation and other resource management, such as the types and amounts of commercial and USFS recreation facilities to be provided. Desired future conditions for Shasta Lake are described, and management recommendations aimed at implementing the LRMP and achieving desired future conditions are detailed for both lake and land-based recreation and for commercial recreation operations within the NRA.

Mendocino National Forest Land and Resource Management Plan (1995) The *Mendocino National Forest Land and Resource Management Plan* (Mendocino National Forest LRMP) (USFS 1995b) guides management of the Mendocino National Forest with the goals of integrating a mixture of management activities that protect forest resources and allow use, fulfill guiding legislation, and address local, regional, and national issues. Management Area #38, Lake Red Bluff Recreation Area, is at the extreme downstream end of the primary study area. (The Lake Red Bluff Recreation Area was transferred from Reclamation ownership in the late 1980s and is isolated from the rest of the National Forest; all other lands are well to the west of the study area.)

The Mendocino National Forest LRMP states that management and development should conform to the record of decision for the Final Environmental Impact Statement for the Lake Red Bluff Recreational Development. Relevant recreation-related major aspects of this decision include a management direction emphasizing supplying quality water-oriented recreation experiences for the public, maintaining a safe setting for recreational users, and providing educational and interpretive opportunities. The management area is also managed under the Recreation Area prescription, which "provides direction for maintaining attractive landscapes and recreation quality around major lakes and within other areas of concentrated recreation use" (USFS 1995b). The area is to be managed to maintain a Recreation Opportunity Spectrum (ROS) class of "Roaded Natural."

U.S. Bureau of Land Management

Overview BLM administers most of the public lands along the Sacramento River between Shasta Dam and Keswick Dam, and additional lands between Keswick Dam and the city of Redding, as part of the 23,000-acre Interlakes Special Recreation Management Area. BLM also administers more than 17,000 acres of public lands on both sides of the river within the Sacramento River Management Area, which extends from just downstream from Redding downstream to the Tehama County/Glenn County boundary, about 25 miles south of Red Bluff. Most of the BLM lands are concentrated above Red Bluff, between Jellys Ferry and Iron Canyon. A few hundred additional acres of BLM lands are at two island parcels downstream from Red Bluff.

Proposed Redding Resource Management Plan and Final Environmental Impact Statement (1992) The proposed resource management plan (RMP) and Final Environmental Impact Statement (BLM 1992) for the Redding Resource Area (BLM 1992) identifies proposed management direction for BLM-administered public lands within the Redding Resource Area, totaling approximately 250,000 acres of land in north-central California. The RMP focuses on resolving four main issues: land tenure adjustment, recreation management, access, and forest management. BLM selected a preferred alternative for each of the seven management areas and collectively these preferred alternatives compose the proposed action of the RMP. The project is located within the Shasta and Sacramento River management areas. The Shasta Management Area includes the lands southwest of Lake Shasta within the Interlakes Special Recreation Management Area. General recreation management direction for the entire Redding Resource Area is also provided within the RMP and focuses on ROS designations and guidelines, camping limits, OHV designations, and wild and scenic rivers.

Recreation-related management direction for the Interlakes Special Recreation Management Area includes objectives to provide a regional opportunity for motorized recreation with a focus within the Gene Chappie/Shasta OHV Area and to enhance nonmotorized recreation opportunities within the area via a greenway connecting Redding to Shasta Dam along the Sacramento River. Motorized vehicle use is limited to designated roads and trails that may be closed between November 15 and April 15 to protect the wintering deer herd. The area is managed as Semi-Primitive, Non-Motorized, Semi-Urban, Semi-Primitive Motorized, and Roaded Natural (ROS Classes).

The Sacramento River Management Area includes the Sacramento Island area, between Redding and Anderson, a large block of contiguous parcels along the river between Balls Ferry (RM 276) and Iron Canyon (RM 250), and two islands downstream from Red Bluff. Recreation-related management direction for these areas includes management within the Semi-Primitive Motorized (ROS class), closure to motorized vehicles, and an emphasis on boat-in access and use. Because of the special value of the Valley oak riparian forest at Sacramento Island, the area has been designated as a Research Natural

Area/Area of Critical Environmental Concern, with special management plans to protect and improve the plant communities and habitat there.

The 25 miles of the Sacramento River between Balls Ferry and Iron Canyon have been determined to be eligible for inclusion in the National Wild and Scenic Rivers System, with recreational, scenic, and wild classifications for various segments. All public lands within one-quarter mile of normal high water will be managed to protect the outstandingly remarkable values and free-flowing character that led to their determination of eligibility.

18.2.2 State

California Department of Fish and Game

DFG manages the ecological reserve and the wildlife areas within the study area under Title 14 of the California Code of Regulations and the California Fish and Game Code. The regulations provide for various types of public uses on the wildlife areas. However, fish and wildlife protection and enhancement are the primary management purposes of the wildlife areas; recreation and public use is secondary to habitat preservation. Ecological reserves are established to provide rare, threatened, or endangered plants and wildlife and special habitat types; public entry may be restricted to protect wildlife or habitat.

The DFG-administered wildlife areas on the Sacramento River within the primary and extended study areas are designated by the California Fish and Game Code as "Type C" areas, which generally have no or minimal developed facilities. A "Type C" area designation does not require hunters to have a permit or pass (other than a valid California hunting license and any required stamps) for most areas. General "Type C" area regulations apply to all of the wildlife area within the study area; special regulations for each area prohibit camping and establish other restrictions on hunting and other uses (see Title 14 of the California Code of Regulations).

DFG interacts with other management agencies in the study area to ensure that hunting and fishing regulations are enforced on public and private lands and maintains authority over all activities that have the potential to affect wildlife or wildlife habitat. DFG administers the waterfowl hunting program on a number of Federal wildlife refuges, including the Sacramento River National Wildlife Refuge.

California Department of Parks and Recreation

State Parks manages the State park and recreation areas within the study area under Title 14 of the California Code of Regulations and the California Public Resources Code. Specific management direction and guidance is provided by general plans for individual parks. A preliminary draft general plan has recently been developed for the Bidwell-Sacramento River State Recreation Area. The plan provides specific goals and guidelines for a range of issues related to environmental resources, visitor use and opportunities, and park administration

and operations. Additional direction for facility development at each of the park's four subunits is also provided. The management recommendations contained in the 1990 general plan for William B. Ide Adobe State Historic Park are focused on protecting the historic integrity that is the primary value of the 3-acre site, as well as protection of the riparian forest in the riverbank area (State Parks 1990). No current park management plans were available for the two other small State Parks units on the river.

18.2.3 Regional and Local

Shasta County

The Open Space and Recreation Element of the *Shasta County General Plan* (Shasta County 2004) is intended to preserve open space for the economy, enjoyment of scenic beauty, recreation, and use of natural resources. The Open Space and Recreation Element addresses recreation as it relates to the tourist industry and recreation at the countywide level. Recreation is considered the active use of open space land. "Recreational areas are essentially open space lands which are designed to accommodate recreational activities such as hiking, picnicking, or camping" (Shasta County 2004). Several sites that fall under the recreation analysis herein are included under Shasta County's Open Space Inventory: the Shasta-Trinity National Forest, BLM holdings, Balls Ferry Fishing Access, Anderson River Park and Fishing Access, Lake Redding–Caldwell Memorial Park, Turtle Bay Regional Park, Turtle Bay East, privately owned and operated recreational facilities such as resorts and RV parks, and historic landmarks and points of interest (Shasta County 2004).

The Open Space and Recreation Element describes goals and objectives for protection of open space and recreation resources including the following (Shasta County 2004):

- Protection of open space through certain land-use classifications
- Coordination of parks and recreation systems planning, acquisition, development and operation among Federal, State, county, and city governments
- Using the National Resource Protection–Recreation Resources land use designation to protect the quality of recreation resource values of national parks and recreation areas, wilderness areas, and State parks
- Permitting commercial recreation uses
- Requirement of public access and easements provided by the Subdivision Map Act along the Sacramento River (Keswick Dam to the county line) and Battle Creek (downstream from Coleman Powerhouse)

- Provision of public access and easements for recreation if riparian habitat is not significantly affected, public access is not available within a reasonable distance, or the corridor is located near urban, town, and rural community centers

The Public Facilities Element contains a discussion of recreation at the community level. The element states that the "community recreation needs of Shasta County residents and the degree to which these needs are met by County government vary with the type of community in which they live" (Shasta County 2004). Recreation needs in urban areas are primarily for publicly owned parklands. The element identifies that "recreation officials in the unincorporated urban areas of the County indicate that a substantial portion of the recreation needs of the residents of these communities is not being met" (Shasta County 2004). An increase in recreational demand is expected as a result of the growth of urban areas over the 20-year planning period. County policy "will rely upon interagency planning efforts and providing long-term protection of resource and open space lands and features that exhibit future recreation potential" (Shasta County 2004). The objective in the Public Facilities Element related to recreation describes developing a land use pattern that adequately serves for community recreation. The policy that supports this objective relates to designation of the locations of existing and proposed large-scale community recreation facilities as Natural Resources Protection Parklands (Shasta County 2004).

Tehama County

The Open Space and Conservation Element of the *Tehama County General Plan Update 2009–2029* (March 2009) (Tehama County 2009) addresses several resource areas, including Natural Resource Land and Recreation. The element includes a brief description of national forests located within the county, Lassen Volcanic National Park, BLM lands, State parks, Black Butte Lake (USACE), and county parks. The element states one overarching Natural Resource Land and Recreation goal (Goal OS-9): "To protect and enhance resource lands in the County for the continued benefit of agriculture, timber, grazing, recreation, wildlife habitat, and quality of life" (Tehama County 2009). Supporting policies aim to do all of the following:

- Protect and enhance resource lands

- Protect reasonable access to resource lands and not unreasonably deprive users of enjoyment of previously accessible areas through closure

- Coordinate natural resource practices and recreation plans of different jurisdictions and assure cooperation

- Promote recreation opportunities including agritourism, nature tourism, and environmental learning tourism

The Public Services Element of the general plan includes goals and policies related to recreation facilities. The goals and policies aim to develop local services that meet local needs in a cost-effective manner, including supporting enhanced recreation services for existing and future residents, and obtaining dedicated lands for new schools, libraries, and recreational facilities when existing facilities are not adequate.

City of Redding

The Recreation Element of the City of Redding's general plan (City of Redding 2000) contains goals and objectives on natural and scenic open areas, development of a regional river parkway, archaeological and historic resources related to park and recreation sites, park planning and development, compatibility with adjacent land uses, facility funding and management, recreation programs, citywide trail system, and vandalism and user safety. Recreation-related goals and policies within the Recreation Element address natural and scenic open areas, a citywide trail system, and regional recreation opportunities, among others. The plan specifically recognizes the Sacramento River as "the backbone of the City's park system." Policies are established within the plan for a regional river parkway and for trails along the river, including continued development of the Sacramento River Trail.

The *City of Redding Parks, Trails, and Open Space Master Plan* (City of Redding 2004) includes as part of its parks strategy Goal PK4, "The Sacramento River and its major tributary streams will continue to be the focus and the organizing principle of the park, trail, and open space system." In addition, the plan establishes Goal TB1 within the Trails and Bikeway Strategy, "Promote and facilitate the development of a Citywide Trail System." A subgoal is to "continue development of the Sacramento River Trail to establish a common and continuous thread along the river corridor."

City of Anderson

The Recreation Element of the City of Anderson's general plan "addresses parks and recreation facilities throughout the Anderson Planning Area, including both those owned and maintained by the City of Anderson and those under the purview of other agencies or, selectively, private entities" (City of Anderson 2007). The element includes a description of the parks in the city, park classifications and standards, park issues, and a description of the recreation trails network. One of the identified additional park needs is to extend, enlarge, and protect Anderson River Park, which is located with the primary study area. Relevant recreation-related policies contained with the element aim to do all of the following:

- Allow for expanded and diverse recreational programs, areas, and opportunities
- Facilitate community and cultural opportunities

- Formalize and enhance walking trails in existing city parks
- Provide nonmotorized linkages between parks and open spaces
- Develop and promote community trails to provide health benefits for all residents
- Update the Parks and Recreation System Master Plan, incorporating appropriate provisions of the general plan (including the Trails-Sidewalks Network Concept Plan) into the master plan, and establish clear priorities and phasing plans as part of the master plan process

18.3 Environmental Consequences and Mitigation Measures

18.3.1 Methods and Assumptions

The project could affect recreation and public access resources through a variety of impact mechanisms. Primary effects on recreation facilities and recreation activities at Shasta Lake would be tied directly to the increased full pool elevation. Additional impacts could result from changes in reservoir operations that alter the magnitude, rate, or timing of reservoir drawdown; and from construction-related disruption of recreation access and activities at and near Shasta Dam. Primary conflicts with the use of recreation facilities and recreation-related activities on the Sacramento River and tributaries would be tied directly to the changes in flow regime of the rivers and the seasonal timing of those changes.

More specifically, this chapter evaluates the potential impacts on recreation and public access facilities and recreation activities resulting from the following mechanisms:

- Construction-related disruption of recreation access and activities at and near Shasta Dam
- Seasonal inundation of reservoir recreation facilities and shoreline access sites
- Changes in the magnitude, rate, or timing of reservoir drawdown
- Seasonal inundation of river recreation facilities or access sites
- Increased or decreased river flows during particular recreation use periods
- Disruption of recreation access and boating, or changes in river characteristics related to boating, caused by gravel deposition activities

The evaluation of impacts on Shasta Lake recreation facilities was based on several existing information sources. During previous phases of the project, a detailed inventory was prepared and high-resolution aerial photo–based mapping was completed for all recreation facilities on or near the shoreline of Shasta Lake. The inventory data included descriptions and elevations for the features of each facility up to an elevation 30 feet above the current full pool elevation of 1,067 feet above mean sea level including buildings, paved and unpaved roads, paved and unpaved areas, and miscellaneous objects. The inventory data include the lowest and highest elevations at which each feature would be affected (buildings excepted; only the lowest elevation was recorded for buildings). The inventory did not include buried infrastructure such as electric and water lines and septic systems. However, nearly all developed facilities on the lake are known to include these types of improvements, and these would also be among the features affected at most locations.

The CalSim-II computer model was used to aid in the evaluation of potential impacts of the project on water-related resources, including recreation resources. This computer modeling used historical California hydrology data to represent the variety of weather and hydrologic patterns, including wet periods and droughts, under which the project would be operated. Each model run represented a constant level of development (2005 for the existing case and 2030 for the future case), so that performance of the No-Action Alternative and other alternatives could be evaluated under both existing and future conditions.

For statements based on CalSim-II modeling results (e.g., statements regarding project impacts on mean monthly flow), “existing conditions” refers to modeling runs with 2005 facilities and demands; “future conditions” refers to modeling runs with forecasted 2030 demands and reasonably foreseeable future projects and facilities. The existing and future base cases are the without-project conditions in 2005 and 2030, respectively. The No-Action Alternative represents future conditions in 2030, including other reasonably foreseeable future projects and facilities.

The results of the CalSim-II modeling provide information on seasonal changes in Shasta Lake pool elevation associated with each dam-raise height. This information was used in combination with the inventory data described above to determine impacts of the alternatives on recreation facilities and activities. CalSim-II results also describe flow characteristics for the Sacramento River downstream from Shasta Dam, and for other rivers downstream from reservoirs within the CVP and SWP service areas whose operations may be affected by the project. These data were used to determine potential impacts on recreation and public access on the Sacramento River downstream from Shasta Dam and on tributary rivers and reservoirs within the CVP and SWP service areas. Both average increases and decreases in monthly pool elevation and mean monthly flows are considered with respect to impacts evaluated in this section. Preliminary assessments of impacts on public and commercial recreation

facilities at Shasta Lake were reviewed by USFS and revised based on comments received.

A detailed description of the CalSim-II model, the modeling methodology used to evaluate this project, and key assumptions are provided in the Modeling Appendix. Summaries of the analysis and modeling results are provided in Chapter 6, "Hydraulics, Hydrology, and Water Management."

18.3.2 Criteria for Determining Significance of Effects

An environmental document prepared to comply with NEPA must consider the context and intensity of the environmental effects that would be caused by, or result from, the proposed action. Under NEPA, the significance of an effect is used solely to determine whether an EIS must be prepared. An environmental document prepared to comply with CEQA must identify the potentially significant environmental effects of a proposed project. A "[s]ignificant effect on the environment" means a substantial, or potentially substantial, adverse change in any of the physical conditions within the area affected by the project" (State CEQA Guidelines, Section 15382). CEQA also requires that the environmental document propose feasible measures to avoid or substantially reduce significant environmental effects (State CEQA Guidelines, Section 15126.4(a)).

The following significance criteria were developed based on guidance provided by the State CEQA Guidelines, and consider the context and intensity of the environmental effects as required under NEPA. Impacts of an alternative on recreation and public access would be significant if project implementation would do any of the following:

- Substantially affect the operability or seasonal use of or otherwise affect reservoir and river recreation facilities and access sites as a result of water level changes or flow regime modifications
- Substantially increase recreation use such that existing facilities would be used beyond their capacity and degraded
- Substantially reduce recreational opportunities or substantially degrade recreational experiences
- Create hazardous or unusual conditions for boaters, swimmers, waders, or other water-contact activities as a result of increased or decreased water levels related to flow regime modifications associated with the action alternatives

Significance statements are relative to both existing conditions (2005) and future conditions (2030) unless stated otherwise.

18.3.3 Topics Eliminated from Further Consideration

No topics related to recreation and public access that are included in the significance criteria listed above were eliminated from further consideration. All relevant topics are analyzed below.

18.3.4 Direct and Indirect Effects

No-Action Alternative

Under the No-Action Alternative, the existing Shasta Dam would be operated in the same manner as under current operations. Changes to the reservoir flow regime caused by changes in demand and other factors would be small, with a reduction in Shasta Lake storage of 2 – 4 percent during the fall of some years. Shasta Lake storage under the No-Action Alternative would be within -2 percent and 1 percent of Shasta Lake storage under existing conditions at most times. Also, no new project-related recreation facilities would be constructed and no existing facilities would be altered, expanded, or demolished.

It is anticipated that if the project alternatives were not implemented, CVP and SWP operations would continue under existing regulatory requirements. Analysis of flow modeling indicates that there would be no significant changes in flows with the potential to affect recreation between existing conditions and the future No-Action Alternative conditions.

Under the No-Action Alternative, changes to the flow regime of the upper Sacramento River as a result of changes in demand and other factors would be small; mean monthly flows in the Sacramento River would be within ±5 percent of flows under existing conditions at most times (flows could increase by a greater amount during late summer and early fall of below-normal, dry, and critical years). Also, no new recreation facilities would be constructed and no existing facilities would be altered, expanded, or demolished.

Under the No-Action Alternative, the flow regime in the lower Sacramento River and Delta and in the CVP/SWP service areas would not change as a result of Shasta Lake operations.

Shasta Lake and Vicinity

Impact Rec-1 (No-Action): Increased Use of Shasta Lake Recreation Facilities and Demand for Recreation Opportunities on Shasta Lake and in the Vicinity
Demand for recreation facilities at Shasta Lake and in the vicinity is expected to increase, but recreation opportunities would still be extensive and varied. This impact would be less than significant.

Recreational use at Shasta Lake and in the vicinity is expected to increase in the future simply based on population growth in Northern California and southern Oregon from now until 2030. The resulting increase in demands on all recreational facilities and opportunities could affect the quality of the recreational activity. Recreational opportunities would still be extensive and

varied in the area, however, and USFS management of the Shasta Unit of the Shasta-Trinity NRA would continue to respond to changing recreation needs. Because no substantial hydrologic changes are anticipated under the No-Action Alternative, this impact would be less than significant. Mitigation is not required for the No-Action Alternative.

Upper Sacramento River (Shasta Dam to Red Bluff)
Impact Rec-2 (No-Action): Increased Use and Demand for Recreation Opportunities on the Upper Sacramento River Demand for recreation facilities along the upper Sacramento River is expected to increase, but recreation opportunities would still be extensive and varied. This impact would be less than significant.

Recreational use in the upper Sacramento River portion of the primary study area is expected to increase in the future simply based on population growth in Northern California from now until 2030. The resulting increase in demands on all recreational facilities and opportunities could affect the quality of the recreational activity. Recreational opportunities would still be extensive and varied in the area, however. Because no substantial hydrologic changes are anticipated under the No-Action Alternative, this impact would be less than significant. Mitigation is not required for the No-Action Alternative.

Lower Sacramento River and Delta
Impact Rec-3 (No-Action): Increased Use and Demand for Recreation Opportunities on the Lower Sacramento River and in the Delta Demand for recreation facilities along the lower Sacramento River and in the Delta is expected to increase, but recreation opportunities would still be extensive and varied. This impact would be less than significant.

Recreational use in the lower Sacramento River and Delta portions of the extended study area is expected to increase in the future simply based on population growth in Northern and Central California from now until 2030. The resulting increase in demands on all recreational facilities and opportunities could affect the quality of the recreational activity. Recreational opportunities would still be extensive and varied in the area, however. Because no substantial hydrologic changes are anticipated under the No-Action Alternative, this impact would be less than significant. Mitigation is not required for the No-Action Alternative.

CVP/SWP Service Areas
Impact Rec-4 (No-Action): Increased Use and Demand for Recreation Opportunities in the CVP and SWP Service Areas Demand for recreation facilities in the CVP/SWP service areas is expected to increase, but recreation opportunities in the CVP/SWP service areas would still be extensive and varied. This impact would be less than significant.

Recreational use in the CVP/SWP service areas within the extended study area is expected to increase in the future simply based on population growth in California from now until 2030. The resulting increase in demands on all recreational facilities and opportunities could affect the quality of the recreational activity. Recreational opportunities would still be extensive and varied in the area, however. Because no substantial hydrologic changes are anticipated under the No-Action Alternative, this impact would be less than significant. Mitigation is not required for the No-Action Alternative.

CP1 – 6.5-Foot Dam Raise, Anadromous Fish Survival and Water Supply Reliability

By increasing storage at Shasta Lake, this alternative would change the full pool elevation and seasonal pool elevations at Shasta Lake, and the flow regime downstream in the Sacramento River and potentially several other reservoirs and downstream waterways. In turn, these alterations to reservoir pool elevations and river flows could affect the usability of several types of recreation facilities on Shasta Lake and the downstream reservoirs and waterways, particularly marinas, boat ramps, and nearshore campgrounds and day-use areas. These alterations could also affect the ability of recreationists to use the reservoirs and waterways for boating, camping, fishing, and similar activities.

The full pool elevation of Shasta Lake would increase by 8.5 feet and the pool elevation would average as much as 6 to 10 feet higher than under existing (2005) and No-Action Alternative (2030) conditions at various times of the year. The greatest change would occur during the wettest years. The surface area of the reservoir at full pool would increase by about 1,100 acres (4 percent) with a 6.5-foot dam raise. The width of the water body would not increase substantially in most areas, and much of the increase would occur during spring rather than during the high-traffic summer boating period.

At most times, flows in the upper Sacramento River within the primary study area (between Shasta Dam and RBDD) would be within about ±5 percent of flows relative to existing (2005) and No-Action Alternative (2030) conditions.

Reservoir- and river-based recreation facilities and activities are similar in the primary and extended study areas downstream from Shasta Lake; thus potential effects on reservoir and river recreation would be similar. However, changes to the flow regime affecting reservoirs and rivers in the extended study area would be increasingly attenuated by flows from tributary waterways and other water sources and diversions that are unaffected by the project, reducing the level of effects downstream.

Shasta Lake and Vicinity

Impact Rec-1 (CP1): Seasonal Inundation of Shasta Lake Recreation Facilities or Portions of Recreation Facilities and Public Access at Pool Elevations Above the Current Full Pool Elevation Substantial effects from inundation of recreation facilities or portions of Shasta Lake facilities would result from the 8.5-foot increase in full pool elevation associated with the 6.5-foot dam raise. The reservoir would fill to the new full pool elevation of 1,075.5 feet in some years, and would fill to an elevation greater than the current full pool elevation of 1,067 feet in many years. In each case portions of existing recreation facilities on the shoreline would be inundated. However, construction activities would include relocation of affected recreation facilities. Replacement facilities would be of equivalent quality to affected facilities, provide comparable shoreline access, where applicable, and would comply with Americans with Disabilities Act (ADA) and Architectural Barriers Act (ABA) guidelines. Therefore, this impact would be less than significant.

Within each of the three arms of Shasta Lake with recreation development, effects on individual recreation facilities under CP1 would vary. These effects would range from no effect to effects on several of the facilities' inventoried and mapped features (e.g., roads, parking, and restrooms or other buildings) and on features not specifically inventoried (e.g., campsites and picnic sites). Anticipated effects of CP1 on inventoried and mapped (developed) recreation facilities are shown in Table 18-3.

On the Sacramento River Arm, one of the two boat ramps, one of the four campgrounds, and one of the four marinas would be subjected to effects on several features or a substantial portion of the facility's use area. Other facilities that would be subject to major effects are the USFS Lakeshore Fire Station and the Dry Creek trailhead and trail at the west side of Shasta Dam. The only operational day-use area and one campground would be subject to a somewhat lesser but still substantial effect, while several additional facilities would be subject to relatively minor effects.

On the McCloud River Arm, both marinas and both boat ramps would be subject to major effects, as would the USFS Station at Turntable Cove. At least two of the cabins in the recreation residence tract at Campbell Cove would be affected. Effects would be less but still substantial at several of the six public campgrounds and two of the three day-use areas.

On the Pit River Arm, both of the boat ramps and three of the four marinas would be subject to major effects, whereas the lower loop of the one campground would experience a lesser effect. On the Squaw Creek Arm, one private cabin in the Didallas recreation residence tract would be affected. (This is the only recreation facility on the Squaw Creek Arm, and is not listed in the table.)

Table 18-3. Effects of CP1 on Developed Recreation Facilities at Shasta Lake

Facility Name	Explanation of Effects on Facility at Full Pool Elevation
Sacramento River Arm	
Boat Ramps	
1. Antlers Public Boat Ramp	Boat ramp length reduced but ramp usable; parking lot and restroom unaffected
2. Centimudi Public Boat Ramp	Boat ramp entirely affected, most of lower parking lot affected, access road to ramp and parking partly affected
Campgrounds	
1. Antlers Campground	No effect – all features are above full pool elevation
2. Gregory Creek Campground	One restroom affected and shoreline campsites affected
3. Lakeshore East Campground	One restroom, lower portion of access road, and some campsites affected
4. Nelson Point Campground	Campground access road and possibly some campsites affected
Day-Use Areas	
1. Fisherman's Point Day Use Area	Access road, parking, and restroom unaffected, but part of use area affected
2. Salt Creek Swim Area (nonoperational)	Restroom and portion of paved pathway affected
Marinas	
1. Antlers Resort and Marina	One building affected, boat ramp partially affected
2. Digger Bay Marina	Bottom portion of marina road/ramp affected, but effects appear minor
3. Shasta Marina Resort	Office and equipment shed affected, parking and access roads partially affected
4. Sugarloaf Resort and Marina	Electrical service building and associated structures affected, boat ramp and unpaved parking areas partially affected
Resorts (Nonmarina)	
1. Lakeshore Inn and RV Park	Shoreline campsites and walkway may be affected
2. Salt Creek Resort and RV Park	Resort unaffected; lower part of old road bed used as boat ramp affected, but usable
3. Shasta Lake RV Resort	No effect – entire facility is above full pool elevation
4. Sugarloaf Cottages Resort	Unpaved shoreline access roads affected but usable
5. Tsasdi Resort	Entrance and exit roads connecting to Lakeshore Drive affected; resort cabins appear to be unaffected
Other Facilities	
1. USFS Lakeshore Fire Station	Five buildings affected, entrance road partially affected
2. Dry Creek Trailhead and Trail	Trailhead and portion of trail along shoreline affected

Table 18-3. Effects of CP1 on Developed Recreation Facilities at Shasta Lake (contd.)

Facility Name	Explanation of Effects on Facility at Full Pool Elevation
McCloud River Arm	
Boat Ramps	
1. Bailey Cove Boat Ramp and Day Use Area	Boat ramp entirely affected, parking area, day-use area, and access road partially affected
2. Hirz Bay Public Boat Ramp	Boat ramp entirely affected; some of lower parking area likely to be affected
Campgrounds	
1. Bailey Cove Campground	Campsites appear unaffected; access road may be affected
2. Dekkas Rock Campground	Lower part of loop road affected; possibly a portion of group camp affected
3. Ellery Creek Campground	Lower portion of loop road and shoreline campsites affected
4. Hirz Bay Campgrounds	No effect – entire facility is above full pool elevation
5. Kamloop Camp (private organization)	No effect – entire facility is above full pool elevation
6. McCloud Bridge Campground	Portion of access road affected; some campsites likely affected
7. Moore Creek Campground	Lower portion of loop road and shoreline campsites affected
8. Pine Point Campground	No effect – entire facility is above full pool elevation
Day-Use Areas	
1. Dekkas Rock Day Use Area	Lower portion of loop road and some parking affected
2. McCloud Bridge Day Use Area	Part of use area affected (no permanent infrastructure present)
Marinas	
1. Holiday Harbor Marina	Two marina buildings and boat ramp affected, overflow parking partially affected; RV park/campground likely to be partially affected
2. Lakeview Marina	Four buildings and tank affected, shoreline part of access road affected; access to buildings appears to be unaffected
Other Facilities	
1. Bollibokka Club	No effect – entire facility is above full pool elevation
2. Campbell Creek Cove cabins	At least two cabins affected, possibly others also affected
3. Shasta Caverns ferry landing	Access roads serving east and west shore landings partially affected; parking and building unaffected
4. USFS Station (Turntable Bay)	Four buildings affected and access road affected
Pit River Arm	
Boat Ramps	
1. Jones Valley Public Boat Ramp	Boat ramp entirely affected, access road from parking area partially affected
2. Packers Bay Public Boat Ramp	Boat ramp and information shelter affected, parking partially affected

Table 18-3. Effects of CP1 on Developed Recreation Facilities at Shasta Lake (contd.)

Facility Name	Explanation of Effects on Facility at Full Pool Elevation
Campgrounds	
1. Lower Jones Valley Campground	Footbridge associated with trail affected; culverts and creek may back up into campground during high-water periods
2. Upper Jones Valley Campground	No effect – entire facility is above full pool elevation
Marinas	
1. Bridge Bay Resort and Marina	Seven buildings, boat ramp, parking lots, and roads affected
2. Jones Valley Resort	Three buildings and access road affected, parking area and resort roads partially affected
3. Packers Bay Marina	Boat ramp partially affected but usable
4. Silverthorn Marina Resort	Parking and ramp mostly affected, shoreline road partially affected
Other Facilities	
1. Clikapudi Trail	

Sources: Reclamation 2003

Key:
RV = recreational vehicle
USFS = U.S. Forest Service

It is important to note that effects on roads and bridges that are outside of the recreation facilities themselves but used to access the facilities would also affect recreation at Shasta Lake. (Effects on roads and bridges are discussed in more detail in Chapter 20, "Transportation and Traffic.") A prominent example is the effect on a long stretch of Lakeshore Drive, the primary route on the west side of the Sacramento River Arm providing visitors access to several commercial recreation facilities (marinas and nonmarina resorts) and a campground. Effects on the road would begin at a small segment near the north end of the Doney Creek Bridge and extend about 2 miles south to the Sugarloaf area. Two major bridges over inlets of the lake would be affected as well. (These roads and bridges are also used to access private homes and nonrecreation businesses.) Numerous segments of Shasta County and USFS roads that provide access to facilities or the shoreline on each of the lake's arms would also be affected.

In summary, the most prominent direct effects on recreation facilities and public access at Shasta Lake and in the vicinity from the 6.5-foot dam raise would be the major effects on five of six boat ramps, one of 13 public family campgrounds, six of 10 commercial marinas, and USFS stations on both the Sacramento River and McCloud River arms. A lesser but still substantial effect would occur at several day-use areas and two campgrounds and minor effects would occur at several additional facilities. Table 18-4 summarizes the number of recreation facilities of specific types substantially affected.

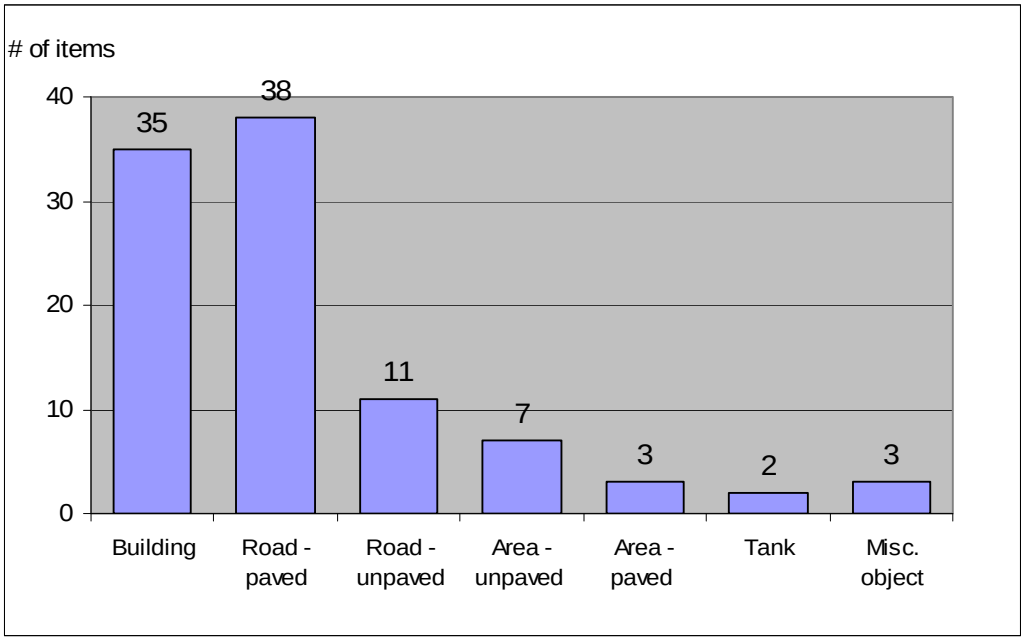
Table 18-4. Tally of Shasta Lake Recreation Facilities Substantially Affected by CP1

Type of Facility	Number of Facilities Affected
Boat ramp	5
Marina	6
Campground (family)	1
Day-use area	3
USFS operations	2
Trailhead	1
Recreation residence tract	1

Source: Reclamation 2003

Key:
USFS = U.S. Forest Service

Figure 18-3 depicts the total number of inventoried Shasta Lake recreation facility items, at all recreation facilities combined, that would be affected by inundation under CP1. A total of 99 facility and infrastructure elements would be affected, with nearly three-fourths of those being buildings and segments of paved roads. A lesser number of unpaved road segments, paved and unpaved areas (usually parking areas), tanks, and miscellaneous objects would also be affected.



Source: Reclamation 2003

Figure 18-3. Number of Recreation Facility Infrastructure Items Affected by a 6.5-Foot Dam Raise Under CP1

As described in Section 2.4.2 in Chapter 2, “Alternatives,” construction activities under all action alternatives would include relocation of affected

recreation facilities. This could include relocation of affected portions of facilities within existing use areas, in adjacent undeveloped areas, or at new sites in the same general vicinity of the lake. Because of consolidation of facilities, the total number of facilities of specific types may be reduced. However, all affected recreation capacity would be replaced. Replacement facilities would be of equivalent quality to affected facilities and provide comparable shoreline access, where applicable. With the relocation of affected facilities, this impact would be less than significant.

Recreation is highly important to the Shasta Lake area. Therefore, mitigation is included to uphold the completion of all actions related to the relocation of affected recreation facilities in order to maintain recreation capacity at Shasta Lake, as included in the project description.

Impact Rec-2 (CP1): Temporary Construction-Related Disruption of Recreation Access and Activities at and near Shasta Dam Construction activity at Shasta Dam that would be necessary to raise the dam and complete related modifications would prevent recreation visitors from crossing the dam, as is possible now with a permit from Reclamation, and thus could affect other recreation activities in the area. These effects are expected only during the construction period. However, this impact would be potentially significant.

One of the primary routes used by recreation visitors to the Chappie-Shasta OHV Area, situated below Shasta Dam on the west side of Keswick Reservoir, crosses Shasta Dam. It is assumed that public access to the road crossing the dam, which is available now with an annual permit issued by Reclamation, would be temporarily suspended during the construction phase of the project. An alternative route to the Chappie-Shasta OHV Area from the south exists, but that route requires several more miles of travel on unpaved roads than the route across the dam, and it may not be suitable for some visitors to the OHV area who bring OHVs to the area on trailers.

The road across the dam is also the primary access route to the Dry Fork Creek trailhead near the west end of Shasta Dam, used by hikers and anglers to access the Dry Fork Creek Trail, which follows the shoreline of Shasta Lake. Access to this trailhead and trail would be disrupted during the project construction period. (As noted under Impact Rec-1 (CP1) above, the trailhead itself would be destroyed by modifications to the dam and portions of the trail would be affected by the increased reservoir elevation.)

Construction at Shasta Dam would also result in a temporary cessation of Reclamation's public tours of the dam and powerhouse, and disturbance of recreation visits to the Shasta Dam Visitor Center (situated just below the east end of the dam), because of noise, dust, and aesthetic changes.

For the reasons described above, this impact would be potentially significant. Mitigation for this impact is proposed in Section 18.3.5.

Impact Rec-3 (CP1): Effects on Boating and Other Recreation Use and Enjoyment of Shasta Lake as a Result of Changes in the Annual Drawdown of the Reservoir An increase in the magnitude or rate or changes in the timing of the annual summer and fall drawdown of Shasta Lake could adversely affect boating enjoyment and safety on the reservoir. Conversely, a reduced or slower drawdown could have beneficial effects. However, under CP1, reservoir operations would not change from existing operations, with little change in annual magnitude, rate, or timing of reservoir drawdown. Therefore, this impact would be less than significant.

Over the past decade, Shasta Lake has had an average drawdown of about 67 feet from the annual high pool. (The annual high pool is typically reached in April or May and the reservoir is drawn down during summer and fall, before the winter rains arrive.) During most of those years, the drawdown has been in the range of 50 to 85 feet but has been as large as 108 feet and as little as 38 feet. Total drawdown, as compared to the full pool elevation of 1,067 feet (which the reservoir does not reach every year), has averaged about 77 feet and has been as great as 130 feet. Both public launch ramps and commercial recreation facilities such as marinas and shoreline resorts on the lake are designed and operated to remain functional at a wide range of pool elevations, although some facilities are closed or have restricted use below certain pool elevations. Boaters familiar with the lake generally know to expect a substantial annual drawdown and are aware of the effects of drawdown on facilities and navigation on the lake. Signs at boat ramps and marinas warn boaters of the potential for rapidly changing conditions on the lake as a result of regular seasonal drawdowns.

Potential adverse effects of an increase in the magnitude or rate of drawdown include an increase in seasonally exposed shoals and other boating hazards, and increased navigation challenges as compared to what boaters have typically experienced in past years. Other potential adverse effects of such changes in drawdown include a need to more frequently adjust docks and moorings at boat launches and marinas and other locations, and an increase in the distance between developed shoreline campsites and day-use areas and the water's edge. Facilities that operate only above a certain pool level would be usable for a shorter period of time each year. Aesthetically, an increased drawdown would result in a less appealing recreation setting characterized by a wider unvegetated inundation zone. Conversely, a reduced drawdown or slower drawdown during the primary summer boating season could have beneficial effects by reducing the adverse effects described above, which normally occur to some degree each year under existing conditions and would continue under the No-Action Alternative.

Under CP1, storage would increase but reservoir operations would not change; therefore, the character of the annual reservoir drawdown would not be expected to change greatly. This conclusion is confirmed by CalSim-II modeling results, which indicate that the reservoir elevation would be as much

as 8 to 10 feet higher at various points in the year, but that the magnitude, rate, and timing of the annual drawdown would be essentially unchanged relative to the existing (2005) and No-Action Alternative (2030) conditions. The only exception to this would occur during some drier-than-average years: increased storage during spring would be followed by a smaller increase or a slight reduction in late summer and early fall, resulting in a slightly greater drawdown than under existing conditions. As a result, no effects related to drawdown changes are expected under CP1. This impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact Rec-4 (CP1): Increased Hazards to Boaters and Other Recreationists at Shasta Lake from Standing Timber and Stumps Remaining in Untreated Areas of the Inundation Zone At full pool, the increased pool elevation would result in approximately 730 acres of newly inundated area where the existing trees and other vegetation would not be removed. Anglers would generally benefit from the associated enhancement of fish habitat; however, the standing trees and stumps remaining in these areas would increase the number of areas and total acreage where this type of hazard to boaters and other recreation visitors would exist. Therefore, this impact would be significant.

Approximately 730 acres (66 percent) of the 1,100 acres of newly inundated area that would result from the 6.5-foot dam raise at full pool would receive no vegetation treatment (no vegetation removed), to maximize the habitat benefits of inundated and residual vegetation. The remaining 370 acres would be subject to either complete vegetation removal or overstory removal. In areas of overstory removal, all trees greater than 10 inches in diameter at breast height would be removed, with stumps cut to within 24 inches of the ground surface. The intent of these treatments would be to minimize the risk to boaters and other visitors from snags and water hazards. These treatments would be targeted for areas adjacent to developed recreation sites and houseboat mooring areas, and other areas where snags pose the greatest risk to boaters.

Because no vegetation would be removed from portions of the newly inundated area, the area at Shasta Lake where boaters would be exposed to potential hazards from standing timber and stumps would increase. The hazards may increase as the trees die and decay, leaving stumps that may be at or just below the water surface. The hazard represented by the standing timber and stumps would exist only when the reservoir surface elevation is above the current full pool elevation, which would occur only during the highest pool elevation period (generally late spring and early summer) of wetter-than-normal years.

Although the number and acreage of areas where this hazard would be present would expand, the hazard already exists on portions of the Pit River and Squaw Creek arms of the lake, where vegetation was not cleared when the reservoir was constructed and where numerous inundated trees still exist. The Shasta Lake Boating Safety brochure provided to Shasta Lake boaters by USFS warns that numerous underwater obstacles (as well as floating debris and shallows) are

present and not marked, and that responsibility for boating safety rests with each individual vessel operator. Also, the Shasta County ordinance that limits boat speeds on Shasta Lake to 5 mph within 100 feet or the shoreline would serve to reduce the hazard. Finally, the standing timber and other remaining vegetation would provide structural diversity that is attractive to fish; therefore, these areas are likely to be attractive to anglers who could benefit from the increase in uncleared areas and who may consider them a recreation enhancement rather than a hindrance.

Despite these factors, the untreated areas of the new inundation zone would represent an increased hazard to boaters and potentially other types of recreationists. For this reason, this impact would be significant. Mitigation for this impact is proposed in Section 18.3.5.

Upper Sacramento River (Shasta Dam to Red Bluff)

Impact Rec-5 (CP1): Seasonal Inundation of Portions of Recreation Facilities or Informal River Access Sites as a Result of Increased River Flows Within the upper Sacramento River portion of the primary study area, inundation of recreation facilities or portions of recreation facilities, such as boat launch ramps and unimproved riverbank sites used for boat launching and other activities, could result from increased mean monthly river flows associated with project implementation and operation. In general, the increases in flow that would occur in some years would be expected to be small (5 percent or less); the area of inundation beyond that which would occur existing conditions or under the No-Action Alternative would be likewise small. As a result, the adverse effects are unlikely to be substantial. This impact would be less than significant.

Increased river flows associated with project implementation could temporarily inundate portions of developed recreation facilities used by boaters, anglers, and other recreationists to access the upper Sacramento River between Shasta Dam and Red Bluff. Any of the more than 15 boat ramps at public and privately operated parks on the river would be affected if increased river flow were to cause the ramps, which are generally designed to be used at a range of river elevations, to be overtopped. These facilities are often associated with picnic areas, shoreline fishing access areas, and similar day-use facilities, as well as campgrounds. The portions of these areas nearest to the riverbank could also be affected. Many of these facilities are used year-round, but the peak period for boating on the river is late spring through fall (May–November), when river flows are most likely to be in the optimum range of 6,000 to 12,000 cfs. Although existing average monthly flows are within this range year-round, in most winter and spring seasons the river experiences much higher peak flows of 30,000 to 50,000 cfs or more that may last several weeks.

Many of the locations that recreationists use to access the river and to hand-launch watercraft are informal sites where conditions such as gradually sloping and sandy riverbanks create beaches that are conducive to recreation

use. Like developed sites, these undeveloped and informal use areas may be affected by increased river flows if increased flows were to result in temporary inundation of the area.

CalSim-II model simulations indicate that at nearly all times, Sacramento River flow below Keswick Dam under CP1 would be within about ±5 percent of flows relative to existing (2005) and No-Action Alternative (2030) conditions. (The only exception suggested by the model results is the potential for a flow increase of up to 30 percent during midwinter of critically dry years.) Regarding increases to river stage, the CalSim-II model simulations indicate that, during late summer (July and August) of some years, mean monthly river stage below Keswick Dam could increase as much as 2 to 5 feet relative to existing (2005) and No-Action Alternative (2030) conditions. (River stage during the summer below Keswick Dam is typically 13 to 14.5 feet under existing conditions.) The model simulations also indicate that in some years, the mean monthly river stage could be up to 2 feet higher during late fall and early winter (October to January) and up to 4 feet higher during late winter and spring (February to May). (The model results also indicate the potential for lower river levels during some of these seasons in some years. Effects of decreased river flows are addressed below under Impact Rec-7 (CP1).)

Although river stage information for points within the primary study area downstream from Keswick Dam was not assessed, the effects of the project on river stage at those locations would be expected to be moderated by inflows from tributaries, and would therefore be less than the potential changes below Keswick Dam. As a result, potential effects of the project on recreation facilities would be progressively less as one moves downstream from Keswick Dam.

Because most recreation facilities are designed to be used well above the river stage elevations that commonly occur during late summer and spring, the stage increases cited above would not affect the functionality of those facilities. The small summer and fall increases in river stage would be likewise unlikely to have noticeable adverse effects on informal use sites, because those sites exist at a range of elevations and at many river locations. During periods of very high flows that may occur during winter and spring, boat ramps and other recreation facilities on the river may close, and safety warnings may be issued to boaters to stay off the river until the flow subsides.

It is important to note that for this assessment of environmental consequences, specific information was not available regarding how specific river stages affect specific recreation facilities. The assessment has also not considered the riverbank slope in specific river reaches, which would determine how much increased inundation would result from river stage increases at undeveloped recreation sites. Additional analysis would be required to provide accurate projections of effects at specific recreation sites or specific stretches of riverbank. Overall, however, the hydrologic changes in the Sacramento River

high flows resulting from CP1 would be relatively small and within the variability of flows that already occur in the river.

For the reasons described above, this impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact Rec-6 (CP1): Increased Difficulty for Boaters in Using the Sacramento River as a Result of Increased River Flows Increased mean monthly flows within the primary study area, particularly during summer and fall when boating activity is most likely, could result in more difficult conditions for boat launching and boating on the Sacramento River. Depending on the time of year and base river flows, increased flow may also have beneficial effects. Because the magnitude of flow increases associated with CP1 would be small (generally less than 5 percent), adverse effects on boaters within the primary study area are unlikely. This impact would be less than significant.

Increased river flows associated with project implementation could affect boating conditions on the upper Sacramento River between Shasta Dam and Red Bluff. Increased flows can make boating on the river more difficult, particularly for nonmotorized boats such as canoes and dories or "drift boats." Drift boats are controlled by oars; these boats are commonly used by anglers and commercial angling guide services, primarily during summer, before lower flows during fall make their use more difficult. Canoeing, kayaking, and similar forms of nonmotorized boating are also most common on the river during summer, but are less affected by low flows than drift boating. Boating activity occurs on the river year-round, but the peak period for boating is late spring through fall (May–November), when river flows are most likely to be in the optimum range.

As described above under Impact Rec-4 (CP1), CalSim-II model simulations indicate that at nearly all times, Sacramento River flow below Keswick Dam under CP1 would be within about ±5 percent of flows relative to existing (2005) and No-Action Alternative (2030) conditions. However, CalSim-II model simulations indicate that mean monthly river stage below Keswick Dam could increase by as much as 2 to 5 feet relative to existing (2005) and No-Action Alternative (2030) conditions during late summer (July and August) of some years, and could increase by as much as 2 to 4 feet during other seasons. Changes in flows farther downstream within the primary study area would be expected to be progressively smaller as the influence of tributary streams increases.

The generally small flow increases that would occur as a result of the project in some years would be unlikely to adversely affect boating, which occurs primarily during summer and fall, and may have small beneficial effects during dry years by reducing exposed sand bars and shallows and thus increasing navigability on the river. Although boating activity is lower during winter, particularly during peak-flow periods when facilities may be closed and

conditions are hazardous, increased flows during dry years and decreased flows during wet years could have similarly minor beneficial effects during those months.

For the reasons described above, this impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact Rec-7 (CP1): Increased Difficulty for Swimmers and Waders in Using the Sacramento River as a Result of Increased River Flows Increased mean monthly flows within the upper Sacramento River, particularly during summer when swimming activity is most likely, and during fall and winter nonpeak-flow periods when wade angling activity is most likely, could result in more difficult swimming and wading conditions. Increased flows can make swimming and wading more challenging and potentially more hazardous. The magnitude of flow increases associated with CP1 would be small (generally less than 5 percent), and the timing of the increases would be such that adverse effects on angling waders within the primary study area are unlikely. Swimming is not a common activity on the main channel of the river because of cold-water temperatures. As a result, this impact would be less than significant.

Increased river flows associated with project implementation could affect swimming and wading conditions on the upper Sacramento River between Shasta Dam and Red Bluff. Increased flows can make swimming and wading more difficult. Because of cold-water temperatures (a maximum of less than 60 degrees during summer), swimming is not a major activity on the Sacramento River, but it does occur, particularly in association with other activities like tubing and nonmotorized boating. Anglers commonly wade in the river; their use is particularly focused on the months of September and October, when flows typically decrease substantially from summer levels and the opportunities for wading correspondingly increase.

As described above under Impact Rec-4 (CP1), CalSim-II model simulations indicate that at nearly all times, Sacramento River flow below Keswick Dam under CP1 would be within about ±5 percent of flows relative to existing (2005) and No-Action Alternative (2030) conditions. However, CalSim-II model simulations indicate that mean monthly river stage below Keswick Dam could increase by as much as 2 to 5 feet relative to existing (2005) and No-Action Alternative (2030) conditions during July and August of some years, and could increase by as much as 2 to 4 feet during other seasons. Changes in flows farther downstream within the primary study area would be expected to be progressively smaller as the influence of tributary streams increases.

The generally small increases in summer flows throughout the primary study area that would occur as a result of the project in some years would be unlikely to adversely affect the limited amount of swimming that occurs during those months. The CalSim-II model simulations suggest that little or no change in river stage is likely during September, relative to existing (2005) and No-Action

Alternative (2030) conditions, and that only very small increases are likely in October and November of some years. The absence or very small magnitude of river stage increases during the fall peak period for wading by anglers indicates that adverse effects of the project on wading anglers are unlikely.

For the reasons described above, this impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact Rec-8 (CP1): Increased Usability of the Sacramento River for Boating and Water-Contact Recreation as a Result of Decreased River Flows
Decreased mean monthly flows within the primary study area, particularly during summer when boating and swimming activity is most likely and during fall and winter low-flow periods when wade angling activity is most likely, could result in enhanced boating, swimming, and wading conditions. Decreased flows during normally high-flow periods can make boating less challenging and potentially less hazardous. The magnitude of flow decreases associated with the project would be small (generally less than 10 percent), and the timing of the decreases (fall and winter months) would be such that effects on boaters, swimmers, and waders within the primary study area are unlikely. As a result, this impact would be less than significant.

Decreased river flows associated with project implementation could benefit boating conditions on the Sacramento River in the primary study area, between Shasta Dam and Red Bluff. Decreased flows can make boating on the river easier, particularly for nonmotorized boats such as canoes and dories or “drift boats.” BLM has identified an optimum range of 6,000 to 12,000 cfs for boating on the Sacramento River in the primary study area. Boating may benefit if the decrease lowers flows below the high end of the optimum range. Under existing conditions, average monthly flows below Keswick Dam and below Cottonwood Creek are above the optimum level during midsummer most years and during much of the winter and early spring of wet years.

Decreased river flows associated with project implementation could also benefit conditions for swimming and wading, although boating conditions may be adversely affected if flow were to fall below the low end of the optimum range of 6,000 cfs. Decreased flow could make swimming and wading easier and may lengthen the period when these activities are best pursued. For example, wading anglers typically concentrate their activity in the fall months, when flows are lowest, whereas fishing from a boat is more common in summer, when flows are higher. Reduced flows in late summer or early fall may extend the wading season.

As described above under Impact Rec-4 (CP1), CalSim-II model simulations indicate that at nearly all times, Sacramento River flow below Keswick Dam under CP1 would be within about ±5 percent of flows relative to existing (2005) and No-Action Alternative (2030) conditions. However, CalSim-II model simulations indicate that mean monthly river stage below Keswick Dam could

decrease by as much as 2 to 6 feet relative to existing (2005) and No-Action Alternative (2030) conditions during the late fall and early winter (November to January) of wetter-than-normal years, and could decrease by as much as 2 to 4 feet during April and May in some years. Again, changes in flows farther downstream within the primary study area would be expected to be progressively smaller as the influence of tributary streams increases.

The reduction in mean monthly flows during fall and early-winter months of wetter-than-normal years would have minimal effects on boating because the existing mean flows during those months are usually within the optimum range. However, the decreased flow could have a beneficial effect on boating during the winter months of wet years, when the existing mean flows are above the optimum range.

The small reduction in flows and the corresponding decrease in river stage during some spring months during both wetter-than-normal and drier-than-normal years could have a beneficial effect on wading, because it could reduce flows to a level that is similar to existing fall conditions, when wading by anglers is most popular. However, given that the spring months are not the period when most wading anglers are present, and that swimming activity is low in the spring months, the effects are likely to be minimal.

For the reasons described above, this impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact Rec-9 (CP1): Enhanced Angling Opportunities in the Upper Sacramento River as a Result of Improved Flows and Reduced Water Temperatures Project operation would result in improved flow and water temperature conditions in the upper Sacramento River, which would benefit all four Chinook salmon runs. This would result in enhanced populations of these game fish in the river, which would provide enhanced sport angling opportunities. This impact would be beneficial.

Chinook salmon contribute to the popular sport fishery in the upper Sacramento River. (The salmon season has been closed on the upper Sacramento River in recent years, but may be reopened if the health of the runs improves.) With increased flows and cooler water temperature resulting from project operation, salmon populations would benefit from reduced mortality. These beneficial effects on Chinook salmon could result in enhanced angling opportunities on the upper Sacramento River, which would have a beneficial effect on recreation. Mitigation for this impact is not needed, and thus not proposed.

Impact Rec-10 (CP1): Disruption of Sacramento River Boating and Access Resulting from the Gravel Augmentation Program The proposed gravel augmentation program would not be implemented under CP1. Therefore, no impact would occur. Mitigation for this impact is not needed, and thus not proposed.

Impact Rec-11 (CP1): Changes in Usability of Reading Island Fishing Access Boat Ramp and Enhanced Recreation at Reading Island The proposed restoration of Sacramento River flow through Anderson Slough at Reading Island, rehabilitation of the Reading Island boat ramp for use by motorized boats, and construction of a handicap fishing access area would not be implemented under CP1. Therefore, no impact would occur. Mitigation for this impact is not needed, and thus not proposed.

Lower Sacramento River and Delta and CVP/SWP Service Areas

Impact Rec-12 (CP1): Seasonal Inundation of Portions of River Recreation Facilities or Informal River Access Sites on the Lower Sacramento River and Rivers Below CVP and SWP Reservoirs as a Result of Increased River Flows Within the extended study area, inundation of recreation facilities or portions of recreation facilities, such as boat launch ramps and unimproved riverbank sites used for boat launching and other activities, could result if increased mean monthly river flows were to occur in some months of some years as a result of project implementation and operation under CP1. However, even with the increases, flows on the Sacramento, American, and Feather rivers would remain moderate and well below normal winter and spring high flows. As a result, adverse effects on river facilities or informal use areas within the extended study area are unlikely. This impact would be less than significant.

Increases in Sacramento River stage (elevation) within the extended study area associated with increased flows under CP1 would be small (only occasionally more than 1 foot, and no more than about 1.3 feet). The area of inundation beyond that which would occur under existing conditions and the No-Action Alternative would be likewise small. Also, the largest increases would occur during late summer and early fall and primarily during drier-than-normal years, when river flow and stage would be below average. On the Feather River below Thermalito Afterbay and on the lower American River (at the H Street Bridge), the increase in flows would be larger during some months of some years (with some increases greater than 25 percent), and these increases would occur during wetter-than-normal as well as drier-than-normal years. Yet here, too, the largest increases would occur during late summer and early fall, when flows are generally moderate. On both rivers, flows would remain moderate and well below winter and spring high flows experienced in most years. Therefore, adverse effects on river recreation facilities and informal use areas appear unlikely.

For the reasons described above, this impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact Rec-13 (CP1): Increased Difficulty for Boaters in Using the Lower Sacramento River and Rivers Below CVP and SWP Reservoirs as a Result of Increased River Flows Increased mean monthly flows within the extended study area, particularly during summer and fall when boating activity is most likely, could result in more difficult conditions for boat launching and boating on the Sacramento River and other rivers affected by the project. Depending on

the time of year and base river flows, increased flow may also have beneficial effects on boating by reducing shallow bars and riffles, thus improving navigability. However, the timing and flow conditions under which the flow increases are likely to occur on the Sacramento, Feather, and American rivers under CP1 and the continuation of moderate flows even with the increase suggest that adverse effects on boaters within the extended study area are unlikely. This impact would be less than significant.

CalSim-II modeling results indicate that the magnitude of flow increases in the Sacramento River associated with CP1 may be as large as about 29 percent at Verona and 23 percent below Wilkins Slough and below Freeport. However, the largest changes would occur primarily during mid- and late summer and early fall (July to September), and primarily during drier-than-normal years, when flows are normally relatively low. Thus, even with the flow increases, flows would remain moderate (12,000 to 15,000 cfs at Verona and 15,000 to 20,000 cfs below Freeport).

CalSim-II modeling results indicate that the magnitude of flow increases in the Feather River below Thermalito Afterbay associated with CP1 may be as large as 43 percent. However, the largest increases would occur during mid- and late summer and early fall and primarily during drier-than-normal years, when flows are often lower than average. Flows would remain moderate (2,200 to 7,600 cfs) with the increases. CalSim-II modeling results also indicate that flows in the American River at the H Street Bridge (below Folsom Lake) would also be substantially increased during some months of some years, but would remain moderate. Although some of the potential flow increases in the Sacramento, Feather, and American rivers would be substantial, adverse effects on boating appear to be unlikely.

Hydrologic changes in more distant areas of the CVP and SWP service areas resulting from CP1 cannot be accurately predicted but would be small. Such slight changes occur on a dynamic and daily basis under existing conditions as water is moved throughout California. Other CVP and SWP reservoir elevations, canal flows, and flows below the reservoirs could be slightly modified, but any resulting effects on recreation would be negligible and speculative.

For the reasons described above, this impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact Rec-14 (CP1): Increased Difficulty for Swimmers and Waders in Using the Sacramento River and Rivers Below CVP and SWP Reservoirs as a Result of Increased River Flows Increased mean monthly river flows within the extended study area during some months of some years, particularly during summer when swimming activity is most likely and nonpeak-flow periods when wade angling activity is most likely, could result in more difficult swimming and wading conditions. These activities could become more hazardous, and thus

less attractive to river users. However, given the timing of the likely flow increases under CP1, the conditions under which such increases would occur, and the continuation of moderate flows even with the increase, adverse effects on swimmers and waders in the extended study area are unlikely. This impact would be less than significant.

Even during the lowest flow months of late summer and early fall, average flow in the more downstream portions of the Sacramento River is around 10,000 cfs; average flow is much higher at other times of the year. As a result, swimming and wading are not common activities on the river in much of the extended study area, where the most common uses are boating and bank angling.

CalSim-II modeling results indicate that, during some months of some years, the magnitude of flow increases in the Sacramento River associated with CP1 may be as large as about 29 percent at Verona and 23 percent below Wilkins Slough and below Freeport. However, the largest changes would occur primarily during mid- and late summer and early fall (July to September), and primarily during drier-than-normal years, when flows are normally relatively low. Thus, even with the flow increases, flows would remain moderate (12,000 to 15,000 cfs at Verona and 15,000 to 20,000 cfs below Freeport).

CalSim-II modeling results indicate that the magnitude of flow increases in the Feather River below Thermalito Afterbay associated with CP1 may be as large as 43 percent. However, the largest increases would occur during mid- and late summer and early fall and primarily during drier-than-normal years, when flows are often lower than average. Flows would remain moderate (2,200 to 7,600 cfs) with the increases. CalSim-II modeling results also indicate that flows in the American River at the H Street Bridge (below Folsom Lake) would also be substantially increased during some months of some years, but would remain moderate. Some of the potential flow increases in the Sacramento, Feather, and American rivers would be substantial; however, adverse effects on swimming and wading appear to be unlikely. Therefore, this impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact Rec-15 (CP1): Increased Difficulty for Boaters and Anglers in Using the Sacramento River and Rivers Below CVP and SWP Reservoirs as a Result of Decreased River Flows Reduced mean monthly flows during fall and winter low-flow periods when wade angling activity is most common, and during summer and fall when boating and river floating is popular in some areas, could have adverse effects if reduced flows were to reduce fishing success or boating navigability. Given the modest flow decreases in the Sacramento River associated with CP1 and the timing of the changes, effects on these recreation uses of the Sacramento River in the extended study area are unlikely. However, given the magnitude and timing of the largest flow decreases during some years on the Feather and American rivers below CVP and SWP reservoirs in the extended study area, adverse effects may occur. This impact would be potentially significant.

CalSim-II results indicate that the magnitude of mean monthly flow decreases that would occur in some years in the Sacramento River below Wilkins Slough, at Verona, and below Freeport associated with CP1 is small (generally less than 8 percent) and equate to elevation (stage) decreases of no more than about 6 inches. The largest changes would occur during mid- and late fall and early winter (October through December) rather than in the summer months, when boating activity is highest. Wade angling is not common on most of the river in the extended study area, because of the depth and volume of the river, among other factors. As a result of these factors, adverse effects on boating or angling from the flow decreases appear to be unlikely.

CalSim-II results indicate that mean monthly flows in the Feather River below Thermalito Afterbay would be reduced in some years by as much as 31 percent during late fall through spring (November through May), particularly during drier-than-normal years. Use is generally lower during that period than during the summer and early and mid-fall; however, some boating and angling activity occurs on the Feather River during those months, and that activity could be adversely affected if navigability or angling success were to be hampered by reduced flow and shallower water.

CalSim-II results indicate that mean monthly flows in the American River at the H Street Bridge (below Folsom Lake) would also be reduced by as much as 10 to 32 percent in some months of some years, primarily during summer to mid-fall (June through October). In general, the effect would be to reduce flows during periods when the flows are already below average. This may adversely affect boating and angling on the river if navigability or angling success is hampered by reduced flow and shallower water.

For the reasons described above, this impact would be potentially significant. Mitigation for this impact is proposed in Section 18.3.5.

CP2 – 12.5-Foot Dam Raise, Anadromous Fish Survival and Water Supply Reliability

Like CP1, by increasing storage at Shasta Lake, CP2 would change the full pool elevation at Shasta Lake, and the seasonal pool elevations and the flow regime in the Sacramento River and potentially several other reservoirs and downstream waterways. In turn, these alterations to reservoir pool elevations and river flows could affect the usability of some types of recreation facilities on the lake and downstream waterways, particularly marinas, boat ramps, and nearshore campgrounds and day-use areas. These alterations could also affect the ability of recreationists to use the reservoirs and waterways for boating, camping, fishing, and similar activities.

The full pool elevation of Shasta Lake would increase by 14.5 feet and the pool elevation would average as much as 12 to 17 feet higher than under existing (2005) and No-Action Alternative (2030) conditions at various times of the year. The greatest change would occur during the wettest years.

Raising the dam by 12.5 feet would increase the surface area of the reservoir at full pool by about 1,750 acres (6 percent). The width of the water body would not increase substantially in most areas, and much of the increase would occur during spring rather than during the high-traffic summer boating period.

In general, the proposed changes in flow and river stage on the upper Sacramento River associated with CP2 are similar to but slightly greater than the changes associated with CP1, as outlined above.

Reservoir- and river-based recreation facilities and activities in the primary and extended study areas downstream from Shasta Lake are similar; thus potential reservoir and river recreation impacts would be similar. However, changes to the flow regime affecting reservoirs and rivers in the extended study area would be increasingly attenuated by flows from tributary waterways and other water sources and diversions that are unaffected by the project, reducing the level of impacts.

Shasta Lake and Vicinity

Impact Rec-1 (CP2): Seasonal Inundation of Shasta Lake Recreation Facilities or Portions of Recreation Facilities and Public Access at Pool Elevations Above the Current Full Pool Elevation Substantial effects from inundation of recreation facilities or portions of Shasta Lake facilities would result from the 14.5-foot increase in full pool elevation associated with the 12.5-foot dam raise. The reservoir would fill to the new full pool elevation of 1,081.5 feet in some years, and would fill to an elevation greater than the current full pool elevation of 1,067 feet in many years. In each case portions of existing recreation facilities on the shoreline would be inundated. However, construction activities would include relocation of affected recreation facilities. Replacement facilities would be of equivalent quality to affected facilities and provide comparable shoreline access, where applicable, and would comply with ADA and ABA guidelines. Therefore, this impact would be less than significant.

Within each of the three arms of Shasta Lake with recreation development, effects on individual recreation facilities under CP2 would vary. These effects would range from no effect to effects on several of the facilities' inventoried and mapped features (e.g., roads, parking, and restrooms or other buildings) and on features not specifically inventoried (e.g., campsites and picnic sites). Anticipated effects of CP2 on inventoried and mapped (developed) recreation facilities are shown in Table 18-5.

Table 18-5. Effects of CP2 on Developed Recreation Facilities at Shasta Lake

Facility Name	Explanation of Effects on Facility at Full Pool Elevation
Sacramento River Arm	
Boat Ramps	
1. Antlers Public Boat Ramp	Boat ramp length shortened but usable; courtesy dock and rail would also be affected
2. Centimudi Public Boat Ramp	Boat ramp and lower parking entirely affected, part of access road to ramp and lower parking affected
Campgrounds	
1. Antlers Campground	All features are above full pool elevation; shoreline erosion may threaten portions of site
2. Gregory Creek Campground	One restroom, part of campground road, and shoreline campsites affected
3. Lakeshore East Campground	One restroom, lower half of campground road, and several campsites affected
4. Nelson Point Campground	Campground road and some campsites affected
Day-Use Areas	
1. Fisherman's Point Day Use Area	Parking and restroom unaffected but most picnic sites affected; also loss of access to shoreline trail
2. Salt Creek Swim Area (nonoperational)	Restroom and portion of paved pathway affected
Marinas	
1. Antlers Resort and Marina	Generator/pumphouse building and boat ramp/dock access road affected
2. Digger Bay Marina	Bottom portion of marina access road/ramp affected, but appears to remain usable
3. Shasta Marina Resort	Two buildings (office and equipment shed) affected, most of parking and access roads affected
4. Sugarloaf Resort and Marina	Electrical service building and associated structures affected, boat ramp and unpaved parking areas partially affected
Resorts (Nonmarina)	
1. Lakeshore Inn and RV Park	Shoreline campsites and walkway, and underground septic system may be affected
2. Salt Creek Resort and RV Park	Resort unaffected; old road bed used as boat ramp (outside resort) affected
3. Shasta Lake RV Resort	Entire facility appears to be unaffected
4. Sugarloaf Cottages Resort	Four cottages and large portion of unpaved shoreline access roads affected
5. Tsasdi Resort	Three cabins and entrance and exit roads connecting to Lakeshore Drive affected

Table 18-5. Effects of CP2 on Developed Recreation Facilities at Shasta Lake (contd.)

Facility Name	Explanation of Effects on Facility at Full Pool Elevation
1. USFS Lakeshore Fire Station	Five buildings and entrance road affected (entire facility)
2. Dry Creek Trail and Trailhead	Beginning of trail and access road/trailhead parking entirely affected
McCloud River Arm	
Boat Ramps	
1. Bailey Cove Boat Ramp and Day Use Area	Boat ramp entirely affected, parking area, day-use area, and access road partially affected
2. Hirz Bay Public Boat Ramp	Boat ramp and lower parking area, restroom, entirely affected
Campgrounds	
1. Bailey Cove Campground	No effects – entire facility is above full pool elevation
2. Dekkas Rock Campground	Lower part of loop road and portion of group camp affected
3. Ellery Creek Campground	Lower portion of loop road and shoreline campsites affected
4. Hirz Bay Campgrounds	No effects – entire facility is above full pool elevation
5. Kamloop Camp (private organization)	No effects – entire facility is above full pool elevation
6. McCloud Bridge Campground	One restroom, lower part of camp loop and shoreline campsites affected
7. Moore Creek Campground	Lower portion of loop road, shoreline campsites likely affected
8. Pine Point Campground	Possible that some shoreline campsites affected
Day-Use Areas	
1. Dekkas Rock Day Use Area	Lower portion of loop road and parking affected
2. McCloud Bridge Day Use Area	Most of picnic sites affected
Marinas	
1. Holiday Harbor Marina	Three buildings, boat ramp, and tank affected, some overflow parking affected; RV park and road to RV park affected
2. Lakeview Marina	Five buildings and tank affected, access to buildings affected
Other Facilities	
1. Bollibokka Club	No effects – entire facility is above the full pool elevation
2. Campbell Creek Cove cabins	At least five cabins affected; possibly others also affected
3. Shasta Caverns ferry landing	Two buildings at east landing affected, access roads serving east and west shore landings partially affected
4. USFS Station (Turntable Bay)	Four buildings and access road affected

Table 18-5. Effects of CP2 on Developed Recreation Facilities at Shasta Lake (contd.)

Facility Name	Explanation of Effects on Facility at Full Pool Elevation
Pit River Arm	
Boat Ramps	
1. Jones Valley Public Boat Ramp	Boat ramp and turnaround area at top of ramp entirely affected, access road to parking lot partially affected
2. Packers Bay Public Boat Ramp	Boat ramp and restroom, information shelter, and pump house buildings affected, portion of parking affected
Campgrounds	
1. Lower Jones Valley Campground	One restroom building and trail footbridge affected, camp loop road and campsites partially affected
2. Upper Jones Valley Campground	No effects – entire facility is above full pool elevation
Marinas	
1. Bridge Bay Resort and Marina	Most of facility – Including eight buildings, boat ramp, parking lots, and roads – affected
2. Jones Valley Resort	Three buildings, parking area, ramp, and shoreline access roads affected
3. Packers Bay Marina	Access road from public ramp affected, boat ramp partially affected
4. Silverthorn Resort	Parking and ramp affected, shoreline access road partially affected

Source: Reclamation 2003; data provided by EDAW (now AECOM) in 2007

Key:
RV = recreational vehicle
USFS = U.S. Forest Service

Under CP2, the recreation facilities on the Sacramento River Arm that would be subject to effects on several features or a substantial portion of the facility's use area are one of the two boat ramps, one of the four campgrounds, two of the four marinas, three of the five nonmarina resorts, and the two day-use areas. The USFS Lakeshore Fire Station and the Dry Creek trailhead would also be subject to major effects.

On the McCloud River Arm, many of the major facilities would be subject to effects on several features or on a substantial portion of the facility's use area: both public boat ramps, all three day-use areas, both marinas, and one of seven campgrounds. Other facilities affected to a similar degree are the USFS station at Turntable Cove, the Shasta Caverns Tour facilities on the east and west shores, and several of the cabins within the recreation residence tract on the east shore at Campbell Creek Cove.

All but one of the public and commercial recreation facilities on the Pit River Arm would be subject to major effects under CP2 – both boat ramps, all four

marinas, and one of the two campgrounds. On the Squaw Creek Arm, one private cabin within the Didallas recreation residence tract would be affected. Although they are not included in the table because of a lack of permanent infrastructure, shoreline camping areas at Beehive Point (Sacramento River Arm) and Mariner Point (Pit River Arm) would also be subject to substantial effects with the inundation of unpaved access roads and use areas. The four boat-in camps on Shasta Lake could also be affected, but the only permanent infrastructure at the boat-in camps is vault toilets. Information about the location of the campsites and vault toilets at the boat-in camps is not available.

Thus, the most prominent direct effects on recreation facilities and public access at Shasta Lake and in the vicinity under CP2 would be the major effects on five of six boat ramps, eight of 10 marinas, two of five resorts, three of 13 public campgrounds, and four of five day-use areas. Other facilities subject to major effects are USFS stations on the Sacramento River and McCloud River arms, the Dry Creek and Clickapudi trailheads near Shasta Dam and on the Pit River Arm, and the Shasta Caverns ferry landing and several private cabins on the McCloud River Arm. Table 18-6 summarizes the number of recreation facilities of specific types substantially affected.

Table 18-6. Tally of Shasta Lake Recreation Facilities Substantially Affected by CP2

Type of Facility	Number of Facilities Affected
Boat ramp	5
Marina	8
Resort	2
Campground (family)	3
Group campground	1
Day-use area	4
USFS operations	2
Trailhead	2
Recreation residence tract	1
Commercial tour	1

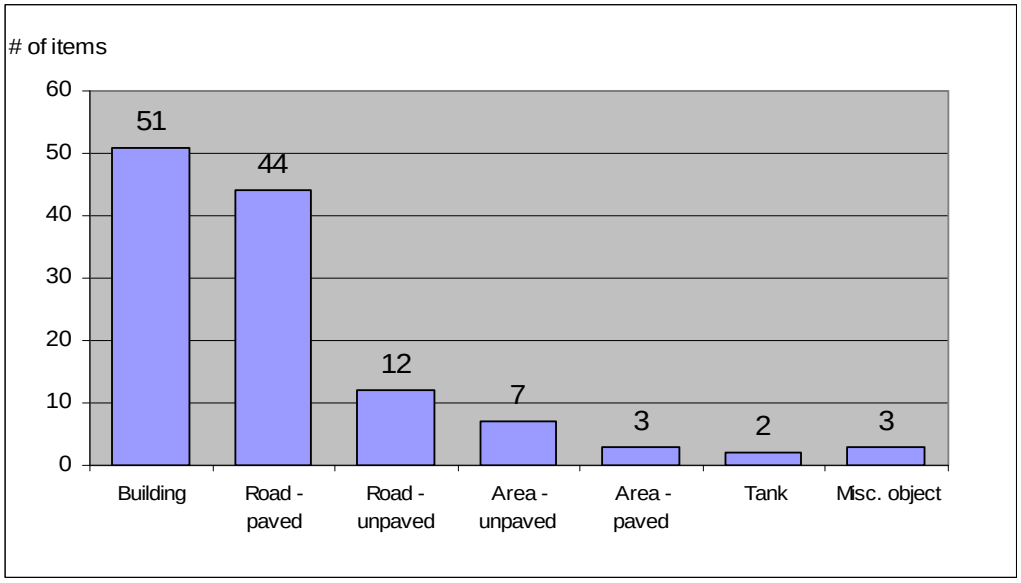
Source: Reclamation 2003; data provided by EDAW (now AECOM) in 2007

Key:
USFS = U.S. Forest Service

Somewhat lesser effects would occur at several campgrounds and one marina. Minor effects would occur at additional facilities of several types.

Figure 18-4 depicts the total number of inventoried Shasta Lake recreation facility items, at all recreation facilities combined, that would be affected by inundation under CP2. A total of 122 facility and infrastructure elements would be affected, with more than three-fourths of those being buildings and segments of paved roads. A lesser number of unpaved road segments, paved and unpaved

areas (usually parking areas), tanks, and miscellaneous objects would also be affected.



Source: Reclamation 2003

Figure 18-4. Number of Recreation Facility Infrastructure Items Affected by a 12.5-Foot Dam Raise Under CP2

As described in Section 2.4.2 in Chapter 2, "Alternatives," construction activities under all action alternatives would include relocation of affected recreation facilities. This could include relocation of affected portions of facilities within existing use areas, in adjacent undeveloped areas, or at new sites in the same general vicinity of the lake. Because of consolidation of facilities, the total number of facilities of specific types may be reduced. However, all affected recreation capacity would be replaced. Replacement facilities would be of equivalent quality to affected facilities and provide comparable shoreline access, where applicable. With the relocation of affected facilities, this impact would be less than significant.

Recreation is highly important to the Shasta Lake area. Therefore, mitigation is included to uphold the completion of all actions related to the relocation of affected recreation facilities in order to maintain recreation capacity at Shasta Lake, as included in the project description.

Impact Rec-2 (CP2): Temporary Construction-Related Disruption of Recreation Access and Activities at and near Shasta Dam Construction activity at Shasta Dam that would be necessary to raise the dam and complete related modifications would prevent recreation visitors from crossing the dam, as is possible now with a permit from Reclamation, and thus could affect other recreation activities in the area. These effects are expected only during the construction period. However, this impact would be potentially significant.

This impact would be similar to Impact Rec-2 (CP1). If the increased dam-raise height relative to CP1 (12.5 feet versus 6.5 feet under CP1) would substantially lengthen the period during which construction would occur or otherwise increase construction-related disruption in the dam area, the effects described under CP1 could be increased. This impact would be potentially significant. Mitigation for this impact is proposed in Section 18.3.5.

Impact Rec-3 (CP2): Effects on Boating and Other Recreation Use and Enjoyment of Shasta Lake as a Result of Changes in the Annual Drawdown of the Reservoir An increase in the magnitude or rate or changes in the timing of the annual summer and fall drawdown of Shasta Lake could adversely affect boating enjoyment and safety on the reservoir. Conversely, a reduced or slower drawdown could have beneficial effects. However, under CP2, reservoir operations would mimic existing operations, with little change in annual magnitude, rate, or timing of reservoir drawdown. Therefore, this impact would be less than significant.

This impact would be similar to Impact Rec-3 (CP1) and would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact Rec-4 (CP2): Increased Hazards to Boaters and Other Recreationists at Shasta Lake from Standing Timber and Stumps Remaining in Untreated Areas of the Inundation Zone At full pool, the increased pool elevation would result in approximately 1,167 acres of newly inundated area where the existing trees and other vegetation would not be removed. Anglers would generally benefit from the associated enhancement of fish habitat; however, the standing trees and stumps that would remain in these areas would increase the number of areas and total area where this type of hazard to boaters and other recreation visitors would exist. Therefore, this impact would be significant.

Approximately 1,167 acres (67 percent) of the 1,750 acres of newly inundated area that would result from the 12.5-foot dam raise at full pool would receive no vegetation treatment (no vegetation removed), to maximize the habitat benefits of inundated and residual vegetation. In general, this impact would be similar to Impact Rec-4 (CP1), although the total area where the potential hazard from remaining trees and stumps would be greater under CP2. Because the untreated areas of the new inundation zone would represent an increased hazard to boaters and potentially other types of recreationists, this impact would be significant. Mitigation for this impact is proposed in Section 18.3.5.

Upper Sacramento River (Shasta Dam to Red Bluff)

Impact Rec-5 (CP2): Seasonal Inundation of Portions of Recreation Facilities or Informal River Access Sites as a Result of Increased River Flows Within the upper Sacramento River portion of the primary study area, inundation of recreation facilities or portions of recreation facilities, such as boat launch ramps and unimproved riverbank sites used for boat launching and other activities, could result from increased mean monthly river flows associated with

project implementation and operation. In general, the increases in flow that would occur in some years would be expected to be small (5 percent or less); the area of inundation beyond that which would occur under existing conditions and the No-Action Alternative would be likewise small. As a result, the adverse effects are unlikely to be substantial. This impact would be less than significant.

This impact would be similar to but slightly greater than Impact Rec-5 (CP1), because the alteration of the flow regime of the Sacramento River under CP2 would be more substantial than under CP1. This impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact Rec-6 (CP2): Increased Difficulty for Boaters in Using the Sacramento River as a Result of Increased River Flows Increased mean monthly flows within the primary study area, particularly during summer and fall when boating activity is most likely, could result in more difficult conditions for boat launching and boating on the Sacramento River. Depending on the time of year and base river flows, increased flow may also have beneficial effects. Because the magnitude of flow increases associated with CP2 would be small (generally less than 5 percent), adverse effects on boaters within the primary study area are unlikely. This impact would be less than significant.

This impact would be similar to but slightly greater than Impact Rec-6 (CP1), because the alteration of the flow regime of the Sacramento River under CP2 would be more substantial than under CP1. This impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact Rec-7 (CP2): Increased Difficulty for Swimmers and Waders in Using the Sacramento River as a Result of Increased River Flows Increased mean monthly flows within the upper Sacramento River, particularly during summer when swimming activity is most likely and during fall and winter nonpeak-flow periods when wade angling activity is most likely, could result in more difficult swimming and wading conditions. Increased flows can make swimming and wading more challenging and potentially more hazardous. The magnitude of flow increases associated with CP2 would be small (generally less than 5 percent), and the timing of the increases would be such that adverse effects on angling waders within the primary study area are unlikely. Swimming is not a common activity on the main channel of the river because of cold-water temperatures. As a result, this impact would be less than significant.

This impact would be similar to but slightly greater than Impact Rec-7 (CP1), because the alteration of the flow regime of the Sacramento River under CP2 would be more substantial than under CP1. This impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact Rec-8 (CP2): Increased Usability of the Sacramento River for Boating and Water-Contact Recreation as a Result of Decreased River Flows Decreased mean monthly flows within the primary study area, particularly

during summer when boating and swimming activity is most likely and during fall and winter low-flow periods when wade angling activity is most likely, could result in enhanced boating, swimming, and wading conditions. Decreased flows during normally high-flow periods can make boating less challenging and potentially less hazardous. The magnitude of flow decreases associated with CP2 would be small (generally less than 10 percent), and the timing of the decreases (fall and winter months) would be such that effects on boaters, swimmers, and waders within the primary study area are unlikely. As a result, this impact would be less than significant.

This impact would be similar to but slightly greater than Impact Rec-8 (CP1), because the alteration of the flow regime of the Sacramento River under CP2 would be more substantial than under CP1. This impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact Rec-9 (CP2): Enhanced Angling Opportunities in the Upper Sacramento River as a Result of Improved Flows and Reduced Water Temperatures Project operation would result in improved flow and water temperature conditions in the upper Sacramento River, which would benefit all four Chinook salmon runs. This would result in enhanced populations of these game fish in the river, which would provide enhanced sport angling opportunities. This impact would be beneficial.

This impact would be similar to Impact Rec-9 (CP1) and would be beneficial. Mitigation for this impact is not needed, and thus not proposed.

Impact Rec-10 (CP2): Disruption of Sacramento River Boating and Access Resulting from the Gravel Augmentation Program The proposed gravel augmentation program would not be implemented under CP2. Therefore, no impact would occur. Mitigation for this impact is not needed, and thus not proposed.

Impact Rec-11 (CP2): Changes in Usability of Reading Island Fishing Access Boat Ramp and Enhanced Recreation at Reading Island The proposed restoration of Sacramento River flow through Anderson Slough at Reading Island, rehabilitation of the Reading Island boat ramp for use by motorized boats, and construction of a handicap fishing access area would not be implemented under CP2. Therefore, no impact would occur. Mitigation for this impact is not needed, and thus not proposed.

Lower Sacramento River and Delta and CVP/SWP Service Areas

Impact Rec-12 (CP2): Seasonal Inundation of Portions of River Recreation Facilities or Informal River Access Sites on the Lower Sacramento River and Rivers Below CVP and SWP Reservoirs as a Result of Increased River Flows Within the extended study area, inundation of recreation facilities or portions of recreation facilities, such as boat launch ramps and unimproved riverbank sites used for boat launching and other activities, could result if increased mean

monthly river flows were to occur in some months of some years as a result of project implementation and operation under CP2. However, even with the increases, flows on the Sacramento, Feather, and American rivers would remain moderate and well below normal winter and spring high flows. As a result, adverse effects on river facilities or informal use areas within the extended study area are unlikely. This impact would be less than significant.

This impact would be similar to but slightly greater than Impact Rec-12 (CP1), because the alteration of flow regimes of the lower Sacramento River and rivers below CVP and SWP reservoirs would be more substantial than under CP1. This impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact Rec-13 (CP2): Increased Difficulty for Boaters in Using the Lower Sacramento River and Rivers Below CVP and SWP Reservoirs as a Result of Increased River Flows Increased mean monthly flows within the extended study area, particularly during summer and fall when boating activity is most likely, could result in more difficult conditions for boat launching and boating on the Sacramento River and other rivers affected by the project. Depending on the time of year and base river flows, increased flow may also have beneficial effects on boating by reducing shallow bars and riffles, thus improving navigability. However, the timing and flow conditions under which the flow increases are likely to occur on the Sacramento, Feather, and American rivers under CP2 and the continuation of moderate flows even with the increase suggest that adverse effects on boaters within the extended study area are unlikely. This impact would be less than significant.

Hydrologic changes in more distant areas of the CVP/SWP service areas resulting from CP2 cannot be accurately predicted but would be small. Such slight changes occur on a dynamic and daily basis under existing conditions as water is moved throughout California. Other CVP and SWP reservoir elevations, canal flows, and flows below the reservoirs could be modified slightly, but any resulting impacts on recreation would be negligible and speculative.

This impact would be similar to but slightly greater than Impact Rec-13 (CP1), because the alteration of flow regimes of the lower Sacramento River and rivers below CVP and SWP reservoirs would be more substantial than under CP1. This impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact Rec-14 (CP2): Increased Difficulty for Swimmers and Waders in Using the Sacramento River and Rivers Below CVP and SWP Reservoirs as a Result of Increased River Flows Increased mean monthly river flows within the extended study area during some months of some years, particularly during summer when swimming activity is most likely and nonpeak-flow periods when wade angling activity is most likely, could result in more difficult swimming

and wading conditions. These activities could become more hazardous and thus less attractive to river users. However, given the timing of the likely flow increases under CP2, the flow conditions under which such increases would occur, and the continuation of moderate flows even with the increase, adverse effects on swimmers and waders within the extended study area are unlikely. This impact would be less than significant.

This impact would be similar to but slightly greater than Impact Rec-14 (CP1), because the alteration of flow regimes of the lower Sacramento River and rivers below CVP and SWP reservoirs would be more substantial than under CP1. This impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact Rec-15 (CP2): Increased Difficulty for Boaters and Anglers in Using the Sacramento River and Rivers Below CVP and SWP Reservoirs as a Result of Decreased River Flows Reduced mean monthly flows during fall and winter low-flow periods when wade angling activity is most common, and during summer and fall when boating and river floating is popular in some areas, could have adverse effects if reduced flows were to reduce fishing success or boating navigability. Given the modest flow decreases in the Sacramento River associated with CP2 and the timing of the changes, effects on these recreation uses of the Sacramento River within the extended study area are unlikely. However, given the magnitude and timing of the largest flow decreases during some years on the Feather and American rivers below CVP and SWP reservoirs in the extended study area, adverse effects may occur. This impact would be potentially significant.

This impact would be similar to but slightly greater than Impact Rec-15 (CP1), because the alteration of flow regimes of the lower Sacramento River and rivers below CVP and SWP reservoirs would be more substantial than under CP1. This impact would be potentially significant. Mitigation for this impact is proposed in Section 18.3.5.

CP3 – 18.5-Foot Dam Raise, Anadromous Fish Survival and Water Supply

Like each of the alternatives discussed above, by altering storage and operations at Shasta Lake, CP3 would change the full pool elevation at Shasta Lake, and the seasonal pool elevations and the flow regime in the Sacramento River and potentially several other reservoirs and downstream waterways. In turn, these alterations to reservoir pool elevations and river flows could affect the usability of some types of recreation facilities on the lake and downstream waterways, particularly marinas, boat ramps, and nearshore campgrounds and day-use areas. These alterations could also affect the ability of recreationists to use the reservoirs and waterways for boating, camping, fishing, and similar activities.

The full pool elevation of Shasta Lake would increase by 20.5 feet and the pool elevation would average as much as 18 to 24 feet higher than under existing (2005) and No-Action (2030) conditions at various times of the year. The

greatest change would occur during the wettest years. Raising the dam by 18.5 feet would increase the surface area of the reservoir at full pool by about 2,570 acres (9 percent). The width of the water body would not increase substantially in most areas, and much of the increase would occur during spring rather than during the high-traffic summer boating period.

In general, the changes in flow and river stage on the upper Sacramento River associated with CP3 are more substantial than the changes associated with CP1 and CP2. However, these changes are still within a few percentage points of the changes associated with CP1 and CP2, as outlined above.

Reservoir- and river-based recreation facilities and activities in the primary and extended study areas downstream from Shasta Lake are similar; thus potential reservoir and river recreation impacts would be similar. However, changes to the flow regime affecting reservoirs and rivers in the extended study area would be increasingly attenuated by flows from tributary waterways and other water sources and diversions that are unaffected by the project, reducing the level of impacts.

Shasta Lake and Vicinity

Impact Rec-1 (CP3): Seasonal Inundation of Shasta Lake Recreation Facilities or Portions of Recreation Facilities and Public Access at Pool Elevations Above the Current Full Pool Elevation Substantial effects from inundation of recreation facilities or portions of Shasta Lake facilities, such as boat launch ramps, campgrounds, marinas, and day-use areas, would result from the 20.5-foot increase in full pool elevation associated with the 18.5-foot dam raise. The reservoir would fill to the new full pool elevation of 1,087.5 feet in some years, and would fill to an elevation greater than the current full pool elevation of 1,067 feet in many years. In each case, portions of existing recreation facilities on the shoreline would be inundated. However, construction activities would include relocation of affected recreation facilities. Replacement facilities would be of equivalent quality to affected facilities and provide comparable shoreline access, where applicable, and would comply with ADA and ABA guidelines. Therefore, this impact would be less than significant.

Within each of the three arms of Shasta Lake with recreation development, effects on individual recreation facilities under CP3 would vary. These effects would range from no effect to effects on several of the facilities' inventoried and mapped features (e.g., roads, parking, and restrooms or other buildings) and on features not specifically inventoried (e.g., campsites and picnic sites). Anticipated effects of CP3 on inventoried and mapped (developed) recreation facilities are shown in Table 18-7.

Table 18-7. Effects of CP3 on Developed Recreation Facilities at Shasta Lake

Facility Name	Explanation of Effects on Facility at Full Pool Elevation
Sacramento River Arm	
Boat Ramps	
1. Antlers Public Boat Ramp	Boat ramp entirely affected; courtesy dock and rail would also be affected; restroom may be affected; parking lot is primarily unaffected
2. Centimudi Public Boat Ramp	Boat ramp and lower parking entirely affected, part of access road to ramp and lower parking affected
Campgrounds	
1. Antlers Campground	Amphitheater may be affected; shoreline erosion may threaten portions of site
2. Gregory Creek Campground	Two restrooms, lower half of campground road, and associated campsites affected
3. Lakeshore East Campground	One restroom and majority of campground road and campsites affected
4. Nelson Point Campground	Most of campground road and several campsites affected
Day-Use Areas	
1. Fisherman's Point Day Use Area	Parking and restroom unaffected but most picnic sites affected; also loss of access to shoreline trail
2. Salt Creek Swim Area (nonoperational)	Two restrooms, bathhouse, and paved pathways affected
Marinas	
1. Antlers Resort and Marina	Generator/pumphouse building and boat ramp/dock access road affected
2. Digger Bay Marina	One building affected; lower portion of marina access road/ramp affected, but appears to remain usable
3. Shasta Marina Resort	Three buildings (office, equipment shed, residence) affected; most parking and access roads affected
4. Sugarloaf Resort and Marina	Electrical service building and associated structures affected, boat ramp and unpaved parking areas partially affected

Table 18-7. Effects of CP3 on Developed Recreation Facilities at Shasta Lake (contd.)

Facility Name	Explanation of Effects on Facility at Full Pool Elevation
Resorts (Nonmarina)	
1. Lakeshore Inn and RV Park	Shoreline campsites and walkway, storage building, cabin, covered patio area affected; underground septic system may be affected
2. Creek Resort and RV Park	Resort unaffected; old road bed used as boat ramp (outside resort) affected
3. Shasta Lake RV Resort	Resort office affected
4. Sugarloaf Cottages Resort	Seven cottages and large portion of unpaved cabin and shoreline access roads affected
5. Tsasdi Resort	Five cabins and entrance and exit roads connecting to Lakeshore Drive affected
Other Facilities	
1. USFS Lakeshore Fire Station	Five buildings and entrance road affected (entire facility)
2. Dry Creek Trail and Trailhead	Beginning of trail and access road/trailhead parking entirely affected
McCloud River Arm	
Boat Ramps	
1. Bailey Cove Boat Ramp and Day Use Area	Boat ramp, parking area, day-use area, and access road entirely affected
2. Hirz Bay Public Boat Ramp	Boat ramp and lower parking area, restroom entirely affected
Campgrounds	
1. Bailey Cove Campground	Access road from ramp/day-use area affected
2. Dekkas Rock Campground	Loop road and associated portion of group camp affected
3. Ellery Creek Campground	Most of loop road and associated campsites affected
4. Hirz Bay Campgrounds	No effect – entire facility is above full pool elevation
5. Kamloop Camp (private organization)	One building affected
6. McCloud Bridge Campground	Entire facility – two restrooms, camp loop road, and associated campsites – affected
7. Moore Creek Campground	Lower portion of loop road and shoreline campsites appear to be affected
8. Pine Point Campground	Possible that some shoreline campsites affected

Table 18-7. Effects of CP3 on Developed Recreation Facilities at Shasta Lake (contd.)

Facility Name	Explanation of Effects on Facility at Full Pool Elevation
Day-Use Areas	
1. Dekkas Rock Day Use Area	Loop road and associated picnic sites and parking affected
2. McCloud Bridge Day Use Area	Entire facility, including picnic sites and restroom, affected
Marinas	
1. Holiday Harbor Marina	Entire facility, including three buildings, boat ramp, and tank affected; most parking, RV park, and road to RV park affected
2. Lakeview Marina	Entire facility, including five buildings, tank, paved access roads affected
Other Facilities	
1. Bollibokka Club	Facility appears to be unaffected; McCloud River Arm would extend near one building and one miscellaneous object, which may be affected
2. Campbell Creek Cove cabins	At least seven cabins affected; possibly others also affected
3. Shasta Caverns ferry landing	Most of east and west side landings affected; two buildings at east landing, and access roads serving east and west shore landings also affected
4. USFS Station (Turntable Bay)	Entire facility, including four buildings and access road, affected
Pit River Arm	
Boat Ramps	
1. Jones Valley Public Boat Ramp	Boat ramp and turnaround area at top of ramp entirely affected, access road to parking lot partially affected
2. Packers Bay Public Boat Ramp	Boat ramp and restroom, information shelter, and pump house buildings affected; large portion of parking affected
Campgrounds	
1. Lower Jones Valley Campground	One restroom building, trail footbridge, and large portion of camp loop road and associated campsites affected
2. Upper Jones Valley Campground	No effects – entire facility is above full pool elevation

Table 18-7. Effects of CP3 on Developed Recreation Facilities at Shasta Lake (contd.)

Facility Name	Explanation of Effects on Facility at Full Pool Elevation
Marinas	
1. Bridge Bay Resort and Marina	Nearly entire facility – eight buildings, boat ramp, parking lots, and access roads – affected
2. Jones Valley Resort	Most of facility – five buildings, parking area, ramp, and shoreline access roads – affected
3. Packers Bay Marina	Access road from public ramp and marina ramp affected
4. Silverthorn Resort	Most of facility – resort office and restaurant building, parking, ramp, and shoreline access road – affected

Source: Reclamation 2003; data provided by EDAW (now AECOM) in 2007

Key:
RV = recreational vehicle
USFS = U.S. Forest Service

Under CP3, nearly all of the public and commercial recreation facilities on the Sacramento River Arm would be subject to effects on several features or a substantial portion of the facility's use area. One of the two boat ramps, three of the four campgrounds, two of the four marinas, three of the five nonmarina resorts, and the one operational day-use area would all be subject to these major effects. The USFS Lakeshore Fire Station and the Dry Creek trailhead and trail would also be subject to a major effect, as would the Salt Creek Swim Area, which is currently not operational but used on occasion for overflow camping and as a base camp for firefighting crews. One marina and one nonmarina resort would be subject to lesser but still substantial effects and several of the remaining facilities would be subject to minor effects.

On the McCloud River Arm, both public boat ramps, all three day-use areas, both marinas, and two of seven campgrounds would be subject to major effects. Other facilities that would experience major effects are the USFS station at Turntable Cove, the Shasta Caverns Tour facilities on the east and west shores, and at least seven cabins on the east shore within the Campbell Creek Cove recreation residence tract.

Effects on recreation facilities on the Pit River Arm under CP3 are similar to those that would occur under CP2. All but one of the public and commercial recreation facilities – both boat ramps, all four marinas, and one of the two campgrounds – would be subject to major effects. On the Squaw Creek Arm, one cabin within the Didallas recreation residence tract would be affected.

Shoreline camping areas at Beehive Point (Sacramento River Arm) and Mariner Point (Pit River Arm) would also be subject to substantial effects, with the unpaved access roads and use areas mostly inundated. The four boat-in camps

on Shasta Lake would most likely also be affected. However, as noted previously, the only permanent infrastructure at the boat-in camps is vault toilets, and information about the locations of the campsites and vault toilets at the boat-in camps is not available. Thus, the most prominent direct effects on recreation facilities and public access at Shasta Lake and in the vicinity under CP3 would be the major effects on all six boat ramps, nine of 10 marinas, four of five nonmarina resorts, all five day-use areas, six of 13 public campgrounds, and one private campground. Other facilities subject to major effects are USFS stations on the Sacramento River and McCloud River arms, the Dry Creek Trail and trailhead near the dam, and the Shasta Caverns ferry landing and seven private cabins on the McCloud River Arm. Many of these facilities would be entirely or nearly inundated at the new full pool elevation associated with CP3. Table 18-8 summarizes the number of recreation facilities of specific types affected.

Table 18-8. Tally of Shasta Lake Recreation Facilities Substantially Affected by CP3

Type of Facility	Number of Facilities Affected
Boat ramp	6
Marina	9
Resort	4
Campground (family)	6
Group campground	1
Private campground	1
Day-use area	5
USFS operations	2
Trailhead	2
Recreation residence tract	2
Commercial tour	1

Source: Reclamation 2003; data provided by EDAW (now AECOM) in 2007

Key:
USFS = U.S. Forest Service

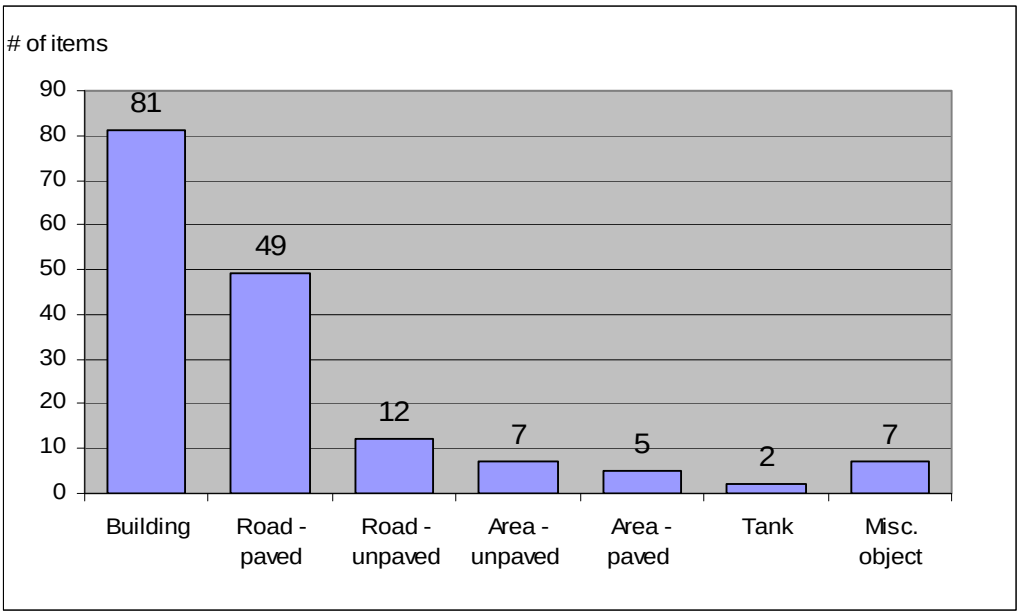
Somewhat lesser but still considerable effects would occur at one campground and one marina while relatively minor effects would occur at additional facilities of several types. Additional effects would occur at trailheads (most located at day-use areas or boat ramps addressed above) and at numerous segments of trail near the present shoreline.

Figure 18-5 depicts the total number of inventoried Shasta Lake recreation facility items, at all recreation facilities combined, that would be affected by inundation under CP3. A total of 163 facility and infrastructure elements would be affected, with more than three-fourths of those being buildings and segments of paved roads. A lesser number of unpaved road segments, paved and unpaved

areas (usually parking areas), tanks, and miscellaneous objects would also be affected.

As described in Section 2.4.2 in Chapter 2, "Alternatives," construction activities under all action alternatives would include relocation of affected recreation facilities. This could include relocation of affected portions of facilities within existing use areas, in adjacent undeveloped areas, or at new sites in the same general vicinity of the lake. Because of consolidation of facilities, the total number of facilities of specific types may be reduced. However, all affected recreation capacity would be replaced. Replacement facilities would be of equivalent quality to affected facilities and provide comparable shoreline access, where applicable. With the relocation of affected facilities, this impact would be less than significant.

Recreation is highly important to the Shasta Lake area. Therefore, mitigation is included to uphold the completion of all actions related to the relocation of affected recreation facilities in order to maintain recreation capacity at Shasta Lake, as included in the project description.



Source: Reclamation 2003

Figure 18-5. Number of Recreation Facility Infrastructure Items Affected by an 18.5-Foot Dam Raise Under CP3

Impact Rec-2 (CP3): Temporary Construction-Related Disruption of Recreation Access and Activities at and near Shasta Dam Construction activity at Shasta Dam that would be necessary to raise the dam and complete related modifications would prevent recreation visitors from crossing the dam, as is possible now with a permit from Reclamation, and thus could affect other

recreation activities in the area. These effects are expected only during the construction period. However, this impact would be potentially significant.

This impact would be similar to Impact Rec-2 (CP1). If the increased dam raise height relative to CP1 (18.5 feet versus 6.5 feet under CP1) would substantially lengthen the period during which construction would occur or otherwise increase construction-related disruption in the dam area, the effects described under CP1 could be increased. This impact would be potentially significant. Mitigation for this impact is proposed in Section 18.3.5.

Impact Rec-3 (CP3): Effects on Boating and Other Recreation Use and Enjoyment of Shasta Lake as a Result of Changes in the Annual Drawdown of the Reservoir An increase in the magnitude or rate or changes in the timing of the annual summer and fall drawdown of Shasta Lake could adversely affect boating enjoyment and safety on the reservoir. Conversely, a reduced or slower drawdown could have beneficial effects. However, under CP3, reservoir operations would mimic existing operations, with little change in annual magnitude, rate, or timing of reservoir drawdown. Therefore, this impact would be less than significant.

This impact would be similar to Impact Rec-3 (CP1) and would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact Rec-4 (CP3): Increased Hazards to Boaters and Other Recreationists at Shasta Lake from Standing Timber and Stumps Remaining in Untreated Areas of the Inundation Zone At full pool, the increased pool elevation would result in approximately 1,738 acres of newly inundated area where the existing trees and other vegetation would not be removed. Anglers would generally benefit from the associated enhancement of fish habitat; however, the standing trees and stumps that would remain in these areas would increase the number of areas and total area where this type of hazard to boaters and other types of recreation visitors would exist. Therefore, this impact would be significant.

Approximately 1,738 acres (68 percent) of the 2,570 acres of newly inundated area that would result from the 18.5-foot dam raise at full pool would receive no vegetation treatment (no vegetation removed), to maximize the habitat benefits of inundated and residual vegetation. In general, this impact would be similar to Impacts Rec-4 (CP1) and Rec-4 (CP2), although the total area where the potential hazard resulting from remaining trees and stumps would be greater under CP3. Because the untreated areas of the new inundation zone would represent an increased hazard to boaters and potentially other types of recreationists, this impact would be significant. Mitigation for this impact is proposed in Section 18.3.5.

Upper Sacramento River (Shasta Dam to Red Bluff)
Impact Rec-5 (CP3): Seasonal Inundation of Portions of Recreation Facilities or Informal River Access Sites as a Result of Increased River Flows Within the

upper Sacramento River portion of the primary study area, inundation of recreation facilities or portions of recreation facilities, such as boat launch ramps and unimproved riverbank sites used for boat launching and other activities, could result from increased mean monthly river flows associated with project implementation and operation. In general, the increases in flow that would occur in some years would be expected to be small (5 percent or less); the area of inundation beyond that which would occur under existing conditions and the No-Action Alternative would be likewise small. As a result, the adverse effects are unlikely to be substantial. This impact would be less than significant.

This impact would be similar to but greater than Impacts Rec-5 (CP1) and Rec-5 (CP2), because the alteration of flow regimes of the lower Sacramento River and rivers below CVP and SWP reservoirs would be greater than under CP1 and CP2. This impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact Rec-6 (CP3): Increased Difficulty for Boaters in Using the Sacramento River as a Result of Increased River Flows Increased mean monthly flows within the primary study area, particularly during summer and fall when boating activity is most likely, could result in more difficult conditions for boat launching and boating on the Sacramento River. Depending on the time of year and base river flows, increased flow may also have beneficial effects. Because the magnitude of flow increases associated with CP3 would be small (generally less than 5 percent), adverse effects on boaters within the primary study area are unlikely. This impact would be less than significant.

This impact would be similar to but greater than Impacts Rec-6 (CP1) and Rec-6 (CP2), because the alteration of flow regimes of the lower Sacramento River and rivers below CVP and SWP reservoirs would be greater than under CP1 and CP2. This impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact Rec-7 (CP3): Increased Difficulty for Swimmers and Waders in Using the Sacramento River as a Result of Increased River Flows Increased mean monthly flows within the upper Sacramento River, particularly during summer when swimming activity is most likely and during fall and winter nonpeak-flow periods when wade angling activity is most likely, could result in more difficult swimming and wading conditions. Increased flows can make swimming and wading more challenging and potentially more hazardous. The magnitude of flow increases associated with CP3 would be small (generally less than 5 percent), and the timing of the increases would be such that adverse effects on angling waders within the primary study area are unlikely. Swimming is not a common activity on the main channel of the river because of cold-water temperatures. As a result, this impact would be less than significant.

This impact would be similar to but greater than Impacts Rec-7 (CP1) and Rec-7 (CP2), because the alteration of flow regimes of the lower Sacramento River

and rivers below CVP and SWP reservoirs would be greater than under CP1 and CP2. This impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact Rec-8 (CP3): Increased Usability of the Sacramento River for Boating and Water-Contact Recreation as a Result of Decreased River Flows Decreased mean monthly flows within the primary study area, particularly during summer when boating and swimming activity is most likely and during fall and winter low-flow periods when wade angling activity is most likely, could result in enhanced boating, swimming, and wading conditions. Decreased flows during normally high-flow periods can make boating less challenging and potentially less hazardous. The magnitude of flow decreases associated with CP3 would be small (generally less than 10 percent), and the timing of the decreases (fall and winter months) would be such that effects on boaters, swimmers, and waders within the primary study area are unlikely. As a result, this impact would be less than significant.

This impact would be similar to but greater than Impacts Rec-8 (CP1) and Rec-8 (CP2), because the alteration of flow regimes of the lower Sacramento River and rivers below CVP and SWP reservoirs would be greater than under CP1 and CP2. This impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact Rec-9 (CP3): Enhanced Angling Opportunities in the Upper Sacramento River as a Result of Improved Flows and Reduced Water Temperatures Project operation would result in improved flow and water temperature conditions in the upper Sacramento River, which would benefit all four Chinook salmon runs. This would result in enhanced populations of these game fish in the river, which would provide enhanced sport angling opportunities. This impact would be beneficial.

This impact would be similar to Impact Rec-9 (CP1) and would be beneficial. Mitigation for this impact is not required.

Impact Rec-10 (CP3): Disruption of Sacramento River Boating and Access Resulting from the Gravel Augmentation Program The proposed gravel augmentation program would not be implemented under CP3. Therefore, no impact would occur. Mitigation for this impact is not needed, and thus not proposed.

Impact Rec-11 (CP3): Changes in Usability of Reading Island Fishing Access Boat Ramp and Enhanced Recreation at Reading Island The proposed restoration of Sacramento River flow through Anderson Slough at Reading Island, rehabilitation of the Reading Island boat ramp for use by motorized boats, and construction of a handicap fishing access area would not be implemented under CP3. Therefore, no impact would occur. Mitigation for this impact is not needed, and thus not proposed.

Lower Sacramento River and Delta and CVP/SWP Service Areas

Impact Rec-12 (CP3): Seasonal Inundation of Portions of River Recreation Facilities or Informal River Access Sites on the Lower Sacramento River and Rivers Below CVP and SWP Reservoirs as a Result of Increased River Flows

Within the extended study area, inundation of recreation facilities or portions of recreation facilities, such as boat launch ramps and unimproved riverbank sites used for boat launching and other activities, could result if increased mean monthly river flows were to occur in some months of some years as a result of project implementation and operation under CP3. However, even with the increases, flows on the Sacramento and Feather rivers would remain moderate and well below normal winter and spring high flows. As a result, adverse effects on river facilities or informal use areas within the extended study area are unlikely. This impact would be less than significant.

This impact would be similar to but greater than Impacts Rec-12 (CP1) and Rec-12 (CP2), because the alteration of flow regimes of the lower Sacramento River and rivers below CVP and SWP reservoirs would be greater than under CP1 and CP2. This impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact Rec-13 (CP3): Increased Difficulty for Boaters in Using the Lower Sacramento River and Rivers Below CVP and SWP Reservoirs as a Result of Increased River Flows Increased mean monthly flows within the extended study area, particularly during summer and fall when boating activity is most likely, could result in more difficult boating launching and boating conditions on the Sacramento River and other rivers affected by the project. Depending on the time of year and base river flows, increased flow may also have beneficial effects on boating by reducing shallow bars and riffles, thus improving navigability. However, the timing and flow conditions under which the flow increases are likely to occur on the Sacramento, Feather, and American rivers under CP3 and the continuation of moderate flows even with the increase suggest that adverse effects on boaters within the extended study area are unlikely. This impact would be less than significant.

Hydrologic changes in more distant areas of the CVP and SWP service areas resulting from CP3 cannot be accurately predicted but would be small. Such slight changes occur on a dynamic and daily basis under existing conditions as water is moved throughout California. Other CVP and SWP reservoir elevations, canal flows, and flows below the reservoirs could be modified slightly, but any resulting effects on recreation would be negligible and speculative.

This impact would be similar to but greater than Impacts Rec-13 (CP1) and Rec-13 (CP2), because the alteration of flow regimes of the lower Sacramento River and rivers below CVP and SWP reservoirs would be greater than under CP1 and CP2. This impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact Rec-14 (CP3): Increased Difficulty for Swimmers and Waders in Using the Sacramento River and Rivers Below CVP and SWP Reservoirs as a Result of Increased River Flows Increased mean monthly river flows within the extended study area during some months of some years, particularly during summer when swimming activity is most likely and during nonpeak-flow periods when wade angling activity is most likely, could result in more difficult swimming and wading conditions. These activities could become more hazardous and thus less attractive to river users. However, given the timing of the likely flow increases under CP3, the conditions under which such increases would occur, and the continuation of moderate flows even with the increase, adverse effects on swimmers and waders in the extended study area are unlikely. This impact would be less than significant.

This impact would be similar to but greater than Impacts Rec-14 (CP1) and Rec-14 (CP2), because the alteration of flow regimes of the lower Sacramento River and rivers below CVP and SWP reservoirs would be greater than under CP1 and CP2. This impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact Rec-15 (CP3): Increased Difficulty for Boaters and Anglers in Using the Sacramento River and Rivers Below CVP and SWP Reservoirs as a Result of Decreased River Flows Reduced mean monthly flows during fall and winter low-flow periods when wade angling activity is most common, and during summer and fall when boating and river floating is popular in some areas, could have adverse effects if reduced flows were to reduce fishing success or boating navigability. Given the modest flow decreases in the Sacramento River associated with CP3 and the timing of the changes, effects on these recreation uses of the Sacramento River in the extended study area are unlikely. However, given the magnitude and timing of the largest flow decreases during some years on the Feather and American rivers below CVP and SWP reservoirs in the extended study area, adverse effects may occur. This impact would be potentially significant.

This impact would be similar to but greater than Impacts Rec-15 (CP1) and Rec-15 (CP2), because the alteration of flow regimes of the lower Sacramento River and rivers below CVP and SWP reservoirs would be greater than under CP1 and CP2. This impact would be potentially significant. Mitigation for this impact is proposed in Section 18.3.5.

CP4 – 18.5-Foot Dam Raise, Anadromous Fish Focus With Water Supply Reliability

Like each of the alternatives discussed above, by increasing storage at Shasta Lake, CP4 would change the full pool elevation at Shasta Lake, and the seasonal pool elevations and the flow regime in the Sacramento River and potentially several other reservoirs and downstream waterways. In turn, these alterations to reservoir pool elevations and river flows could affect the usability of some types of recreation facilities on the lake and downstream waterways,

particularly marinas, boat ramps, and nearshore campgrounds and day-use areas. These alterations could also affect the ability of recreationists to use the reservoirs and waterways for boating, camping, fishing, and similar activities.

As under CP3, under CP4 the full pool elevation of Shasta Lake would increase by 20.5 feet and the pool elevation would average as much as 18 to 24 feet higher than under existing (2005) and No-Action Alternative (2030) conditions at various times of the year. The greatest change would occur during the wettest years. However, the dedicated Shasta Lake storage of 378 thousand acre-feet (TAF) is unique to CP4 and would result in a different drawdown scenario than under CP3. In general, Shasta Lake storage would be 100–140 TAF greater under CP4 than under CP3 at various times of the year, with the greatest difference occurring during October and November. This equates to an increase in pool elevation of about 3 to 5 feet throughout the year.

Raising the dam by 18.5 feet would increase the surface area of the reservoir at full pool by about 2,570 acres (9 percent). In general, the effect of this increase would be slight, given that the reservoir would exceed the current full pool elevation only during wetter-than-normal years. Also, the increase in acreage would be distributed around the several hundred miles of the reservoir's rim. The width of the water body would not increase substantially in most areas, and much of the increase would occur during spring rather than during the high-traffic summer boating period.

The changes in flow and river stage on the upper Sacramento River associated with CP4 would be the same as the changes associated with CP1, as outlined above, in that the operated storage of 256 TAF would be the same for CP1 and CP4.

Reservoir- and river-based recreation facilities and activities are similar in the primary and extended study areas downstream from Shasta Lake; thus potential reservoir and river recreation impacts would be similar. However, changes to the flow regime affecting reservoirs and rivers in the extended study area would be increasingly attenuated by flows from tributary waterways and other water sources and diversions that are unaffected by the project, reducing the level of effects.

Shasta Lake and Vicinity

Impact Rec-1 (CP4): Seasonal Inundation of Shasta Lake Recreation Facilities or Portions of Recreation Facilities and Public Access at Pool Elevations Above the Current Full Pool Elevation Substantial effects from inundation of recreation facilities or portions of Shasta Lake facilities, such as boat launch ramps, campgrounds, marinas, and day-use areas, would result from the 20.5-foot increase in full pool elevation associated with the 18.5-foot dam raise. The reservoir would fill to the new full pool elevation of 1,087.5 feet in some years, and would fill to an elevation greater than the current full pool elevation of 1,067 feet in many years. In each case portions of existing recreation

facilities on the shoreline would be inundated. However, construction activities would include relocation of affected recreation facilities. Replacement facilities would be of equivalent quality to affected facilities and provide comparable shoreline access, where applicable, and would comply with ADA and ABA guidelines. Therefore, this impact would be less than significant.

As described in Section 2.4.2 in Chapter 2, "Alternatives," construction activities under all action alternatives would include relocation of affected recreation facilities. This could include relocation of affected portions of facilities within existing use areas, in adjacent undeveloped areas, or at new sites in the same general vicinity of the lake. Because of consolidation of facilities, the total number of facilities of specific types may be reduced. However, all affected recreation capacity would be replaced. Replacement facilities would be of equivalent quality to affected facilities and provide comparable shoreline access, where applicable. With the relocation of affected facilities, this impact would be less than significant.

Recreation is highly important to the Shasta Lake area. Therefore, mitigation is included to uphold the completion of all actions related to the relocation of affected recreation facilities in order to maintain recreation capacity at Shasta Lake, as included in the project description.

Impact Rec-2 (CP4): Temporary Construction-Related Disruption of Recreation Access and Activities at and near Shasta Dam Construction activity at Shasta Dam that would be necessary to raise the dam and complete related modifications would prevent recreation visitors from crossing the dam, as is possible now with a permit from Reclamation, and could affect other recreation activities in the area. These effects are expected only during the construction period. However, this impact would be potentially significant.

This impact would be similar to Impact Rec-2 (CP1). If the increased dam-raise height relative to CP1 (18.5 feet versus 6.5 feet under CP1) would substantially lengthen the period during which construction would occur or otherwise increase construction-related disruption in the dam area, the effects described under CP1 could be increased. This impact would be potentially significant. Mitigation for this impact is proposed in Section 18.3.5.

Impact Rec-3 (CP4): Effects on Boating and Other Recreation Use and Enjoyment of Shasta Lake as a Result of Changes in the Annual Drawdown of the Reservoir An increase in the magnitude or rate or changes in the timing of the annual summer and fall drawdown of Shasta Lake could adversely affect boating enjoyment and safety on the reservoir. Conversely, a reduced or slower drawdown could have beneficial effects. However, under CP4 reservoir operations would mimic existing operations, with little change in annual magnitude, rate, or timing of reservoir drawdown. Therefore, this impact would be less than significant.

This impact would be similar to Impact Rec-3 (CP1) and would be significant. Mitigation for this impact is proposed in Section 18.3.5.

Impact Rec-4 (CP4): Increased Hazards to Boaters and Other Recreationists at Shasta Lake from Standing Timber and Stumps Remaining in Untreated Areas of the Inundation Zone At full pool, the increased pool elevation would result in approximately 1,738 acres of newly inundated area where the existing trees and other vegetation would not be removed. Anglers would generally benefit from the associated enhancement of fish habitat; however, the standing trees and stumps that would remain in these areas would increase the number of areas and total area where this type of hazard to boaters and other types of recreation visitors would exist. Therefore, this impact would be significant.

This impact would be the same as Impact Rec-4 (CP3) and would be significant. Mitigation for this impact is proposed in Section 18.3.5.

Upper Sacramento River (Shasta Dam to Red Bluff)

Impact Rec-5 (CP4): Seasonal Inundation of Portions of Recreation Facilities or Informal River Access Sites as a Result of Increased River Flows Within the upper Sacramento River portion of the primary study area, inundation of recreation facilities or portions of recreation facilities, such as boat launch ramps and unimproved riverbank sites used for boat launching and other activities, could result from increased mean monthly river flows associated with project implementation and operation. In general, the increases in flow that would occur in some years would be expected to be small (5 percent or less); the area of inundation beyond that which would occur under existing conditions and the No-Action Alternative would be likewise small. As a result, the adverse effects are unlikely to be substantial. This impact would be less than significant.

This impact would be the same as Impact Rec-5 (CP1) and would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact Rec-6 (CP4): Increased Difficulty for Boaters in Using the Sacramento River as a Result of Increased River Flows Increased mean monthly flows within the primary study area, particularly during summer and fall when boating activity is most likely, could result in more difficult conditions for boat launching and boating on the Sacramento River. Depending on the time of year and base river flows, increased flow may also have beneficial effects. Because the magnitude of flow increases associated with CP4 would be small (generally less than 5 percent), adverse effects on boaters within the primary study area are unlikely. As a result, this impact would be less than significant.

This impact would be the same as Impact Rec-6 (CP1) and would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact Rec-7 (CP4): Increased Difficulty for Swimmers and Waders in Using the Sacramento River as a Result of Increased River Flows Increased mean

monthly flows within the upper Sacramento River, particularly during summer when swimming activity is most likely and during fall and winter nonpeak-flow periods when wade angling activity is most likely, could result in more difficult swimming and wading conditions. Increased flows can make swimming and wading more challenging and potentially more hazardous. The magnitude of flow increases associated with CP4 would be small (generally less than 5 percent), and the timing of the increases would be such that adverse effects on angling waders within the primary study area are unlikely. Swimming is not a common activity on the main channel of the river because of cold-water temperatures. As a result, this impact would be less than significant.

This impact would be the same as Impact Rec-7 (CP1) and would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact Rec-8 (CP4): Increased Usability of the Sacramento River for Boating and Water-Contact Recreation as a Result of Decreased River Flows Decreased mean monthly flows within the primary study area, particularly during the summer months when boating and swimming activity is most likely and during fall and winter low-flow periods when wade angling activity is most likely, could result in enhanced boating, swimming, and wading conditions. Decreased flows during normally high-flow periods can make boating less challenging and potentially less hazardous. The magnitude of flow decreases associated with CP4 is small (generally less than 10 percent), and the timing of the decreases (fall and winter months) is such that effects on boaters, swimmers, and waders within the primary study area are unlikely. As a result, this impact would be less than significant.

This impact would be the same as Impact Rec-8 (CP1) and would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact Rec-9 (CP4): Enhanced Angling Opportunities in the Upper Sacramento River as a Result of Improved Flows and Reduced Water Temperatures Project operation would result in improved flow and water temperature conditions in the upper Sacramento River, which would benefit all four Chinook salmon runs, as well as steelhead, American shad, and striped bass. This would result in enhanced populations of these game fish in the river, which would provide enhanced sport angling opportunities. This impact would be beneficial.

Chinook salmon, steelhead, American shad, and striped bass all contribute to the popular sport fishery in the upper Sacramento River. (The salmon season has been closed on the upper Sacramento River in recent years, but may be reopened if the health of the runs improves.) With increased flows and cooler water temperature resulting from project operation, salmon populations would benefit from reduced mortality. Cooler water temperatures would also create more suitable conditions in the river for steelhead, American shad, and striped bass. These beneficial effects on game fish species could result in enhanced angling opportunities on the upper Sacramento River, which would have a

beneficial effect on recreation. Mitigation for this impact is not needed, and thus not proposed.

Impact Rec-10 (CP4): Disruption of Sacramento River Boating and Access Resulting from the Gravel Augmentation Program Access to and boating on the upper Sacramento River may be temporarily affected while gravel is placed in the river under the proposed gravel augmentation program. However, gravel placement would occur during only a 1-month period and most augmentation sites would not be adjacent to public river access sites; further, the method of gravel deposition would have little effect on boating. The program could increase the number of shallows encountered by boaters, but shallows are normal characteristics of the targeted river reaches. Therefore, this impact would be less than significant.

The proposed gravel augmentation program could affect boating on the upper Sacramento River by increasing the number of shallow riffles where boating could be made more difficult or hazardous, or where boats may drag the bottom during low-water periods. In the short term, river access and boating may be affected while the gravel is being placed in the river. However, the program would affect only a few sites between Keswick Dam and Clear Creek each year, and the sites under consideration are well distributed along more than 10 miles of the river. Gravel placement would most likely occur only during an approximately 1-month period of late summer (late August to late September), limiting the time during which access or boating could be disrupted. Only a few of the gravel augmentation sites under consideration are adjacent to public river access sites, where access could be disrupted for 1 or 2 days during gravel placement. Deposition of gravel at most sites would occur using a talus cone or lateral berm method, which would use dump trucks or conveyors to place gravel near the riverbank, and would have little effect on boating. Only a few sites would use a direct placement method, which would use front-end loaders to deposit gravel directly in the river channel, and which could conflict with boating during the 1 or 2 days of gravel deposition.

The gravel augmentation program would increase the number of shallows that boaters on the river could encounter. However, shallows as well as rocks and other obstructions are normal characteristics of the targeted reaches of the river (Tuthill 2005). As a result, the boats most commonly used on the upper river (e.g., shallow-draft prop and jet-driven power boats, canoes, kayaks, and rafts) are able to navigate shallow waters, and published boating guides warn boaters of depth changes caused by shifting sands and silts, shallowness, snags, and other obstructions they may encounter (DBW 2011b). For these reasons, both short- and long-term effects on river access and boating are likely to be minimal. As a result, this impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact Rec-11 (CP4): Changes in Usability of Reading Island Fishing Access Boat Ramp and Enhanced Recreation at Reading Island Restoring Sacramento

River flow through Anderson Slough at Reading Island would increase boating and fishing access and opportunities for day-use visitors to the park. This impact would be beneficial.

Several options for restoring Sacramento River flow through Anderson Slough at Reading Island are under consideration, with the primary purpose of recreating habitat for anadromous salmonid fish species. This restoration would deepen the slough and flush out the aquatic vegetation that now clogs the waterway and renders the Reading Island boat ramp on the slough nearly unusable. Also under consideration are rehabilitation of the boat ramp for motorized boat use and construction of a handicap fishing access area. These actions to restore habitat and rehabilitate and enhance recreation facilities would increase boating and fishing access and opportunities for day-use visitors to the park. They would also make the park more functional and attractive for river float trip groups that occasionally camp at the island under BLM special-use permits. This impact would be beneficial. Mitigation for this impact is not needed, and thus not proposed.

Lower Sacramento River and Delta and CVP/SWP Service Areas

Impact Rec-12 (CP4): Seasonal Inundation of Portions of River Recreation Facilities or Informal River Access Sites on the Lower Sacramento River and Rivers Below CVP and SWP Reservoirs as a Result of Increased River Flows

Within the extended study area, inundation of recreation facilities or portions of recreation facilities such as boat launch ramps and unimproved riverbank sites used for boat launching and other activities could result if increased mean monthly river flows were to occur in some months of some years as a result of project implementation and operation under CP4. However, even with the increases, flows on the Sacramento, Feather, and American rivers would remain moderate and well below normal winter and spring high flows. As a result, adverse effects on river facilities or informal use areas within the extended study area are unlikely. This impact would be less than significant.

This impact would be the same as Impact Rec-12 (CP1) and would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact Rec-13 (CP4): Increased Difficulty for Boaters in Using the Lower Sacramento River and Rivers Below CVP and SWP Reservoirs as a Result of Increased River Flows

Increased mean monthly flows within the extended study area, particularly during summer and fall when boating activity is most likely, could result in more difficult conditions for boat launching and boating on the Sacramento River and other rivers affected by the project. Depending on the time of year and base river flows, increased flow may also have beneficial effects on boating by reducing shallow bars and riffles, thus improving navigability. However, the timing and flow conditions under which the flow increases are likely to occur on the Sacramento, Feather, and American rivers under CP4 and the continuation of moderate flows even with the increase

suggest that adverse effects on boaters within the extended study area are unlikely. This impact would be less than significant.

Hydrologic changes in more distant areas of the CVP/SWP service areas resulting from CP4 cannot be accurately predicted but would be small. Such slight changes occur on a dynamic and daily basis under existing conditions as water is moved throughout California. Other CVP and SWP reservoir elevations, canal flows, and flows below the reservoirs could be slightly modified, but any resulting impacts on recreation would be negligible and speculative.

This impact would be the same as Impact Rec-13 (CP1) and would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact Rec-14 (CP4): Increased Difficulty for Swimmers and Waders in Using the Sacramento River and Rivers Below CVP and SWP Reservoirs as a Result of Increased River Flows Increased mean monthly river flows within the extended study area during some months of some years, particularly during summer when swimming activity is most likely and during nonpeak-flow periods when wade angling activity is most likely, could result in more difficult swimming and wading conditions. These activities could become more hazardous and thus less attractive to river users. However, given the timing of the likely flow increases under CP1, the conditions under which such increases would occur, and the continuation of moderate flows even with the increase, adverse effects on swimmers and waders within the extended study area are unlikely. This impact would be less than significant.

This impact would be the same as Impact Rec-14 (CP1) and would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact Rec-15 (CP4): Increased Difficulty for Boaters and Anglers in Using the Sacramento River and Rivers Below CVP and SWP Reservoirs as a Result of Decreased River Flows Reduced mean monthly flows during fall and winter low-flow periods when wade angling activity is most common, and during summer and fall when boating and river floating is popular in some areas, could have adverse effects if reduced flows were to reduce fishing success or boating navigability. Given the modest flow decreases in the Sacramento River associated with CP4 and the timing of the changes, effects on these recreation uses of the Sacramento River in the extended study area are unlikely. However, given the magnitude and timing of the largest flow decreases during some years on the Feather and American rivers below CVP and SWP reservoirs in the extended study area, adverse effects may occur. This impact would be potentially significant.

This impact would be the same as Impact Rec-15 (CP1) and would be potentially significant. Mitigation for this impact is proposed in Section 18.3.5.

CP5 – 18.5-Foot Dam Raise, Combination Plan

Like each of the alternatives discussed above, by increasing storage at Shasta Lake, CP5 would increase the full pool elevation at Shasta Lake, and the seasonal pool elevations and the flow regime in the Sacramento River and potentially several other reservoirs and downstream waterways. In turn, these alterations to reservoir pool elevations and river flows could affect the usability of some types of recreation facilities on the lake and downstream waterways, particularly marinas, boat ramps, and nearshore campgrounds and day-use areas. These alterations could also affect the ability of recreationists to use the reservoirs and waterways for boating, camping, fishing, and similar activities.

The full pool elevation of Shasta Lake would increase by 20.5 feet and the pool elevation would average as much as 18 to 24 feet higher than under existing (2005) and No-Action Alternative (2030) conditions at various times of the year. The greatest change would occur during the wettest years. Raising the dam by 18.5 feet would increase the surface area of the reservoir at full pool by about 2,570 acres (9 percent). In general, the effect of this increase would be slight, given that the reservoir would exceed the current full pool elevation only during wetter-than-normal years. Also, the increase in acreage would be distributed around the several hundred miles of the reservoir's rim. The width of the water body would not increase substantially in most areas, and much of the increase would occur during spring rather than during the high-traffic summer boating period.

Changes in flow and river stage on the upper Sacramento River associated with CP5 would be the same as those associated with CP3, as outlined above.

Reservoir- and river-based recreation facilities and activities in the primary and extended study areas downstream from Shasta Lake are similar; thus potential reservoir and river recreation impacts would be similar. However, changes to the flow regime affecting reservoirs and rivers in the extended study area would be increasingly attenuated by flows from tributary waterways and other water sources and diversions that are unaffected by the project, reducing the level of impacts.

Shasta Lake and Vicinity

Impact Rec-1 (CP5): Seasonal Inundation of Shasta Lake Recreation Facilities or Portions of Recreation Facilities and Public Access at Pool Elevations Above the Current Full Pool Elevation Substantial effects from inundation of recreation facilities or portions of Shasta Lake facilities, such as boat launch ramps, campgrounds, marinas, and day-use areas, would result from the 20.5-foot increase in full pool elevation associated with the 18.5-foot dam raise. The reservoir would fill to the new full pool elevation of 1,087.5 feet in some years, and would fill to an elevation greater than the current full pool elevation of 1,067 feet in many years. In each case portions of existing recreation facilities on the shoreline would be inundated. However, construction activities would include relocation of affected recreation facilities. Replacement facilities

would be of equivalent quality to affected facilities and provide comparable shoreline access, where applicable, and would comply with ADA and ABA guidelines. Therefore, this impact would be less than significant.

As described in Section 2.4.2, construction activities under all action alternatives would include relocation of affected recreation facilities. This could include relocation of affected portions of facilities within existing use areas, in adjacent undeveloped areas, or at new sites in the same general vicinity of the lake. Because of consolidation of facilities, the total number of facilities of specific types may be reduced. However, all affected recreation capacity would be replaced. Replacement facilities would be of equivalent quality to affected facilities and provide comparable shoreline access, where applicable. With the relocation of affected facilities, this impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Recreation is highly important to the Shasta Lake area. Therefore, mitigation is included to uphold the completion of all actions related to the relocation of affected recreation facilities in order to maintain recreation capacity at Shasta Lake, as included in the project description.

Impact Rec-2 (CP5): Temporary Construction-Related Disruption of Recreation Access and Activities at and near Shasta Dam Construction activity at Shasta Dam that would be necessary to raise the dam and complete related modifications would prevent recreation visitors from crossing the dam, as is possible now with a permit from Reclamation, and could affect other recreation activities in the area. These effects are expected only during the construction period. However, this impact would be potentially significant.

This impact would be similar to Impact Rec-2 (CP1). If the increased dam-raise height relative to CP1 (18.5 feet versus 6.5 feet under CP1) would substantially lengthen the period during which construction would occur or otherwise increase construction-related disruption in the dam area, the effects described under CP1 could be increased. This impact would be potentially significant. Mitigation for this impact is proposed in Section 18.3.5.

Impact Rec-3 (CP5): Effects on Boating and Other Recreation Use and Enjoyment of Shasta Lake as a Result of Changes in the Annual Drawdown of the Reservoir An increase in the magnitude or rate or changes in the timing of the annual summer and fall drawdown of Shasta Lake could adversely affect boating enjoyment and safety on the reservoir. Conversely, a reduced or slower drawdown could have beneficial effects. However, under CP5, reservoir operations would mimic existing operations, with little change in annual magnitude, rate, or timing of reservoir drawdown. Therefore, the impact would be less than significant.

This impact would be the same as Impact Rec-3 (CP3) and would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact Rec-4 (CP5): Increased Hazards to Boaters and Other Recreationists at Shasta Lake from Standing Timber and Stumps Remaining in Untreated Areas of the Inundation Zone At full pool, the increased pool elevation would result in approximately 1,738 acres of newly inundated area where the existing trees and other vegetation would not be removed. Anglers would generally benefit from the associated enhancement of fish habitat; however, the standing trees and stumps that would remain in these areas would increase the number of areas and total area where this type of hazard to boaters and other recreation visitors would exist. Therefore, this impact would be significant.

This impact would be the same as Impact Rec-4 (CP3) and would be significant. Mitigation for this impact is proposed in Section 18.3.5.

Upper Sacramento River (Shasta Dam to Red Bluff)

Impact Rec-5 (CP5): Seasonal Inundation of Portions of Recreation Facilities or Informal River Access Sites as a Result of Increased River Flows Within the upper Sacramento River portion of the primary study area, inundation of recreation facilities or portions of recreation facilities, such as boat launch ramps and unimproved riverbank sites used for boat launching and other activities, could result from increased mean monthly river flows associated with project implementation and operation. In general, the increases in flow that would occur in some years would be expected to be small (5 percent or less); the area of inundation beyond that which would occur under existing conditions and the No-Action Alternative would be likewise small. As a result, the adverse effects are unlikely to be substantial. This impact would be less than significant.

This impact would be the same as Impact Rec-5 (CP3) and would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact Rec-6 (CP5): Increased Difficulty for Boaters in Using the Sacramento River as a Result of Increased River Flows Increased mean monthly flows within the primary study area, particularly during summer and fall when boating activity is most likely, could result in more difficult conditions for boat launching and boating on the Sacramento River. Depending on the time of year and base river flows, increased flow may also have beneficial effects. Because the magnitude of flow increases associated with CP5 would be small (generally less than 5 percent), adverse effects on boaters within the primary study area are unlikely. This impact would be less than significant.

This impact would be the same as Impact Rec-6 (CP3) and would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact Rec-7 (CP5): Increased Difficulty for Swimmers and Waders in Using the Sacramento River as a Result of Increased River Flows Increased mean monthly flows within the upper Sacramento River, particularly during summer when swimming activity is most likely and during fall and winter nonpeak-flow periods when wade angling activity is most likely, could result in more difficult

swimming and wading conditions. Increased flows can make swimming and wading more challenging and potentially more hazardous. The magnitude of flow increases associated with CP5 would be small (generally less than 5 percent), and the timing of the increases would be such that adverse effects on angling waders within the primary study area are unlikely. Swimming is not a common activity on the main channel of the river because of cold-water temperatures. As a result, this impact would be less than significant.

This impact would be the same as Impact Rec-7 (CP3) and would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact Rec-8 (CP5): Increased Usability of the Sacramento River for Boating and Water-Contact Recreation as a Result of Decreased River Flows Decreased mean monthly flows within the primary study area, particularly during summer when boating and swimming activity is most likely and during fall and winter low-flow periods when wade angling activity is most likely, could result in enhanced boating, swimming and wading conditions. Decreased flows during normally high-flow periods can make boating less challenging and potentially less hazardous. The magnitude of flow decreases associated with CP5 would be small (generally less than 10 percent), and the timing of the decreases (fall and winter months) would be such that effects on boaters, swimmers, and waders within the primary study area are unlikely. As a result, this impact would be less than significant.

This impact would be the same as Impact Rec-8 (CP3) and would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact Rec-9 (CP5): Enhanced Angling Opportunities in the Upper Sacramento River as a Result of Improved Flows and Reduced Water Temperatures Project operation would result in improved flow and water temperature conditions in the upper Sacramento River, which would benefit all four Chinook salmon runs. This would result in enhanced populations of these game fish in the river, which would provide enhanced sport angling opportunities. This impact would be beneficial.

This impact would be similar to Impact Rec-9 (CP1) and would be beneficial. Mitigation for this impact is not needed, and thus not proposed.

Impact Rec-10 (CP5): Disruption of Sacramento River Boating and Access Resulting from the Gravel Augmentation Program Access to and boating on the upper Sacramento River may be temporarily affected while gravel is placed in the river under the proposed gravel augmentation program. However, gravel placement would occur during only a 1-month period and most augmentation sites would not be adjacent to public river access sites; further, the method of gravel deposition would have little effect on boating. The program could increase the number of shallows encountered by boaters, but shallows are

normal characteristics of the targeted river reaches. Therefore, this impact would be less than significant.

This impact would be the same as Impact Rec-10 (CP4) and would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact Rec-11 (CP5): Changes in Usability of Reading Island Fishing Access Boat Ramp and Enhanced Recreation at Reading Island Restoring Sacramento River flow through Anderson Slough at Reading Island would increase boating and fishing access and opportunities for day-use visitors to the park. This impact would be beneficial.

This impact would be the same as Impact Rec-11 (CP4) and would be beneficial. Mitigation for this impact is not needed, and thus not proposed.

Lower Sacramento River and Delta and CVP/SWP Service Areas

Impact Rec-12 (CP5): Seasonal Inundation of Portions of River Recreation Facilities or Informal River Access Sites on the Lower Sacramento River and Rivers Below CVP and SWP Reservoirs as a Result of Increased River Flows Within the extended study area, inundation of recreation facilities or portions of recreation facilities, such as boat launch ramps and unimproved riverbank sites used for boat launching and other activities, could result if increased mean monthly river flows were to occur in some months of some years as a result of project implementation and operation under CP5. However, even with the increases, flows on the Sacramento, Feather, and American rivers would remain moderate and well below normal winter and spring high flows. As a result, adverse effects on river facilities or informal use areas within the extended study area are unlikely. This impact would be less than significant.

This impact would be the same as Impact Rec-12 (CP3) and would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact Rec-13 (CP5): Increased Difficulty for Boaters in Using the Lower Sacramento River and Rivers Below CVP and SWP Reservoirs as a Result of Increased River Flows Increased mean monthly flows within the extended study area, particularly during summer and fall when boating activity is most likely, could result in more difficult conditions for boat launching and boating on the Sacramento River and other rivers affected by the project. Depending on the time of year and base river flows, increased flow may also have beneficial effects on boating by reducing shallow bars and riffles, thus improving navigability. However, the timing and flow conditions under which the flow increases are likely to occur on the Sacramento, American, and Feather rivers under CP5 and the continuation of moderate flows even with the increase suggest that adverse effects on boaters within the extended study area are unlikely. This impact would be less than significant.

This impact would be the same as Impact Rec-13 (CP3) and would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact Rec-14 (CP5): Increased Difficulty for Swimmers and Waders in Using the Sacramento River and Rivers below CVP and SWP Reservoirs as a Result of Increased River Flows Increased mean monthly river flows within the extended study area during some months of some years, particularly during summer when swimming activity is most likely and during nonpeak-flow periods when wade angling activity is most likely, could result in more difficult swimming and wading conditions. These activities could become more hazardous and thus less attractive to river users. However, given the timing of the likely flow increases under CP5, the conditions under such increases would occur, and the continuation of moderate flows even with the increase, adverse effects on swimmers and waders in the extended study area are unlikely. This impact would be less than significant.

This impact would be the same as Impact Rec-14 (CP3) and would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact Rec-15 (CP5): Increased Difficulty for Boaters and Anglers in Using the Sacramento River and Rivers Below CVP and SWP Reservoirs as a Result of Decreased River Flows Reduced mean monthly flows during fall and winter low-flow periods when wade angling activity is most common, and during summer and fall when boating and river floating is popular in some areas, could have adverse effects if reduced flows were to reduce fishing success or boating navigability. Given the modest flow decreases in the Sacramento River associated with CP5 and the timing of the changes, effects on these recreation uses of the Sacramento River within the extended study area are unlikely. However, given the magnitude and timing of the largest flow decreases during some years on the Feather and American rivers below CVP and SWP reservoirs in the extended study area, adverse effects may occur. This impact would be potentially significant.

This impact would be the same as Impact Rec-15 (CP3) and would be potentially significant. Mitigation for this impact is proposed in Section 18.3.5.

18.3.5 Mitigation Measures

Table 18-9 presents a summary of mitigation measures for recreation and public access.

Table 18-9. Summary of Mitigation Measures for Recreation and Public Access

Impact		No-Action Alternative	CP1	CP2	CP3	CP4	CP5
Impact Rec-1 (No-Action): Increased Use of Shasta Lake Recreation Facilities and Demand for Recreation Opportunities on Shasta Lake and in the Vicinity Impact Rec-1 (CP1 – CP5): Seasonal Inundation of Shasta Lake Recreation Facilities or Portions of Recreation Facilities and Public Access at Pool Elevations Above the Current Full Pool Elevation	LOS before Mitigation	LTS	LTS	LTS	LTS	LTS	LTS
	Mitigation Measure	None required.	Mitigation Measure Rec-1: Modify and Relocate Recreation Facilities Inundated by Increases in Shasta Lake Full Pool Elevation.				
	LOS after Mitigation	LTS	LTS	LTS	LTS	LTS	LTS
Impact Rec-2 (No-Action): Increased Use and Demand for Recreation Opportunities on the Upper Sacramento River Impact Rec-2 (CP1 – CP5): Temporary Construction-Related Disruption of Recreation Access and Activities at and near Shasta Dam	LOS before Mitigation	LTS	PS	PS	PS	PS	PS
	Mitigation Measure	None required.	Mitigation Measure Rec-2: Provide Information About and Improve Alternate Recreation Access and Opportunities to Mitigate the Temporary Loss of Recreation Access and Opportunities During Construction at Shasta Dam.				
	LOS after Mitigation	LTS	LTS	LTS	LTS	LTS	LTS
Impact Rec-3 (No-Action): Increased Use and Demand for Recreation Opportunities on the Lower Sacramento River and in the Delta Impact Rec-3 (CP1 – CP5): Effects on Boating and Other Recreation Use and Enjoyment of Shasta Lake as a Result of Changes in the Annual Drawdown of the Reservoir	LOS before Mitigation	LTS	LTS	LTS	LTS	LTS	LTS
	Mitigation Measure	None required.	None needed; thus, none proposed.				
	LOS after Mitigation	LTS	LTS	LTS	LTS	LTS	LTS
Impact Rec-4 (No-Action): Increased Use and Demand for Recreation Opportunities in the CVP and SWP Service Areas Impact Rec-4 (CP1 – CP5): Increased Hazards to Boaters and Other Recreationists at Shasta Lake from Standing Timber and Stumps Remaining in Untreated Areas of the Inundation Zone	LOS before Mitigation	LTS	S	S	S	S	S
	Mitigation Measure	None required.	Mitigation Measure Rec-4: Provide Information to Shasta Lake Visitors About Potential Safety Hazards in Newly Inundated Areas from Standing Timber and Stumps.				
	LOS after Mitigation	LTS	LTS	LTS	LTS	LTS	LTS

Table 18-9. Summary of Mitigation Measures for Recreation and Public Access (contd.)

Impact		No-Action Alternative	CP1	CP2	CP3	CP4	CP5
Impact Rec-5 (CP1 – CP5): Seasonal Inundation of Portions of Recreation Facilities or Informal River Access Sites as a Result of Increased River Flows	LOS before Mitigation	NI	LTS	LTS	LTS	LTS	LTS
	Mitigation Measure	None Required.	None needed; thus, none proposed.				
	LOS after Mitigation	NI	LTS	LTS	LTS	LTS	LTS
Impact Rec-6 (CP1 – CP5): Increased Difficulty for Boaters in Using the Sacramento River as a Result of Increased River Flows	LOS before Mitigation	NI	LTS	LTS	LTS	LTS	LTS
	Mitigation Measure	None Required.	None needed; thus, none proposed.				
	LOS after Mitigation	NI	LTS	LTS	LTS	LTS	LTS
Impact Rec-7 (CP1 – CP5): Increased Difficulty for Swimmers and Waders in Using the Sacramento River as a Result of Increased River Flows	LOS before Mitigation	NI	LTS	LTS	LTS	LTS	LTS
	Mitigation Measure	None Required.	None needed; thus, none proposed.				
	LOS after Mitigation	NI	LTS	LTS	LTS	LTS	LTS
Impact Rec-8 (CP1 – CP5): Increased Usability of the Sacramento River for Boating and Water-Contact Recreation as a Result of Decreased River Flows	LOS before Mitigation	NI	LTS	LTS	LTS	LTS	LTS
	Mitigation Measure	None Required.	None needed; thus, none proposed.				
	LOS after Mitigation	NI	LTS	LTS	LTS	LTS	LTS
Impact Rec-9 (CP1 – CP5): Enhanced Angling Opportunities in the Upper Sacramento River as a Result of Improved Flows and Reduced Water Temperatures	LOS before Mitigation	NI	B	B	B	B	B
	Mitigation Measure	None Required.	None needed; thus, none proposed.				
	LOS after Mitigation	NI	B	B	B	B	B

Table 18-9. Summary of Mitigation Measures for Recreation and Public Access (contd.)

Impact		No-Action Alternative	CP1	CP2	CP3	CP4	CP5
Impact Rec-10 (CP1–CP5): Disruption of Sacramento River Boating and Access Resulting from the Gravel Augmentation Program	LOS before Mitigation	NI	NI	NI	NI	LTS	LTS
	Mitigation Measure	None Required.	None needed; thus, none proposed.				
	LOS after Mitigation	NI	NI	NI	NI	LTS	LTS
Impact Rec-11 (CP1–CP5): Changes in Usability of Reading Island Fishing Access Boat Ramp and Enhanced Recreation at Reading Island	LOS before Mitigation	NI	NI	NI	NI	B	B
	Mitigation Measure	None Required.	None needed; thus, none proposed.				
	LOS after Mitigation	NI	NI	NI	NI	B	B
Impact Rec-12 (CP1–CP5): Seasonal Inundation of Portions of River Recreation Facilities or Informal River Access Sites on the Lower Sacramento River and Rivers Below CVP and SWP Reservoirs as a Result of Increased River Flows	LOS before Mitigation	NI	LTS	LTS	LTS	LTS	LTS
	Mitigation Measure	None Required.	None needed; thus, none proposed.				
	LOS after Mitigation	NI	LTS	LTS	LTS	LTS	LTS
Impact Rec-13 (CP1–CP5): Increased Difficulty for Boaters in Using the Lower Sacramento River and Rivers Below CVP and SWP Reservoirs as a Result of Increased River Flows	LOS before Mitigation	NI	LTS	LTS	LTS	LTS	LTS
	Mitigation Measure	None Required.	None needed; thus, none proposed.				
	LOS after Mitigation	NI	LTS	LTS	LTS	LTS	LTS

Table 18-9. Summary of Mitigation Measures for Recreation and Public Access (contd.)

Impact		No-Action Alternative	CP1	CP2	CP3	CP4	CP5
Impact Rec-14 (CP1–CP5): Increased Difficulty for Swimmers and Waders in Using the Sacramento River and Rivers Below CVP and SWP Reservoirs as a Result of Increased River Flows	LOS before Mitigation	NI	LTS	LTS	LTS	LTS	LTS
	Mitigation Measure	None Required.	None needed; thus, none proposed.				
	LOS after Mitigation	NI	LTS	LTS	LTS	LTS	LTS
Impact Rec-15 (CP1–CP5): Increased Difficulty for Boaters and Anglers in Using the Sacramento River and Rivers Below CVP and SWP Reservoirs as a Result of Decreased River Flows	LOS before Mitigation	NI	PS	PS	PS	PS	PS
	Mitigation Measure	None Required.	Mitigation Measure Rec-15: Implement Mitigation Measure Aqua-15: Maintain Flows in the Feather River, American River, and Trinity River Consistent with Existing Regulatory and Operational Requirements and Agreements.				
	LOS after Mitigation	NI	LTS	LTS	LTS	LTS	LTS

Key:
B = beneficial
LOS = level of significance
LTS = less than significant
NI = no impact
PS = potentially significant
S = significant

No-Action Alternative

No mitigation measures are needed for this alternative.

CP1 – 6.5-Foot Dam Raise, Anadromous Fish Survival and Water Supply Reliability

No mitigation is needed for Impact Rec-3 (CP1) and Impacts Rec-5 (CP1) through Rec-14 (CP1). Mitigation is provided below for Impacts Rec-2 (CP1), and Rec-4 (CP1), which would affect recreation at Shasta Lake recreation facilities, and for Impact Rec-15 (CP1), which would affect recreation on rivers in the extended study area.

Mitigation Measure Rec-1 (CP1): Modify and Relocate Recreation Facilities Inundated by Increases in Shasta Lake Full Pool Elevation

Recreation is highly important to the Shasta Lake area. This mitigation measure is included to uphold the completion of all actions related to the relocation of affected recreation facilities in order to maintain recreation capacity at Shasta Lake, as included in the project description.

To avoid physical impacts of an increase in Shasta Lake's full pool elevation on recreation facilities, Reclamation will protect such facilities from inundation, modify existing facilities to replace affected areas, or endon existing facilities and replace them at other suitable sites (i.e., relocate facilities). Facilities will be protected, modified, or relocated as described below.

Where feasible, Reclamation will protect recreation facilities from seasonal high-water levels by installing berms, dikes, retaining walls, or similar structures to prevent inundation. The surface level of affected paved and unpaved areas (most used for parking) will be raised if that would prevent inundation. In areas where this is not feasible or is impractical, new facilities to replace lost parking areas will be constructed in adjacent unaffected areas. Reclamation will mitigate effects on parking areas in conjunction with mitigation for effects on boat ramps served by the parking areas.

Affected buildings and other facilities will be relocated. Such buildings and facilities include boat ramps, campgrounds, and day-use area restrooms, and marina and resort buildings (restrooms, cabins, offices, retail stores, storage facilities, and restaurants).

Effects on boat ramps may be difficult to mitigate on existing sites, given the need to have ample ramp space above the full pool level for the facility to function properly and the need to consider parking for vehicles and boat trailers in mitigation plans. Therefore, the elevation of both the ramp and parking area will be raised as on-site mitigation, or boat ramp facilities will be replaced with new facilities in the same general area of the lake that would serve launching needs for that local area.

Affected segments of hiking and biking trails will be relocated upslope in order to restore the continuity of the affected trails.

All capacity of recreation facilities (e.g., boat launching, campsites, picnic sites, marina moorage and related services, resort lodging) lost as a result of inundation will be replaced. Decisions about whether individual affected facilities will be modified or relocated will be addressed in conjunction with USFS, based on overall effects on the features of individual facilities as well as operational needs. Some relocated facilities may be consolidated within other existing facilities, rather than being relocated at a currently undeveloped area. All plans for replacement of facilities will be evaluated and approved by USFS.

Preliminary mitigation plans for effects of an 18.5-foot dam raise on Shasta Lake recreation facilities have been developed with the cooperation of USFS. The proposed mitigation for Impact Rec-1 under CP3 (which also applies to this impact under CP4 and CP5) is summarized by facility type in Table 18-10 (presented under "CP3 – 18.5-Foot Dam Raise, Anadromous Fish Survival and Water Supply" below). Under CP1, fewer facilities would be affected than under CP3, and effects on other recreation facilities would be less than under CP3; therefore, the amount of mitigation required under CP1 would also be less than the amount shown in Table 18-10, although required mitigation for effects of CP1 would still be substantial.

Reclamation's mitigation plans for recreation facilities will include mitigation of project effects on roads and bridges, many of which are used for access to recreation facilities. Facility access roads may be relocated, raised, or abandoned. If abandoned roads serve a substantial recreation-access purpose, mitigation may take the form of upgrading alternative access routes that serve the same areas.

Implementation of this mitigation measure would maintain Impact Rec-1 (CP1) at a less than significant level.

Mitigation Measure Rec-2 (CP1): Provide Information About and Improve Alternate Recreation Access and Opportunities to Mitigate the Temporary Loss of Recreation Access and Opportunities During Construction at Shasta Dam Reclamation will inform recreation users of the Chappie-Shasta OHV Area about an alternate route to the area from the south, and will improve this alternative route (e.g., by grading unpaved portions) if necessary for vehicles pulling trailers to use the road. To mitigate the temporary disruption in public tours of Shasta Dam during construction, Reclamation will develop and provide enhanced information about the dam and its operation at the Reclamation Visitor Center at the dam, which would remain open. Mitigation for temporary loss of access to the trailhead at the west end of Shasta Dam is not necessary because the trailhead itself would be affected by construction.

Implementation of this mitigation measure would reduce Impact Rec-2 (CP1) to a less than significant level.

Mitigation Measure Rec-4 (CP1): Provide Information to Shasta Lake Visitors About Potential Safety Hazards in Newly Inundated Areas from Standing Timber and Stumps To mitigate impacts on visitor safety from remaining trees and stumps in untreated areas of the newly inundated zone, Reclamation will work with USFS to provide maps, bulletins, informational postings, and other media as deemed appropriate by USFS at boat ramps, marinas, and other developed Shasta Lake recreation sites. Similar information could be provided at public meetings and events and at USFS and other Web sites used by Shasta Lake visitors to learn about conditions at the lake. The information provided will identify the general areas of the shoreline where the hazard exists, and will inform boaters or the nature of the hazard, the periods of time when the hazard is of concern (i.e., when the reservoir elevation is above the current full pool elevation), and best practices to avoid the hazard while recreating on the lake.

Mitigation Measure Rec-15 (CP1): Implement Mitigation Measure Aqua-15 (CP1): Maintain Flows in the Feather River, American River, and Trinity River Consistent with Existing Regulatory and Operational Requirements and Agreements This measure is identical to Mitigation Measure Aqua-15 (CP1), described in Chapter 11, "Fisheries and Aquatic Ecosystems."

This measure will also protect recreation uses on these rivers by ensuring that any potential changes in flow would be within the current range of variability. Implementation of this mitigation measure would reduce Impact Rec-15 (CP1) to a less than significant level.

CP2 – 12.5-Foot Dam Raise, Anadromous Fish Survival and Water Supply Reliability

No mitigation is needed for Impact Rec-3 (CP2), and Impacts Rec-5 (CP1) through Rec-14 (CP2). Mitigation is provided below for Impacts Rec-2 (CP2) and Rec-4 (CP2), which would affect recreation at Shasta Lake recreation facilities, and for Impact Rec-15 (CP2), which would affect recreation on rivers in the extended study area.

Mitigation Measure Rec-1 (CP2): Modify and Relocate Recreation Facilities Inundated by Increases in Shasta Lake Full Pool Elevation This mitigation measure is identical to Mitigation Measure Rec-1 (CP1). Implementation of this mitigation measure would maintain Impact Rec-1 (CP2) at a less than significant level.

Mitigation Measure Rec-2 (CP2): Provide Information About and Improve Alternate Recreation Access and Opportunities to Mitigate the Temporary Loss of Recreation Access and Opportunities During Construction at

Shasta Dam This mitigation measure is identical to Mitigation Measure Rec-2 (CP1). Implementation of this mitigation measure would reduce Impact Rec-2 (CP2) to a less than significant level.

Mitigation Measure Rec-4 (CP2): Provide Information to Shasta Lake Visitors About Potential Safety Hazards in Newly Inundated Areas from Standing Timber and Stumps This mitigation measure is identical to Mitigation Measure Rec-4 (CP1). Implementation of this mitigation measure would reduce Impact Rec-4 (CP2) to a less than significant level.

Mitigation Measure Rec-15 (CP2): Implement Mitigation Measure Aqua-15 (CP2): Maintain Flows in the Feather River, American River, and Trinity River Consistent with Existing Regulatory and Operational Requirements and Agreements This mitigation measure is identical to Mitigation Measure Aqua-15 (CP2). Implementation of this mitigation measure would reduce Impact Rec-15 (CP2) to a less than significant level.

CP3 – 18.5-Foot Dam Raise, Anadromous Fish Survival and Water Supply

No mitigation is needed for Impact Rec-3 (CP3) and Impacts Rec-5 through Rec-14 (CP3). Mitigation is provided below for Impacts Rec-2 (CP3), and Rec-4 (CP3), which would affect recreation at Shasta Lake recreation facilities, and for Impact Rec-15 (CP3), which would affect recreation on rivers in the extended study area.

Mitigation Measure Rec-1 (CP3): Modify and Relocate Recreation Facilities Inundated by Increases in Shasta Lake Full Pool Elevation This mitigation measure is identical to Mitigation Measure Rec-1 (CP1). Implementation of this mitigation measure would maintain Impact Rec-1 (CP3) at a less than significant level.

Mitigation Measure Rec-2 (CP3): Provide Information About and Improve Alternate Recreation Access and Opportunities to Mitigate the Temporary Loss of Recreation Access and Opportunities During Construction at Shasta Dam This mitigation measure is identical to Mitigation Measure Rec-2 (CP1). Implementation of this mitigation measure would reduce Impact Rec-2 (CP3) to a less than significant level.

Mitigation Measure Rec-4 (CP3): Provide Information to Shasta Lake Visitors About Potential Safety Hazards in Newly Inundated Areas from Standing Timber and Stumps This mitigation measure is identical to Mitigation Measure Rec-4 (CP1). Implementation of this mitigation measure would reduce Impact Rec-4 (CP3) to a less than significant level.

Mitigation Measure Rec-15 (CP3): Implement Mitigation Measure Aqua-15 (CP3): Maintain Flows in the Feather River, American River, and Trinity River Consistent with Existing Regulatory and Operational Requirements and Agreements This mitigation measure is identical to

Mitigation Measure Aqua-15 (CP3). Implementation of this mitigation measure would reduce Impact Rec-15 (CP3) to a less than significant level.

CP4 – 18.5-Foot Dam Raise, Anadromous Fish Focus With Water Supply Reliability

No mitigation is needed for Impact Rec-3 (CP4), and Impacts Rec-5 through Rec-14 (CP4). Mitigation is provided below for Impacts Rec-2 (CP4) and Rec-4 (CP4), which would affect recreation at Shasta Lake recreation facilities, and for Impact Rec-15 (CP4), which would affect recreation on rivers in the extended study area.

Mitigation Measure Rec-1 (CP4): Modify and Relocate Recreation Facilities Inundated by Increases in Shasta Lake Full Pool Elevation This mitigation measure is identical to Mitigation Measure Rec-1 (CP1). Implementation of this mitigation measure would maintain Impact Rec-1 (CP4) at a less than significant level.

Mitigation Measure Rec-2 (CP4): Provide Information About and Improve Alternate Recreation Access and Opportunities to Mitigate the Temporary Loss of Recreation Access and Opportunities During Construction at Shasta Dam This mitigation measure is identical to Mitigation Measure Rec-2 (CP1). Implementation of this mitigation measure would reduce Impact Rec-2 (CP4) to a less than significant level.

Mitigation Measure Rec-4 (CP4): Provide Information to Shasta Lake Visitors About Potential Safety Hazards in Newly Inundated Areas from Standing Timber and Stumps This mitigation measure is identical to Mitigation Measure Rec-4 (CP1). Implementation of this mitigation measure would reduce Impact Rec-4 (CP4) to a less than significant level.

Mitigation Measure Rec-15 (CP4): Implement Mitigation Measure Aqua-15 (CP4): Maintain Flows in the Feather River, American River, and Trinity River Consistent with Existing Regulatory and Operational Requirements and Agreements This mitigation measure is identical to Mitigation Measure Aqua-15 (CP1). Implementation of this mitigation measure would reduce Impact Rec-15 (CP4) to a less than significant level.

CP5 – 18.5-Foot Dam Raise, Combination Plan

No mitigation is needed for Impact Rec-3 (CP5), and Impacts Rec-5 (CP5) through Rec-14 (CP5). Mitigation is provided below for Impacts Rec-2 (CP5) and Rec-4 (CP5), which would affect recreation at Shasta Lake recreation facilities, and for Impact Rec-15 (CP5), which would affect recreation on rivers in the extended study area.

Mitigation Measure Rec-1 (CP5): Modify and Relocate Recreation Facilities Inundated by Increases in Shasta Lake Full Pool Elevation This mitigation measure is identical to Mitigation Measure Rec-1 (CP1).

Implementation of this mitigation measure would maintain Impact Rec-1 (CP5) at a less than significant level.

Mitigation Measure Rec-2 (CP5): Provide Information About and Improve Alternate Recreation Access and Opportunities to Mitigate the Temporary Loss of Recreation Access and Opportunities During Construction at Shasta Dam This mitigation measure is identical to Mitigation Measure Rec-2 (CP1). Implementation of this mitigation measure would reduce Impact Rec-2 (CP5) to a less than significant level.

Mitigation Measure Rec-4 (CP5): Provide Information to Shasta Lake Visitors About Potential Safety Hazards in Newly Inundated Areas from Standing Timber and Stumps This mitigation measure is identical to Mitigation Measure Rec-4 (CP1). Implementation of this mitigation measure would reduce Impact Rec-4 (CP5) to a less than significant level.

Mitigation Measure Rec-15 (CP5): Implement Mitigation Measure Aqua-15 (CP5): Maintain Flows in the Feather River , American River, and Trinity River Consistent with Existing Regulatory and Operational Requirements and Agreements This mitigation measure is identical to Mitigation Measure Aqua-15 (CP1). Implementation of this mitigation measure would reduce Impact Rec-15 (CP5) to a less than significant level.

18.3.6 Cumulative Effects

A diverse variety of programs that have been developed or are under development by Federal, State, and local agencies – individually and in conjunction with other agencies – are among the other past, present, and reasonably foreseeable future projects that may affect environmental conditions in the primary and extended study areas and therefore may contribute to cumulative effects.

These projects include construction and operation of projects or implementation of programs that may have the potential to adversely affect both land- and water-based recreation and, in combination, cause an existing significant cumulative effect. For example, construction of some projects or implementation of programs may temporarily constrain boat navigation. Some of these project's facilities may displace recreation facilities or activities, or may cause a long-term impediment to navigation on waterways. Water-based recreation may also be indirectly affected because of changes in reservoir water storage or changes in river flows downstream from reservoirs attributable to these projects. To the extent possible, foreseeable actions have been incorporated in the CalSim-II model and data developed for analysis of operational impacts on reservoir elevations and river flows under the project alternatives.

Several programs provide only general plans or frameworks for potential future projects or actions; no construction or other implementation of the programs has

yet occurred, and no site-specific projects have been identified or undergone environmental analysis. Therefore, there are no effects of past or present projects associated with these programs, and future projects that may occur are uncertain. Some of the programs or projects may result in temporary construction effects; however, the exact locations of these projects are unknown at this time. Many ongoing and future programs include public access or recreation objectives or measures, or would protect or enhance water quality, fisheries, wildlife habitat, and other biological resources that support recreation uses. These programs have the potential to result in beneficial effects on recreation, which could help reduce potentially significant cumulative effects.

The effects of climate change on operations at Shasta Lake could potentially affect water-based recreation opportunities both at the lake and downstream. As described in the Climate Change Projection Appendix, climate change could result in higher reservoir releases in the future because of an increase in winter and early-spring inflow into the lake from high-intensity storm events. The change in reservoir releases could be necessary to manage for flood events resulting from these potentially larger storms. The potential increase in releases from the reservoir could lead to long-term changes in downstream channel equilibrium, which could affect the Sacramento River's ease of use for water-based recreation.

CP1 – 6.5-Foot Dam Raise, Anadromous Fish Survival and Water Supply Reliability

As described in Section 18.3.4 above, without mitigation, CP1 could cause significant and potentially significant effects on recreation and public access. These effects would result from seasonal inundation of recreational facilities and public access routes, temporary construction-related disruption of recreation access and activities at and near Shasta Dam, and increased difficulty for boaters and anglers in using the Sacramento River and rivers below CVP and SWP reservoirs as a result of decreased river flows. These contributing adverse effects from CP1 would be cumulatively considerable. With implementation of Mitigation Measures Rec-2 (CP1), Rec-4 (CP1), and Rec-15 (CP1), adverse effects from CP1 would be reduced to a less than significant level and would no longer result in a cumulatively considerable incremental contribution to cumulative effects on recreation and public access. This would not be a cumulatively significant effect.

As stated previously, effects of climate change on operations at Shasta Lake could include a higher frequency of high-flow events, potentially resulting in changes to water-based recreation opportunities downstream. As described in the Climate Change Projection Appendix, climate warming could result in more intense rainstorms, an increased occurrence of high-intensity rainfall, earlier melting of seasonal snowpack, and more events of rain or snow. These expected consequences of climate change may create more frequent and severe flooding associated with lakes and rivers, and thus greater challenges to water-based recreation in the Sacramento River in the primary and extended study areas.

However, as noted in the Climate Change Projection Appendix, studies also generally predict that climate change may cause Shasta Lake to be unable to stay above the 550-TAF dead pool in some critically dry years. With the lake at such a low level, an increase in adverse effects on recreation on the lake could result in critically dry years. Implementation of CP1 could potentially diminish the effects of increased flows and potential flooding on downstream recreation in the Sacramento River by providing additional reservoir storage capacity after construction; however, it would not likely increase the anticipated adverse effects on recreation on Shasta Lake in critically dry years. When added to the anticipated effects of climate change, raising Shasta Dam would not have a significant cumulative effect.

CP2 – 12.5-Foot Dam Raise, Anadromous Fish Survival and Water Supply Reliability

The cumulative effects of CP2 would be similar to those of CP1, but greater in magnitude. With implementation of Mitigation Measures Rec-2 (CP2), Rec-4 (CP2), and Rec-15 (CP2), adverse effects from CP2 would be reduced to a less than significant level and would no longer result in a cumulatively considerable incremental contribution to cumulative effects on recreation and public access. This would not be a cumulatively significant effect.

CP3 – 18.5-Foot Dam Raise, Anadromous Fish Survival and Water Supply

The cumulative effects of CP3 would be similar to those of CP1, but greater in magnitude. With implementation of Mitigation Measures Rec-2 (CP3), Rec-4 (CP3), and Rec-15 (CP3), adverse effects from CP3 would be reduced to a less than significant level and would no longer result in a cumulatively considerable incremental contribution to cumulative effects on recreation and public access. This would not be a cumulatively significant effect.

CP4 – 18.5-Foot Dam Raise, Anadromous Fish Focus With Water Supply Reliability

The cumulative effects of CP4 would be similar to those of CP1, but greater in magnitude. With implementation of Mitigation Measures Rec-2 (CP4), Rec-4 (CP4), and Rec-15 (CP4), adverse effects from CP4 would be reduced to a less than significant level and would no longer result in a cumulatively considerable incremental contribution to cumulative effects on recreation and public access. This would not be a cumulatively significant effect.

CP5 – 18.5-Foot Dam Raise, Combination Plan

The cumulative effects of CP5 would be similar to those of CP1, but greater in magnitude. With implementation of Mitigation Measures Rec-2 (CP5), Rec-4 (CP5), and Rec-15 (CP5), adverse effects from CP5 would be reduced to a less than significant level and would no longer result in a cumulatively considerable incremental contribution to cumulative effects on recreation and public access. This would not be a cumulatively significant effect.

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Chapter 19
Aesthetics and Visual Resources

19.1 Affected Environment

This chapter describes the affected environment related to aesthetics and visual resources for the dam and reservoir modifications proposed under the SLWRI.

Because of the potential influence of the proposed modification of Shasta Dam on water deliveries over a large geographic area, the SLWRI includes both a primary study area and an extended study area. The primary study area has been further divided into Shasta Lake and vicinity and the upper Sacramento River (Shasta Dam to Red Bluff). The extended study area consists of the lower Sacramento River and Delta and the CVP/SWP service areas.

19.1.1 Visual Environment

Both natural and artificial landscape features contribute to perceived visual images and the aesthetic value of a view. The value is determined by contrasts, forms, and textures exhibited by the natural environment (e.g., geology, hydrology, vegetation, and wildlife), as well as human-made features. The aesthetic value of an area is a measure of its visual character and quality combined with the viewer's response to the area (DOT 1981). In general terms, the visual landscape is considered to be a vital component of an area's overall resource value. The ability of the landscape to undergo alteration without losing its visual character is considered important for the maintenance of high scenic value. As development deviates from the natural landscape, visual impacts increase. The visual impacts of a project are determined by a number of factors, including effects on the visual character and quality (e.g., form, line, color, and texture), visual exposure, viewer sensitivity, and the number of viewers who are expected to see the project.

People respond differently to changes in the physical environment, depending on their prior experiences and expectations, their proximity to the views, and the length of time the view is visible to them. Visual effects analyses tend to be highly subjective. For this reason, aesthetics and visual resources are addressed qualitatively rather than quantitatively.

This section focuses on the primary study area consisting of Shasta Lake and vicinity and the upper Sacramento River from Shasta Dam downstream to the Red Bluff Diversion Dam. The focus is on the primary study area because implementation of the project would have virtually no effect on aesthetic values and visual resources in the extended study area.

The visual environment, or character, is a function of both the natural and artificial landscape features that make up a view. The character of any given area is influenced by geologic, hydrologic, botanical, wildlife, recreational, and urban features. The perception of visual character can vary significantly as season, hour, light, shadow, weather, and the other elements of a view change. Form, line, color, and texture are the basic components used to describe visual character and quality for most visual assessments (DOT 1981). The dominance of each of these components on the landscape forms the viewer's impression of the landscape and, therefore, the aesthetic value of the landscape. The aesthetic value of an area is a measure of its visual character and scenic quality combined with the viewer response.

The overall sensitivity and response of a viewer to the quality of a view is based on a combination of viewer exposure and viewer sensitivity. Viewer exposure refers to the visibility of resources in the landscape, the proximity of the vantage point to the view, the elevation of the viewer relative to the view, the frequency and duration of the viewing, the number of observers, and preconceived expectations of individual viewers or groups. Viewer sensitivity refers to the extent of the public's concern for particular landscapes. Judgments of visual quality and viewer response should be based on a regional frame of reference The geographical setting and nature of the visual resource will significantly influence the degree of visual quality and sensitivity experienced by the viewer. For example, the presence of a small hill in an otherwise flat landscape may be considered a significant visual element, but a hill of the same size may have very little significance when located in mountainous terrain.

For purposes of this report, a viewshed is defined as the surface area visible from a particular location (e.g., a highway pull-out, campground, or marina) or sequence of locations (e.g., along a highway or trail). The scenic attractiveness and distance zones also influence the aesthetic value of a viewshed.

Scenic Attractiveness

Scenic attractiveness is classified as:

- **Class A "distinctive" –** Areas where landform, vegetation patterns, water characteristics, and cultural features combine to provide unusual, unique, or outstanding scenic quality. These landscapes have strong positive attributes of variety, unity, vividness, mystery, intactness, order, harmony, uniqueness, pattern, and balance.

- **Class B "typical" –** Areas where landform, vegetation patterns, water characteristics, and cultural features combine to provide ordinary or common scenic quality. These landscapes generally have positive, yet common, attributes of variety, unity, vividness, mystery, intactness, order, harmony, uniqueness, pattern, and balance.

- **Class C "indistinctive" –** Areas where landform, vegetation patterns, water characteristics, and cultural features have low scenic quality. Water and rock forms of any consequence are often missing in Class C landscapes. These landscapes have weak or missing attributes of variety, unity, vividness, mystery, intactness, order, harmony, uniqueness, pattern, and balance.

Class A and B visual resources typically are found in State or Federal parks, recreation areas, and wilderness areas, including rivers and lakes. Class C resources generally are areas that have low scenic quality and consist of more common landscapes.

Distance Zones

In addition to scenic attractiveness, three primary distance zones are used, as appropriate, to characterize the viewsheds described in the following sections. These distance zones, described below, are foreground, middle ground, and background.

- **Foreground (0 to 0.5 mile) –** At a foreground distance, people can distinguish small boughs or leaf clusters, tree trunks and large branches, individual shrubs, clumps of wildflowers, medium-sized animals, and medium to large birds.

- **Middle ground (0.5 to 4 miles) –** At a middle ground distance, people can distinguish individual tree forms, large boulders, flower fields, small openings in the forest or tree line, and small rock outcrops. Form, texture, and color remain dominant and pattern is important.

- **Background (4 miles to horizon) –** At a background distance, people can distinguish groves or stands of trees, large openings in the forest, and large rock outcrops. Texture is not detectable and color has flattened, but large patterns of vegetation or rocks are still distinguishable, and landform ridgelines and horizon lines are the dominant visual characteristics.

Shasta Lake and Vicinity and Upper Sacramento River (Shasta Dam to Red Bluff)

For purposes of the aesthetics and visual resources assessment, the primary study area encompasses Shasta Lake and vicinity and the upper Sacramento River in Northern California. Shasta Dam is located about 9 miles northwest of Redding, and the dam and the entire reservoir are in Shasta County. The Shasta Lake and vicinity portion of the primary study area is composed of Shasta Dam and Shasta Lake and the lower reaches of the tributaries draining into Shasta Lake. The upper Sacramento River portion includes dam-related infrastructure downstream from the dam, Keswick Reservoir, and watersheds that are tributary to the Sacramento River downstream to Red Bluff.

The terrain of the primary study area is extremely diverse and includes the mountainous terrain surrounding Shasta Lake as well as the landscapes of the Central Valley below Keswick Reservoir. Upstream from Keswick Reservoir, slopes are characterized by a mix of pine and oak forests and, to varying degrees, chaparral and rock outcrops. The landscape includes topographic features of the Klamath Mountains, the southern Cascade Range, and the Central Valley. Two volcanic features – Mount Shasta and Mount Lassen – can be seen from numerous vantage points throughout the area.

Shasta Lake is the central visual attraction of the primary study area. It is the largest lake in the Whiskeytown-Shasta-Trinity National Recreation Area (NRA). The Shasta-Trinity Unit of the NRA is managed by the USFS, Shasta-Trinity National Forest (STNF) to provide high-quality recreational experiences and visual perceptions to the public. Shasta Lake offers the public a variety of outdoor recreational experiences and activities, including boating, water-skiing, swimming, fishing, camping, picnicking, hiking, hunting, and mountain biking. Recreation at the lake is managed by the USFS consistent with the STNF *Land and Resource Management Plan* (LRMP) and guidelines established for the Whiskeytown-Shasta-Trinity NRA.

Shasta Lake has a surface area of 29,500 acres, with a shoreline of about 420 miles. Currently, there are 10 marinas on Shasta Lake, most of which are located in coves. Although numerous campgrounds provide facilities for land-based recreation, the primary recreational use of the lake is water-based. Many types of boats use the lake, including private and commercial houseboats, powerboats, and personal watercraft.

The construction of Shasta Dam inundated the canyons of the Sacramento, Pit, and McCloud rivers, as well as numerous tributaries. The diversity of visual experiences at Shasta Lake and the surrounding slopes is influenced by fluctuating water levels, compounded by human-made features such as Interstate 5 (I-5), the Union Pacific Railroad (UPRR), and electrical transmission facilities. A variety of commercial and residential uses occurs in, on, or near Shasta Lake.

Shasta Lake is crossed from north to south by I-5 via the Pit River Bridge at the western end of the Pit Arm and the Antlers Bridge near the northern end of the Sacramento Arm. Views from both of these bridges are dominated by Shasta Lake and the surrounding landscapes; the views encompass minimal development, although Bridge Bay Resort can be clearly seen from the southbound lanes of the Pit River Bridge and some commercial and residential development can be seen from the Antlers Bridge.

The STNF LRMP classifies National Forest System (NFS) lands based on visual quality objectives (VQO). VQOs identify how much a management activity can contrast visually with the character of the landscape. The Shasta-Trinity Unit of the NRA includes lands managed by the STNF to meet the

following VQOs: modification, partial retention, and retention. Areas designated as "modification" are typically developed areas, such as campgrounds, marinas, and boat launch ramps, with management activities in the foreground and a natural appearance in the middle ground. "Partial retention" refers to those areas where management activities remain visually subordinate on the landscape. "Retention" areas are those where management activities are not visually evident.

The LRMP defines three principal criteria to classify VQOs: (1) sensitivity levels, (2) scenic quality of the landscape, and (3) distance from the main viewing areas. Table 19-1 compares the acreage of VQOs (as defined in the LRMP) to the total area of NFS lands managed by USFS in the Shasta-Trinity Unit of the NRA.

Table 19-1. Shasta-Trinity National Forest Inventoried Visual Quality Objectives

Inventoried VQO	NFS Lands (2,705,234 acres)		NRA Lands (Shasta-Trinity Unit) (121,505 acres)	
	Acres[1]	Percent[2]	Acres[3]	Percent[4]
Preservation	498,700	18	28,095	23
Retention	175,000	6	92,387	76
Partial Retention	590,600	22	0	0
Modification	597,600	22	1,112	1
Maximum Modification	259,100	10	0	0

Sources: (USFS 1995b, 2007)

Notes:

[1] Number of acres of lands of the VQO type in the LRMP management area (NFS land only)

[2] Percentage of lands of the VQO type in the LRMP management area (NFS land only)

[3] Number of acres of land by VQO type in the NRA (Shasta-Trinity Unit) management area (NFS land only)

[4] Percentage of lands by VQO type in the LRMP management area (NFS land only)

Key:

NFS = National Forest System

VQO = visual quality objective

In the NRA, Shasta Dam and Shasta Lake are the dominant components of the visual environment. The lake, combined with constructed facilities (e.g., Shasta Dam, Pit River Bridge, Bridge Bay Resort) and natural features (e.g., mountains, rivers, canyons, vegetation) observable from various locations have a substantial influence on the visual character of the existing landscape.

The remaining parts of this section describe the visual resources in the primary study area. Much of the content of these descriptions was taken from reconnaissance-level data gathered during the SLWRI by Reclamation and its consultants. The STNF also provided information used to characterize these

visual resources. Visual resources are described in terms of visual sensitivity and viewer response.

Viewsheds A number of factors can influence the aesthetic value of viewsheds in the primary study area, which are dominated by constructed features and natural landscapes. Although exposed surfaces associated with grading and barren shoreline may be obvious, factors such as vegetation, lighting, and glare can also substantially influence these viewsheds both spatially and temporally. The viewshed types that occur in the primary study area are listed below and described in the following sections:

- Panoramic views
- Vista points
- Landscape features
- Distinctive built features
- Built features (detractions)
- Exposed shoreline of Shasta Lake
- External views

Panoramic Views A panoramic view is defined as the unbroken view of an entire surrounding area. In the Shasta Dam and Shasta Lake area, panoramic viewing opportunities are governed by the elevation, aspect, and location of the viewer. The steep, mountainous topography around Shasta Lake largely influences the degree to which any given area can be seen from a particular vantage point. Vegetation, lighting, and glare also influence a panoramic view. For example, panoramic views as seen from the lake level vary greatly from those seen from the I-5 corridor higher up the slope.

The contrast between Shasta Lake and the surrounding mountains affords visitors a diversity of views from various locations around the lake. The length and configuration of the shoreline of Shasta Lake coupled with the mountainous terrain represent an important visual and scenic resource in the region.

Panoramic viewsheds are plentiful throughout the primary study area. Among the most dramatic and high-quality views is that of the so-called “Three Shastas,” consisting of Shasta Dam, Shasta Lake, and Mount Shasta. The photograph in Figure 19-1, taken from the State Route (SR) 151 vista point above the Shasta Dam Visitor Center, illustrates the Three Shastas with the dam in the foreground, the lake in the middle ground, and Mount Shasta in the background. This view is a widely publicized panorama that draws large numbers of visitors to the area annually. Class A and B views extend for miles to the north, east, and west from the SR 151 vista point.



Figure 19-1. Panoramic view of the Three Shastas (Shasta Dam, Shasta Lake, and Mount Shasta) as seen from the State Route 151 Vista Point

For purposes of this assessment, panoramic viewsheds consist primarily of views visible from locations immediately adjacent to or above Shasta Dam that are subject to heavy use (e.g., Bridge Bay Resort, Shasta Dam Visitor Center, the I-5 corridor). However, some less accessible, but nonetheless important, locations such as residences, campgrounds, marinas, and other facilities may also provide opportunities for panoramic views and thus have been included in the assessment of potential impacts on panoramic views.

Vista Points Vista points differ from panoramic views in the level of visible expanse. Panoramic views encompass an entire surrounding area, whereas views from vista points are limited by what can be seen through an opening, such as between rows of trees or buildings. Shasta Lake and the surrounding area offer almost limitless viewing opportunities. Viewsheds have been assessed based on sites that are representative of popular use areas such as marinas, residences, and other recreational features.



Figure 19-2. Typical View of Shasta Lake from a Lakeside Campsite (taken from the Dekkas Rock Campground, McCloud Arm)

Most of the shoreline around the lake (above the ordinary high-water line) is heavily vegetated and its topography varies significantly. Views from most onshore recreation areas are limited by stands of trees and undulating banks. Figure 19-2 shows a view of the lake from a typical lakeside campsite, in this case the Dekkas Rock Campground located on the McCloud Arm. Views of the shoreline from the water are also influenced by topography and vegetation. Although large expanses of the shoreline may be visible to boaters, lake elevation and bank topography ultimately determine what can be seen by boaters.

Landscape Features
"Landscape feature" is a term used to describe the land characteristics of a particular area, such as a forested or mountainous site. Several landscape features characterize the primary study area, including forest, rocky outcrops, and urban development. Well-known landscape features in the primary study area include Shasta Dam, Mount Shasta, the Sundial Bridge, and the Sacramento River. The distance of the feature upstream from Shasta Dam, coupled with variations in lake levels, influences the view of landscape features. As the lake level falls, the various arms look more like rivers (e.g., channelized, boulder-strewn) and less like a lake. Figure 19-3 illustrates some of the distinctive landscape features visible from the Bridge Bay Resort, including the marina, the Pit River Bridge, and limestone outcrops located along the McCloud Arm.



Figure 19-3. Some of the Distinctive Landscape Features Visible from the Bridge Bay Resort, Including a Portion of the Bridge Bay Marina, the Pit River Bridge, and Dramatic Limestone Outcrops Along the McCloud Arm

Distinctive Built Features The aesthetic quality of a distinctive built feature is subject to individual interpretation. This subjective interpretation is influenced by the contrast of these features with their setting. For example, engineered features such as Shasta Dam and its infrastructure (Figure 19-4) can be considered to detract from the "natural" character of the setting, because some viewers might argue that the natural character of the features inundated by Shasta Lake is its greatest strength. The dam, which was completed in 1945, is a curved concrete gravity-type dam containing 6.5 million cubic yards of concrete weighing 15 million tons. It is the second largest dam in mass in the United States. (Grand Coulee Dam on the Columbia River in Washington State is the largest.)

The 3,460-foot-long dam is 602 feet high, 543 feet thick at the bottom, and 30 feet thick at the top (Reclamation 2005). The face of the dam covers 31 acres,



Figure 19-4. Shasta Dam and Infrastructure

equal to six football fields and their stadiums, and the 487-foot spillway is the largest built waterfall in the world – three times the height of Niagara Falls. The spillway, as seen from the west, measures 375 feet in width with three drum gates, each 110 feet wide, 28 feet tall, and weighing 500 tons. There are 18 outlets on the face of the dam, each 8½ feet in diameter (large enough to drive a pickup truck through) with a maximum spillage capacity of 186,000 cubic feet per second.

With 420 miles of shoreline, Shasta Lake is the largest human-made lake in California. The water storage capacity is more than 4.5 million acre-feet. The surface area of the lake is 29,740 acres, and the lake drains 6,665 square miles (Reclamation 2005). The lake is one of the major landmarks in Northern California.

Built Features (Detractions) An opinion concerning the attractiveness of a built feature is formed by the viewer's perception, biases, and personal preferences. A feature seen as an eyesore by one viewer may very well be considered attractive by another. Built features such as bridges, structures, roads, power transmission lines, and water storage tanks are generally visible only from site-specific locations (e.g., the visitor center, marinas, sections of I-5) in the primary study area. Figure 19-5 shows an example of built features found in the primary study area (in this case, a railroad bridge in the foreground and the Antlers/I-5 Bridge in the background, as seen from Lakeshore Drive).



Figure 19-5. Examples of Built Features in the Primary Study Area

Additional built features of interest in the primary study area include bridges, roads, utilities, and commercial, administrative, and residential structures.

Exposed Shoreline of Shasta Lake Currently, Shasta Lake reaches or nearly reaches full-pool levels about once every 5 years. Because it is a reservoir, water levels fluctuate in response to climatic conditions and operational requirements. Typical operational scenarios involve drawing the reservoir down during the demand period (May through October) and storing runoff during the winter/spring period. By its nature, the amount of shoreline exposed below the 1,070-foot elevation fluctuates daily. In extremely dry years, more than 200 vertical feet of shoreline may be exposed for extended periods through the fall.

Unlike bodies of water that are influenced by tides or other natural fluctuations, Shasta Lake does not support habitats that can adapt to large changes in

environmental conditions. Therefore, the exposed shoreline below the ordinary high water line is essentially devoid of vegetation (Figure 19-6). The relatively gradual slope to the lake bottom results in a greater area of exposed shoreline with lower water levels, resulting in the "bathtub ring" effect common to California reservoirs (Reclamation 2006). As the elevation of the water level decreases, the viewing quality changes spatially and temporally. Erosional processes, primarily wave erosion, exacerbate this situation. The seasonal fluctuations in water levels and, consequently, the amount of exposed shoreline greatly affect the visual quality of Shasta Lake.

External Views A number of factors may affect the viewsheds described in the preceding section. Exposed surfaces associated with barren shoreline and activities such as grading may be obvious, but factors such as vegetation, lighting, and glare could also substantially affect these viewsheds both spatially and temporally.



Figure 19-6. The "Bathtub Ring" Effect

Topography and property boundaries influence the public's external views of the primary study area. Views of the lake from private property are infrequent. Most private properties are located some distance from the lake, and views of the lake are buffered by vegetation and the topography of NFS lands surrounding the lake. Nevertheless, some of the private properties in the vicinity of Shasta Lake have views of the lake, although the quality of these views varies. Figure 19-7 shows a view of Shasta Lake from a nearby residence (the McCloud Arm is seen in the middle ground and the Pit Arm in the background).



Figure 19-7. View of Shasta Lake from a Residence Located off Northwoods Road, Lakehead, California

Light and Glare A majority of the lands surrounding Shasta Lake are densely vegetated and undeveloped. As a result, there are relatively few sources of artificial light and glare in the Shasta

Lake and vicinity portion of the primary study area. The reaches of the upper Sacramento River that pass through developed communities, such as Redding and Anderson, do have substantial sources of light and glare, and, to a lesser degree, light and glare are observable between the City of Shasta Lake and Lakehead. Vehicle traffic and roadway lighting along the I-5 corridor, scattered residential and commercial development, and reflective surfaces such as boats and marinas are among the primary sources of light and glare. The Shasta Dam compound has a variety of sources of light and glare. The backdrop of Shasta Dam at night is nonetheless an attraction for visitors and residents.

Exposed bare mineral soils, which characterize the "bathtub ring" around the perimeter of the lake during periods of drawdown, are a potential source of glare (Figure 19-6). The chroma of these soils is generally light, and the contrast of the bathtub ring with upslope vegetation and downslope water is readily apparent from various distances.

Vegetation Vegetation is an important variable in characterizing visual conditions. The type, location, diversity, and distribution of vegetation influence form and texture, depending on the vantage point of the viewer. The diverse assemblage of vegetation and barren areas in and adjacent to the primary study area varies seasonally. As mentioned previously, forestlands surround Shasta Lake. The transition from chaparral/montane hardwood–dominated habitat at the southern end of the lake to a conifer-dominated forest to the north and east is apparent to travelers on I-5 as well as to people viewing the area from the lake level or a vista point.

Typically, vegetation extends from the ordinary high-water line of Shasta Lake into the adjacent uplands. Changes in vegetation type are apparent as the viewer's eye is drawn upward from lake level to surrounding ridgelines. Because there is no vegetation below the ordinary high-water line, a distinct demarcation is visible between upland vegetation and water levels as the reservoir fluctuates.

Viewer Groups The perceptions of viewers are influenced by their location, specific activities in which they are engaged, personal degree of awareness, and individual values and goals. Activities associated with the project could affect three distinct viewer groups: motorists, residents, and recreationists.

Motorists For the purposes of this report, motorists are people who view the primary study area from a moving vehicle. Motorists can be drivers or passengers. This group typically consists of commuters, local residents, business travelers, and tourists.

Tourists are often acutely aware of viewsheds. Business travelers, commuters, and local residents who travel the same routes frequently may become inured to a view but, at the same time, are more likely to be aware of visual changes than occasional passersby. In general, views of Shasta Lake from motorists on I-5 are

of short duration but relatively frequent from Bridge Bay north to Lakehead. The longest duration and most expansive panoramic view of Shasta Lake from I-5 occurs as the roadway approaches and crosses Shasta Lake over the Pit River Bridge from both the north and the south. Traveling this route at a speed of 55 miles per hour, the viewer would be able to observe the lake and its vicinity for approximately 1 minute. Other I-5 views may vary from 4 to 16 seconds, depending on the direction and speed of travel.

Less traveled roads in the vicinity of Shasta Lake, such as SR 151, Salt Creek Road, and Gilman Road, also offer views of the lake. Most views of the lake from these roads are limited to vistas (views framed by trees or structures) and are, therefore, of short duration. However, one of the best vantage points from which to view the Three Shastas is at an overlook along SR 151, a state scenic highway (Figure 19-1). Motorists traveling north who do not stop at the overlook also see a spectacular view of the Three Shastas while traveling, although the view is of short duration.

Residents For the purposes of this report, residents are people whose homes, businesses, and/or property are near, and have a view of, a portion of the primary study area. The sensitivity of residents to aesthetic values and changes to a viewshed is highly individual. In addition, the sensitivity of residents to changes in a viewshed is influenced, in part, by the location and the length of time that the view from a particular location appears altered from its previous condition (e.g., temporary changes during construction or long-term modifications to the landscape).

Views of Shasta Lake from private properties are limited by land ownership patterns – most of the lands surrounding Shasta Lake are Federally owned – as well as access, vegetation, and topography. Homes on nearby ridges, such as those on the ridgeline between Packers Bay and Turntable Bay, typically have partial views of Shasta Lake. Similarly, homes clustered along the Sacramento Arm near Lakehead have views upstream and downstream from the arm, although the views are limited by the steep topography.

Recreationists For the purposes of this report, recreationists are people who use the lands in the NRA for recreation. Like residents, recreational users of Shasta Lake are highly sensitive to the visual character of Shasta Lake and the surrounding environment.

Recreationists are people who participate in land-based activities, such as hiking along the shoreline, camping in the NRA's many campgrounds, or water-based activities, such as boating, fishing, or rafting. Several commercial facilities offer overnight accommodations adjacent to the shoreline. Recreational users often have a unique perspective on the surrounding environment.

Visual Assessment Units and Key Observation Points Visual assessment units (VAU) are areas of distinct visual character in a viewshed that provide a

framework for comparing the visual effects of alternatives. Key observation points (KOP) are commonly traveled routes or other likely observation points in a VAU from which a representative group (motorists, residents, and recreationists) can observe a viewshed.

VAUs are defined by areas where the features or activities associated with the project would occur in the line of sight of a KOP and represent foreground or middle ground views (i.e., within 4 miles of a KOP in the VAU). KOPs were established at locations from which portions of the primary study area can clearly be seen by members of the various viewer groups. Table 19-2 lists the KOPs established in the primary study area. Locations of VAUs and KOPs are shown in Figures 19-8a through 19-8h. Photographs taken from each KOP are provided after each figure.

Table 19-2. Key Observation Points

VAU	Figure	KOP #	Photo #	Description of Key Observation Point
Shasta Dam	19-8a	1	1a	View of the Three Shastas (Shasta Dam, Shasta Lake, and Mount Shasta) from the SR 151 overlook above the Shasta Dam Visitor Center and downstream from Shasta Dam
		1	1b	View of the upper Sacramento River below Shasta Dam from the SR 151 overlook above the Shasta Dam Visitor Center and downstream from Shasta Dam
		2	2a	View of the Main Body of Shasta Lake from Shasta Dam
		2	2b	View of the Shasta Dam spillway and the upper Sacramento River from Shasta Dam
		2	2c	View of the Centimudi Boat Ramp from Shasta Dam
		3	3a	View from the Chappie-Shasta OHV Area staging area looking northeast
		3	3b	View from the Chappie-Shasta OHV Area staging area looking south
		4	4a	View from the Chappie-Shasta OHV Area campground looking northeast
		4	4b	View from the Chappie-Shasta OHV Area campground looking southwest
		5	5a	View from the Coram Ranch River House looking northeast
		5	5b	View from the Coram Ranch River House looking southeast
		6	6a	View from the Coram Ranch Dogwood House looking northeast
		6	6b	View from the Coram Ranch Dogwood House looking southeast
		7	7a	View from the Coram Ranch residence looking northeast
		7	7b	View from the Coram Ranch residence looking east

Table 19-2. Key Observation Points (contd.)

VAU	Figure	KOP #	Photo #	Description of Key Observation Point
Shasta Dam (contd.)	19-8a (contd.)	7	7c	View from the Coram Ranch residence looking southeast
		8	8	View from the Coram Ranch guest quarters looking northeast
		9	9a	View from the road above the Chappie-Shasta OHV Area staging area looking northeast
		9	9b	View from the road above the Chappie-Shasta OHV Area staging area looking southwest
		10	10a	View of Shasta Dam from a pullout east of the dam on Lake Boulevard looking northwest
		10	10b	View of Shasta Lake from a pullout east of the dam on Lake Boulevard looking northeast
		11	11	View of Shasta Dam from the Main Body of Shasta Lake
Dry Creek Trail	19-8b	1	1	View of Dry Creek Trail northwest of Shasta Dam looking west from the Main Body of Shasta Lake
Little Backbone Inlet	19-8b	1	1a	View of the mouth of Little Backbone inlet looking northeast from the Main Body of Shasta Lake
		1	1b	View of the mouth of Little Backbone inlet looking northwest from the Main Body of Shasta Lake
Digger Bay	19-8b	1	1	View of the Main Body of Shasta Lake from the upper parking area west of the Digger Bay boat ramp
		2	2	View of the upper parking area at Digger Bay Marina looking east
		3	3a	View of Digger Bay Marina looking northwest from the boat ramp
		3	3b	View of Digger Bay Marina shoreline looking west from the boat ramp
		3	3c	View of the Digger Bay Boat Ramp and parking area looking south from the marina
Packers Bay	19-8c	1	1	View of Packers Bay from the Packers Bay Boat Ramp
Bridge Bay	19-8c	1	1a	View of Bridge Bay looking north from the Bridge Bay store
		1	1b	View of Bridge Bay looking northwest from the parking lot of the Bridge Bay store
		2	2	View of the I-5/Pit River Bridge from Bridge Bay
		3	3a	View of the Union Pacific Railroad train tunnel looking south from the Bridge Bay Resort maintenance area
		3	3b	View of the Union Pacific Railroad train tunnel looking north from the Bridge Bay Resort maintenance area

Table 19-2. Key Observation Points (contd.)

VAU	Figure	KOP #	Photo #	Description of Key Observation Point
Bridge Bay (contd.)	19-8 (contd.)	3	3c	View of Bridge Bay Marina 4 from the Bridge Bay Resort maintenance parking area
		4	4a	View of the south shoreline from Bridge Bay Marina 4 stairway
		4	4b	View looking northwest from Bridge Bay Marina 4 stairway
Sacramento Arm	19-8d	1	1	View of the Sacramento Arm from Riverview Drive southbound near the community of Pollock
		2	2	View of the Sacramento Arm from Riverview Drive southbound near the community of Pollock
		3	3	View of the Sacramento Arm looking east from the Donley Creek Bridge on Lakeshore Drive near the community of Lakehead
		4	4a	View of the Sacramento Arm from Lakeshore East Campground near the community of Lakeshore
		4	4b	View of the Sacramento Arm looking southeast from Lakeshore East Campground
		5	5a	View of the inlet looking northwest from Charlie Creek Bridge on Lakeshore Drive
		5	5b	View of the Sacramento Arm looking south from Charlie Creek Bridge on Lakeshore Drive
		6	6a	View of the Sacramento Arm from the Beehive Campground access road near Lakeshore
		6	6b	View of Sugarloaf Creek inlet/Sacramento Arm from Beehive Campground near Lakeshore
		6	6c	View of Sugarloaf Creek inlet/Sacramento Arm from Beehive Campground near Lakeshore
		7	7a	View of Sugarloaf Cove near Lakeshore from north shore looking south
		7	7b	View of Sugarloaf Cove from north shore looking northwest
		8	8	View of Sugarloaf Marina from the end of Daisy Lane
		9	9a	View looking south from Sugarloaf Resort Marina access
		9	9b	View toward the Salt Creek inlet from Sugarloaf Resort Marina access
		9	9c	View of Sugarloaf Marina from Sugarloaf Resort
		10	10a	View looking south toward Sugarloaf Marina from the Sugarloaf Boat Ramp

Table 19-2. Key Observation Points (contd.)

VAU	Figure	KOP #	Photo #	Description of Key Observation Point
Sacramento Arm (contd.)	19-8d (contd.)	10	10b	View looking southeast at the Sacramento Arm from the Sugarloaf Boat Ramp
		10	10c	View looking northeast at the Sacramento Arm from the Sugarloaf Boat Ramp entrance
		11	11a	View looking east from the Tsasdi Resort Marina
		11	11b	View looking south from the Tsasdi Resort Marina
		12	12a	View looking east toward I-5 from Lakeshore Resort Campground
		12	12b	View looking southeast from the Lakeshore Resort Campground
		13	13	View of the Salt Creek inlet looking south from the Oak Grove Day Use Area
		14	14a	View looking northeast from Lower Salt Creek Road at the Salt Creek Resort
		14	14b	View looking northwest from Lower Salt Creek Road at the Salt Creek Resort
		15	15a	View of the Salt Creek inlet from Lower Salt Creek Road
		15	15b	View of the Salt Creek inlet from Lower Salt Creek Road
		16	16	View of Antlers Bridge/I-5 looking southwest from Antlers Public Boat Ramp
		17	17a	View of Antlers Public Boat Ramp/Picnic Area parking lot from picnic area looking north
		17	17b	View of Sacramento Arm from Antlers Public Boat Ramp/Picnic Area from picnic area looking south
		18	18a	View from typical campsite at Antlers Resort looking north
		18	18b	View from typical campsite at Antlers Resort looking east
		18	18c	View from typical campsite at Antlers Resort looking southwest
McCloud Arm	19-8e	1	1	View of the McCloud Arm, Turntable Bay, and vicinity from a residence located off of Northwoods Road, west of I-5
		2	2	View of Turntable Bay from the McCloud Arm of Shasta Lake
		3	3	View of the Bailey Cove Boat Ramp from the Bailey Cove parking lot
		4	4	View of Holiday Harbor from the Bailey Cove Day Use Area
		5	5	View of Holiday Harbor from the Holiday Harbor Campground entrance

Table 19-2. Key Observation Points (contd.)

VAU	Figure	KOP #	Photo #	Description of Key Observation Point
McCloud Arm (contd.)	19-8e (contd.)	6	6	View looking south toward the McCloud Arm from the Shasta Caverns parking lot
		7	7	View from the Lakeview Resort caretaker residence
		8	8a	View of the McCloud Arm looking south from the Lakeview Resort boat ramp
		8	8b	View of the McCloud Arm looking northeast from the Lakeview Resort boat ramp
		8	8c	View of the Lakeview Resort Marina from the Lakeview Resort boat ramp
		9	9	View of Lakeview Resort from the McCloud Arm of Shasta Lake
		10	10	View of Shasta Caverns dock on east side of lake from the McCloud Arm of Shasta Lake
		11	11a	View of the McCloud Arm downstream from the Hirz Bay Boat Ramp
		11	11b	View of the McCloud Arm upstream from the Hirz Bay Boat Ramp
		12	12	View of Hirz Bay from the McCloud Arm of Shasta Lake
		13	13a	View of Campbell Creek inlet looking southeast from the McCloud Arm of Shasta Lake
		13	13b	View of Campbell Creek inlet looking east from the McCloud Arm of Shasta Lake
		14	14a	View of the McCloud Arm downstream, from the Dekkas Rock Campground
		14	14b	View of the McCloud Arm upstream, from the Dekkas Rock Campground
		15	15a	View of the McCloud River upstream, from the McCloud River Bridge
		15	15b	View of the McCloud River downstream, from the McCloud River Bridge
		16	16	View of the McCloud River Bridge, from the eastern approach
		17	17	View of the McCloud Arm from Space 10, McCloud Bridge Campground
		18	18a	View of the McCloud Arm from open area west of Space 1, McCloud Bridge Campground
		18	18b	View of the McCloud Arm from open area west of Space 1, McCloud Bridge Campground

Table 19-2. Key Observation Points (contd.)

VAU	Figure	KOP #	Photo #	Description of Key Observation Point
McCloud Arm (contd.)	19-8e (contd.)	18	18c	View looking west from the open area west of Space 1, McCloud Bridge Campground
Pit Arm	19-8f	1	1a	View of the Pit Arm from the Jones Valley parking area, looking northwest
		1	1b	View of the Pit Arm from the Jones Valley parking area, looking northeast
		2	2	View of the Pit Arm from the Jones Valley parking area (west end), looking west
		3	3	View of the Pit Arm from the entrance to the Jones Valley Campground
		4	4	View of the Pit Arm looking north from the Jones Valley Resort boat ramp
		5	5	View of the Pit Arm from Juniper Drive, Silverthorn Resort
		6	6a	View of the Silverthorn Marina from the top of the boat ramp looking east
		6	6b	View of the Silverthorn Marina from the top of the boat ramp looking northeast
		6	6c	View of the Silverthorn Marina from the top of the boat ramp looking north
		7	7	View of the Silverthorn Marina looking south from the Pit Arm of Shasta Lake
		8	8	View of the west side of Ski Island looking east from Shasta Lake
Squaw Arm	19-8g	1	1	View of Bully Hill looking north from the Squaw Arm of Shasta Lake
		2	2	View of Monday Flat looking north from the Squaw Arm of Shasta Lake
I-5 Corridor	19-8h	1	1a	View of the Pit Arm (right) and the McCloud Arm (left) from the Pit River Bridge, as seen from I-5 northbound
		1	1b	View of Bridge Bay Resort from the Pit River Bridge, as seen from I-5 southbound
		2	2	View of the Pit River Bridge looking west from the Pit Arm of Shasta Lake
		3	3a	View of the Sacramento Arm looking toward the Antlers Campground from the Antlers Bridge, as seen from I-5 northbound
		3	3b	View of the Antlers Public Boat Launch from the Antlers Bridge, as seen from I-5 northbound

Table 19-2. Key Observation Points (contd.)

VAU	Figure	KOP #	Photo #	Description of Key Observation Point
I-5 Corridor	19-8h	4	4	View of the Sacramento Arm west of the Antlers Bridge, as seen from I-5 southbound
		5	5	View of the McCloud Arm and vicinity at Turntable Bay, as seen from I-5 northbound

Key:
I-5 = Interstate 5
KOP = key observation point
OHV = off-highway vehicle
SR = State Route
VAU = visual assessment unit

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Figure 19-8a. Visual Assessment Unit and Key Observation Points



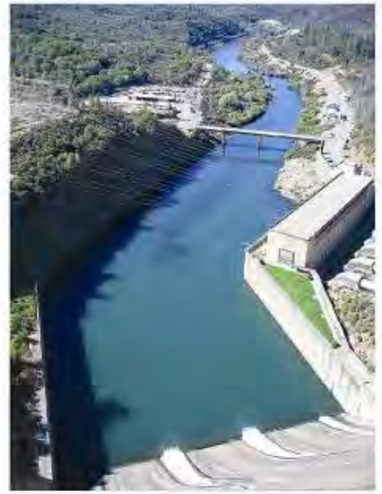
Shasta Dam VAU, KOP 1, Photo 1a
View of the Three Shastas (Shasta Dam, Shasta Lake, and Mount Shasta) from the SR 151 overlook above the Shasta Dam Visitor Center and downstream of Shasta Dam.



Shasta Dam VAU, KOP 1, Photo 1b
View of the upper Sacramento River below Shasta Dam from the SR 151 overlook above the Shasta Dam Visitor Center and downstream of Shasta Dam.



Shasta Dam VAU, KOP 2, Photo 2a
View of the main body of Shasta Lake from Shasta Dam.



Shasta Dam VAU, KOP 2, Photo 2b
View of the Shasta Dam spillway and the upper Sacramento River from Shasta Dam.



Shasta Dam VAU, KOP 2, Photo 2c
View of the Centimudi Boat Launch from Shasta Dam.



Shasta Dam VAU, KOP 3, Photo 3a
View from the Chappie - Shasta Off-Highway Vehicle (OHV) Area staging area looking northeast.



Shasta Dam VAU, KOP 3, Photo 3b
View from the Chappie - Shasta OHV Area staging area looking south.



Shasta Dam VAU, KOP 4, Photo 4a
View from the Chappie - Shasta OHV Area campground looking northeast.

Photographs for Figure 19-8a, Page 1



Shasta Dam VAU, KOP 4, Photo 4b
View from the Chappie - Shasta OHV Area campground looking southwest.



Shasta Dam VAU, KOP 5, Photo 5a
View from the Coram Ranch River House looking northeast.



Shasta Dam VAU, KOP 5, Photo 5b
View from the Coram Ranch River House looking southeast.



Shasta Dam VAU, KOP 6, Photo 6a
View from the Coram Ranch Dogwood House looking northeast.



Shasta Dam VAU, KOP 6, Photo 6b
View from the Coram Ranch Dogwood House looking southeast.



Shasta Dam VAU, KOP 7, Photo 7a
View from the Coram Ranch Residence looking northeast.



Shasta Dam VAU, KOP 7, Photo 7b
View from the Coram Ranch Residence looking east.



Shasta Dam VAU, KOP 7, Photo 7c
View from the Coram Ranch Residence looking southeast.

Photographs for Figure 19-8a, Page 2



Shasta Dam VAU, KOP 8, Photo 8
View from the Coram Ranch Guest Quarters looking northeast.



Shasta Dam VAU, KOP 9, Photo 9a
View from the road above the Chappie - Shasta OHV Area staging area looking northeast.



Shasta Dam VAU, KOP 9, Photo 9b
View from the road above the Chappie - Shasta OHV Area staging area looking southwest.



Shasta Dam VAU, KOP 10, Photo 10a
View of Shasta Dam from pullout east of the dam on Lake Boulevard looking northwest.



Shasta Dam VAU, KOP 10, Photo 10b
View of Shasta Lake from pullout east of the dam on Lake Boulevard looking northeast.



Shasta Dam VAU, KOP 11, Photo 11
View of Shasta Dam from the main body of Shasta Lake.

Photographs for Figure 19-8a, Page 3

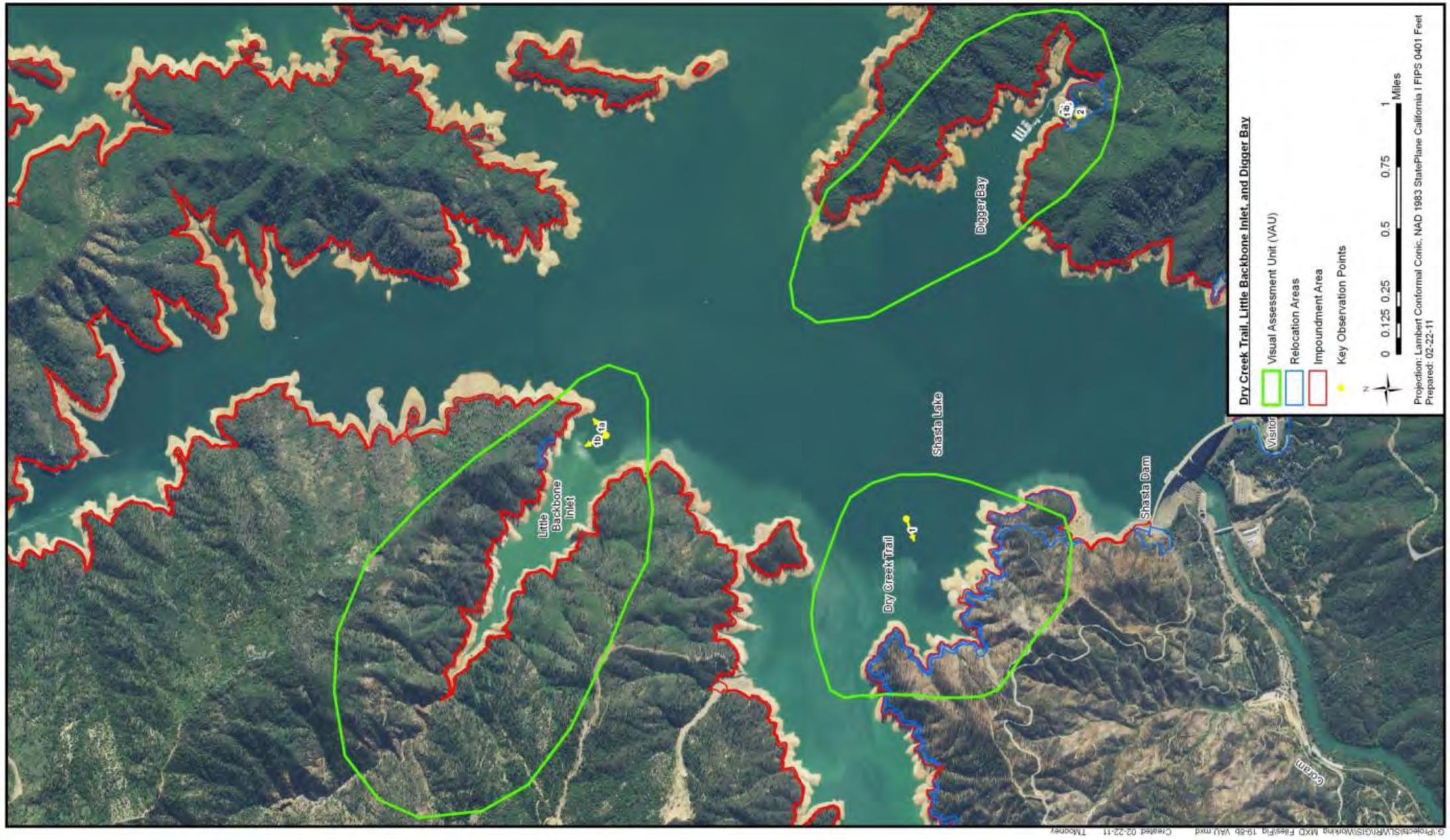


Figure 19-8b. Visual Assessment Unit and Key Observation Points



Dry Creek Trail VAU, KOP1, Photo 1
View of Dry Creek Trail northwest of Shasta Dam looking west from the main body of Shasta Lake.



Little Backbone Inlet VAU, KOP 1, Photo 1a
View of the mouth of Little Backbone inlet looking northeast from the main body of Shasta Lake.



Little Backbone Inlet VAU, KOP 1, Photo 1b
View of the mouth of Little Backbone inlet looking northwest from the main body of Shasta Lake.



Digger Bay VAU, KOP 1, Photo 1
View of the main body of Shasta Lake from the upper parking area west of the Digger Bay Boat Ramp.



Digger Bay VAU, KOP 2, Photo 2
View of the upper parking area at Digger Bay Marina looking east.



Digger Bay VAU, KOP 3, Photo 3a
View of Digger Bay Marina looking northwest from boat ramp.



Digger Bay VAU, KOP 3, Photo 3b
View of Digger Bay Marina shoreline looking west from boat ramp.



Digger Bay VAU, KOP 3, Photo 3c
View of Digger Bay Boat Ramp and parking area looking south from marina.

Photographs for Figure 19-8b, Page 1



Figure 19-8c. Visual Assessment Unit and Key Observation Points



Packers Bay VAU, KOP 1, Photo 1
View of Packers Bay from the Packers Bay Boat Ramp.



Bridge Bay VAU, KOP 1, Photo 1a
View of Bridge Bay looking north from the Bridge Bay store.



Bridge Bay VAU, KOP 1, Photo 1b
View of Bridge Bay looking northwest from the parking lot of the Bridge Bay store.



Bridge Bay VAU, KOP 2, Photo 2
View of the I-5/Pit River Bridge from Bridge Bay.



Bridge Bay VAU, KOP 3, Photo 3a
View of the Union Pacific Railroad train tunnel looking south from the Bridge Bay Resort maintenance area.



Bridge Bay VAU, KOP 3, Photo 3b
View of the Union Pacific Railroad train tunnel looking north from the Bridge Bay Resort maintenance area.



Bridge Bay VAU, KOP 3, Photo 3c
View of Bridge Bay Marina 4 from the Bridge Bay Resort maintenance parking area.



Bridge Bay VAU, KOP 4, Photo 4a
View of the south shoreline from Bridge Bay Marina 4 stairway.

Photographs for Figure 19-8c, Page 1



Bridge Bay VAU, KOP 4, Photo 4b
View looking northwest from Bridge Bay Marina 4 stairway.

Photographs for Figure 19-8c, Page 2

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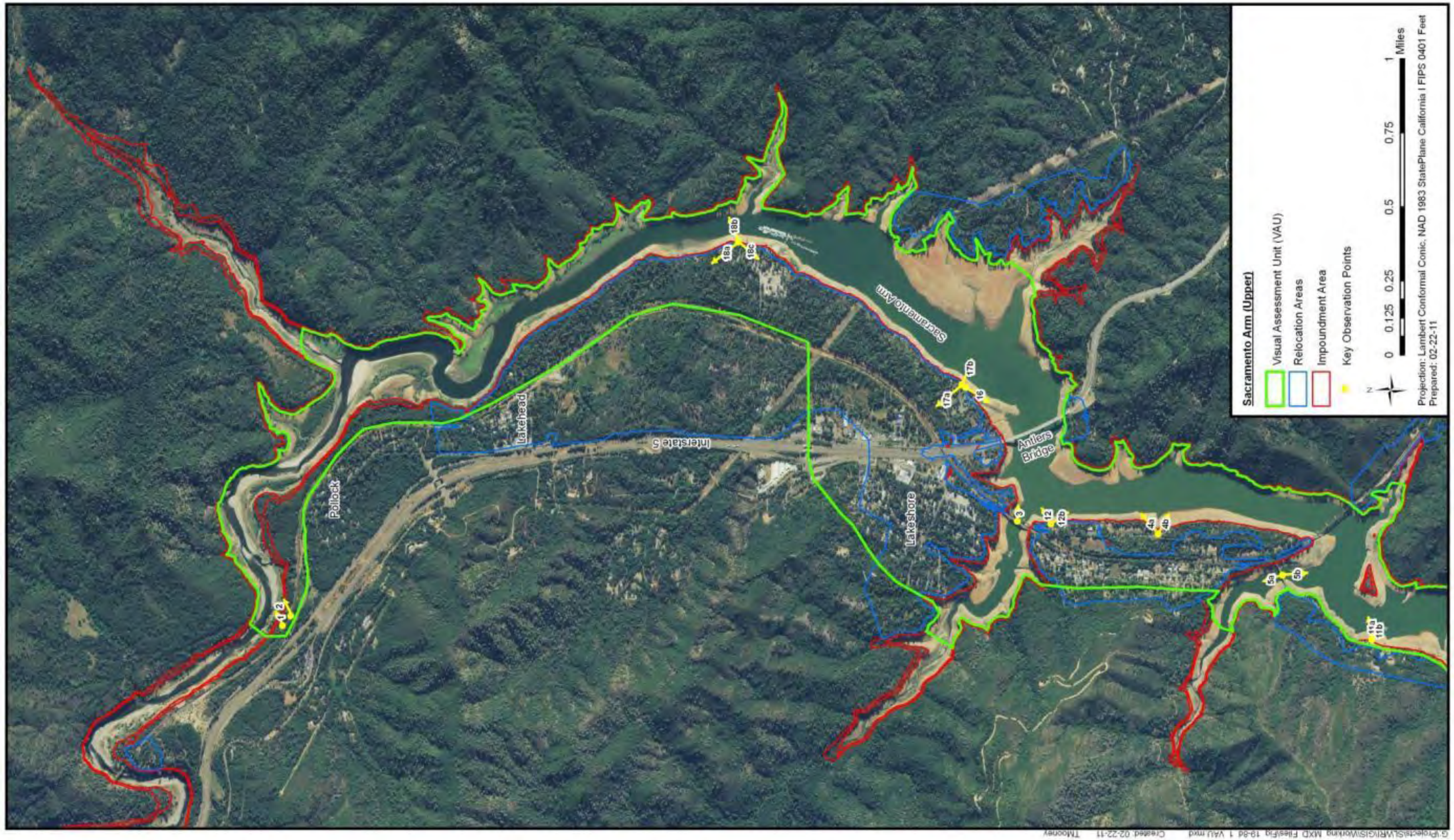


Figure 19-8d. Page 1 – Visual Assessment Unit and Key Observation Points

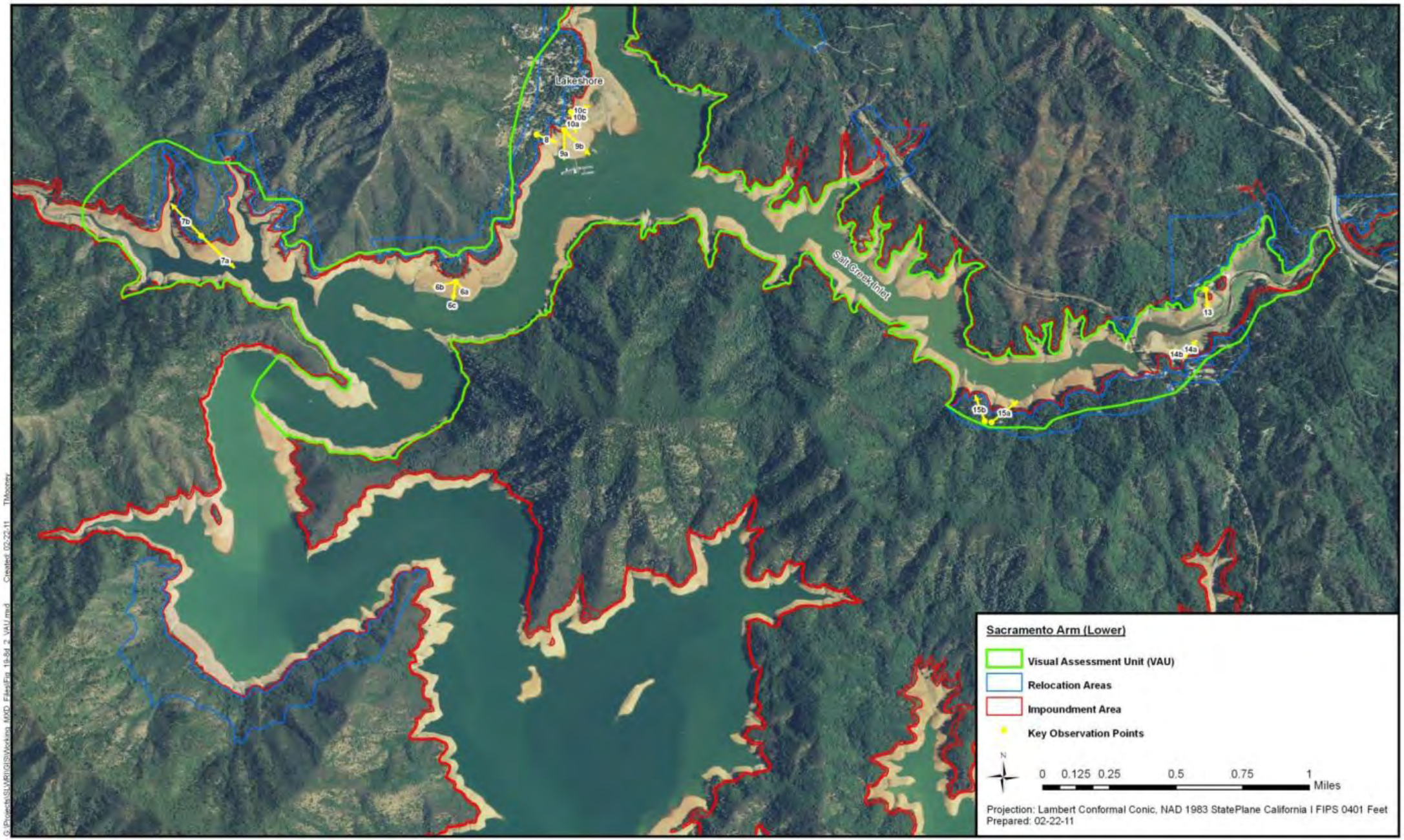


Figure 19-8d. Page 2 – Visual Assessment Unit and Key Observation Points



Sacramento Arm VAU, KOP 1, Photo 1
View of the Sacramento Arm from Riverview Drive southbound near the community of Pollock.



Sacramento Arm VAU, KOP 2, Photo 2
View of the Sacramento Arm from Riverview Drive southbound near the community of Pollock.



Sacramento Arm VAU, KOP 3, Photo 3
View of the Sacramento Arm looking east from the Donley Creek Bridge on Lakeshore Drive near the community of Lakehead.



Sacramento Arm VAU, KOP 4, Photo 4a
View of the Sacramento Arm from Lakeshore East Campground near the community of Lakeshore.



Sacramento Arm VAU, KOP 4, Photo 4b
View of the Sacramento Arm looking southeast from the Lakeshore East Campground.



Sacramento Arm VAU, KOP 5, Photo 5a
View of the inlet looking northwest from Charley Creek Bridge on Lakeshore Drive.



Sacramento Arm VAU, KOP 5, Photo 5b
View of the Sacramento Arm looking south from Charley Creek Bridge on Lakeshore Drive.



Sacramento Arm VAU, KOP 6, Photo 6a
View of the Sacramento Arm from the Beehive Campground access road near Lakeshore.

Photographs for Figure 19-8d, Page 1



Sacramento Arm VAU, KOP 6, Photo 6b
View of Sugarloaf Creek inlet/Sacramento Arm from Beehive Campground near Lakeshore.



Sacramento Arm VAU, KOP 6, Photo 6c
View of Sugarloaf Creek/Sacramento Arm from Beehive Campground near Lakeshore.



Sacramento Arm VAU, KOP 7, Photo 7a
View of Sugarloaf Cove near Lakeshore from north shore looking south.



Sacramento Arm VAU, KOP 7, Photo 7b
View of Sugarloaf Cove from north shore looking northwest.



Sacramento Arm VAU, KOP 8, Photo 8
View of Sugarloaf Marina from the end of Daisy Lane.



Sacramento Arm VAU, KOP 9, Photo 9a
View looking south from Sugarloaf Resort Marina access.



Sacramento Arm VAU, KOP 9, Photo 9b
View toward the Salt Creek Inlet from Sugarloaf Resort Marina access.



Sacramento Arm VAU, KOP 9, Photo 9c
View of Sugarloaf Marina from Sugarloaf Resort.

Photographs for Figure 19-8d, Page 2



Sacramento Arm VAU, KOP 10, Photo 10a
View looking south toward Sugarloaf Marina from the Sugarloaf Boat Ramp.



Sacramento Arm VAU, KOP 10, Photo 10b
View looking southeast at the Sacramento Arm from the Sugarloaf Boat Ramp.



Sacramento Arm VAU, KOP 10, Photo 10c
View looking northeast at the Sacramento Arm from the Sugarloaf Boat Ramp entrance.



Sacramento Arm VAU, KOP 11, Photo 11a
View looking east from the Tsasdi Resort Marina.



Sacramento Arm VAU, KOP 11, Photo 11b
View looking south from the Tsasdi Resort Marina.



Sacramento Arm VAU, KOP 12, Photo 12a
View looking east toward I-5 from the Lakeshore Resort Campground.



Sacramento Arm VAU, KOP 12, Photo 12b
View looking southeast from the Lakeshore Resort Campground.



Sacramento Arm VAU, KOP 13, Photo 13
View of the Salt Creek Inlet looking south from the Oak Grove Day Use Area.

Photographs for Figure 19-8d, Page 3



Sacramento Arm VAU, KOP 14, Photo 14a
View looking northeast from Lower Salt Creek Road at the Salt Creek Resort.



Sacramento Arm VAU, KOP 14, Photo 14b
View looking northwest from Lower Salt Creek Road at the Salt Creek Resort.



Sacramento Arm VAU, KOP 15, Photo 15a
View of the Salt Creek Inlet from Lower Salt Creek Road.



Sacramento Arm VAU, KOP 15, Photo 15b
View of the Salt Creek Inlet from Lower Salt Creek Road.



Sacramento Arm VAU, KOP 16, Photo 16
View of Antlers Bridge/I-5 looking southwest from Antlers Public Boat Ramp.



Sacramento Arm VAU, KOP 17, Photo 17a
View of Antlers Public Boat Ramp/Picnic Area parking lot from picnic area looking north.



Sacramento Arm VAU, KOP 17, Photo 17b
View of Sacramento Arm from Antlers Public Boat Ramp/Picnic Area from picnic area looking south.



Sacramento Arm VAU, KOP 18, Photo 18a
View from typical campsite at Antlers Resort looking north.

Photographs for Figure 19-8d, Page 4



Sacramento Arm VAU, KOP 18, Photo 18b
View from typical campsite at Antlers Resort looking east.



Sacramento Arm VAU, KOP 18, Photo 18c
View from typical campsite at Antlers Resort looking southwest.

Photographs for Figure 19-8d, Page 5

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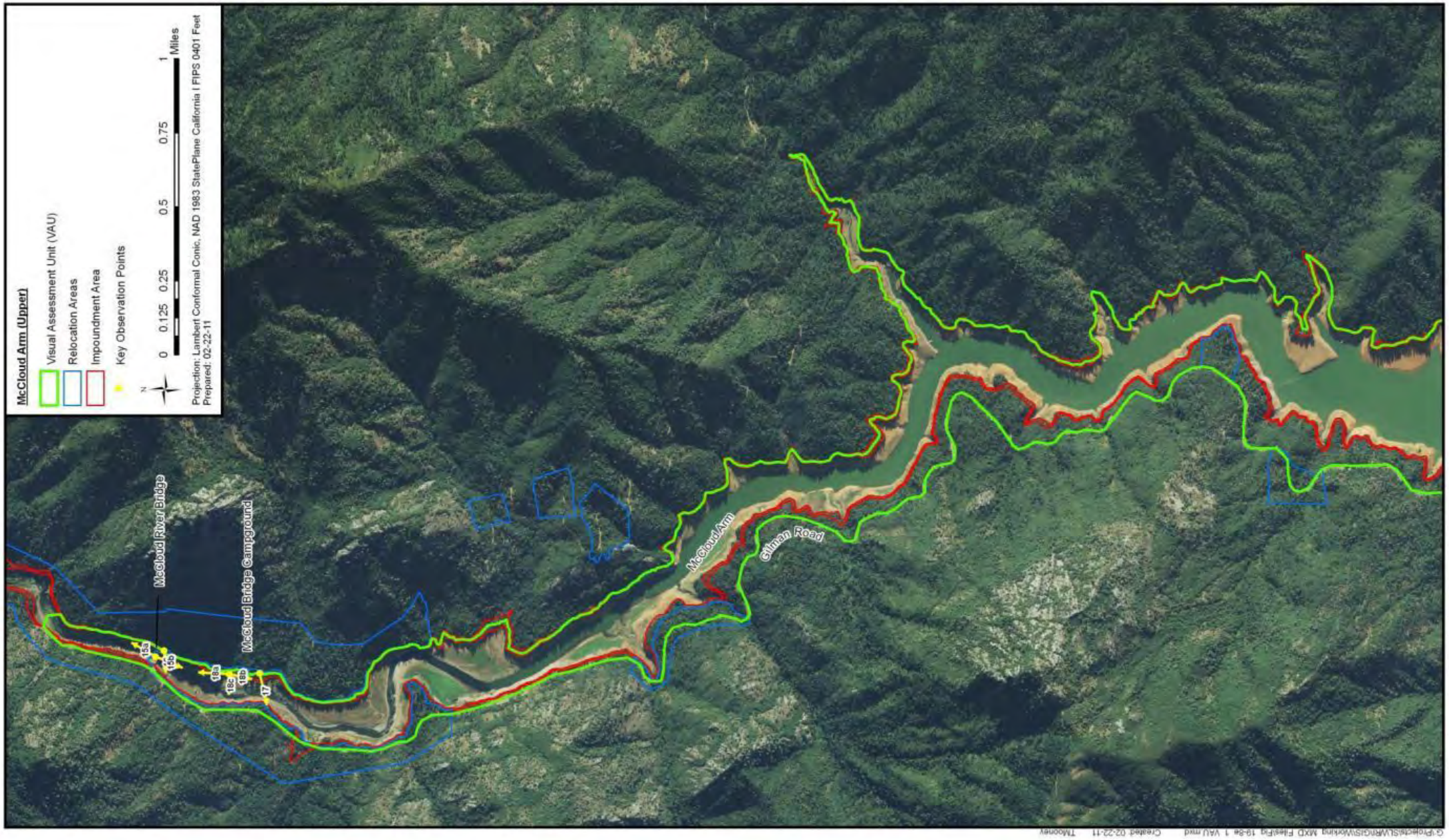


Figure 19-8e. Page 1 – Visual Assessment Unit and Key Observation Points

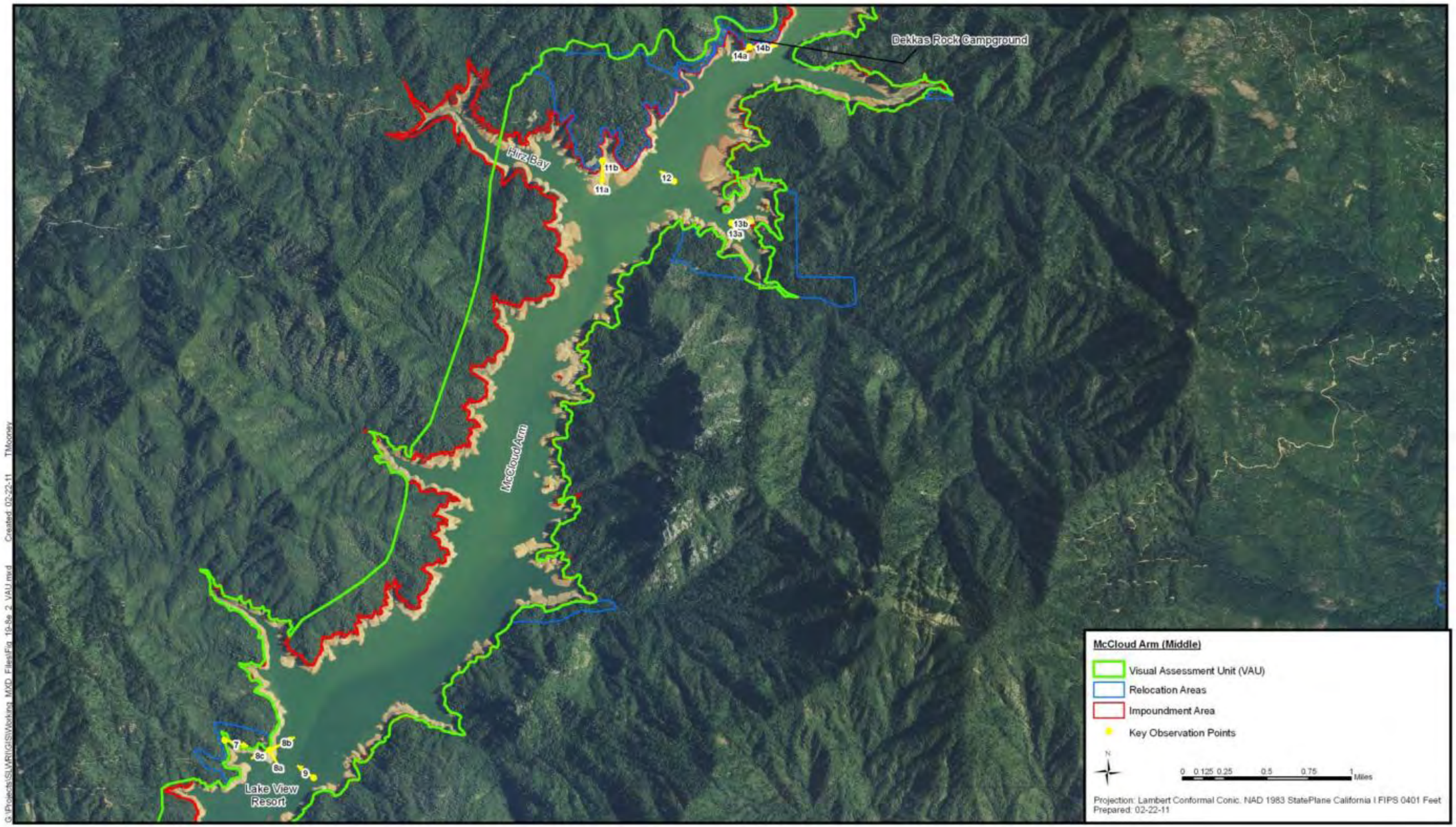


Figure 19-8e. Page 2 – Visual Assessment Unit and Key Observation Points

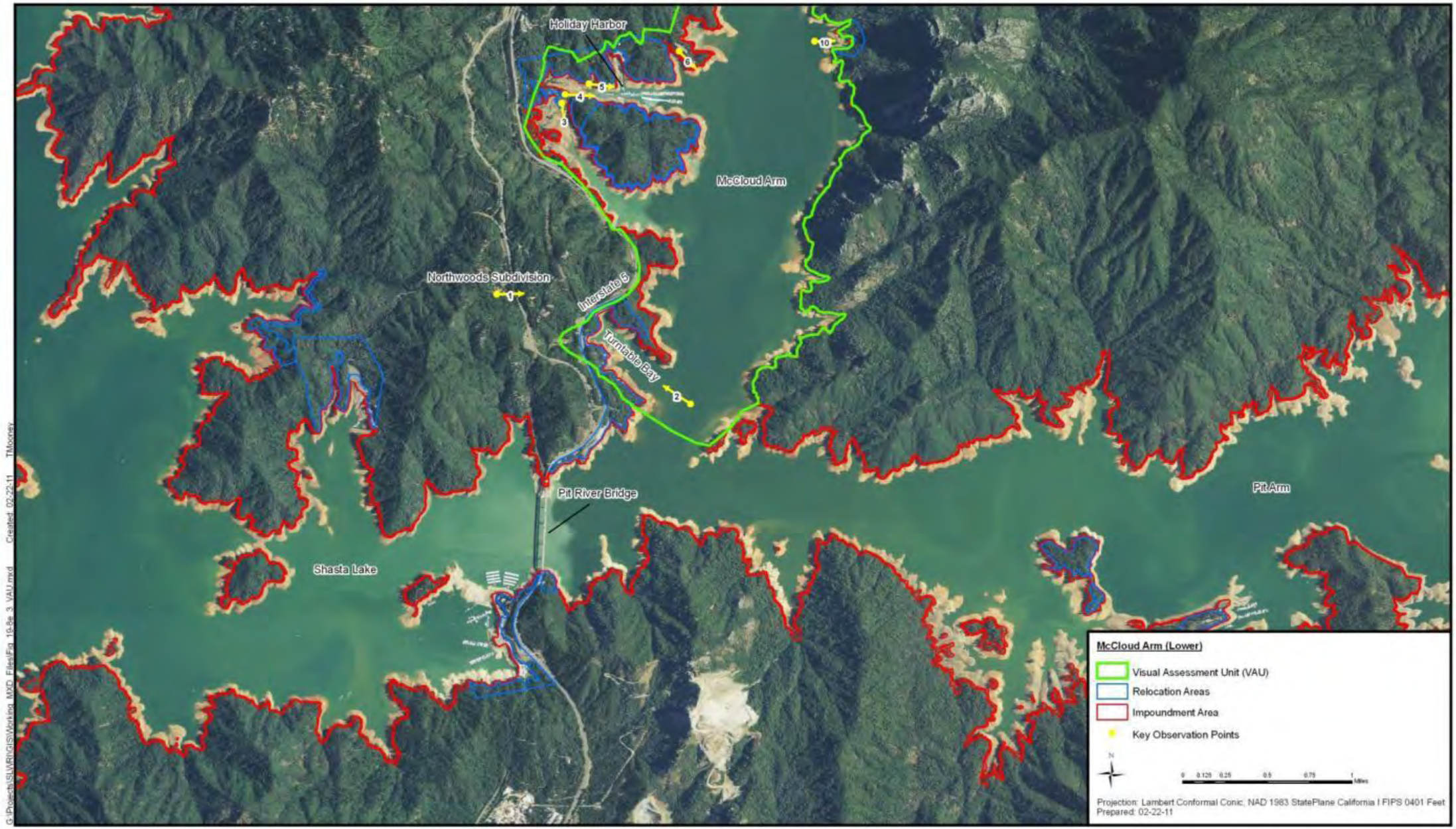


Figure 19-8e. Page 3 – Visual Assessment Unit and Key Observation Points



McCloud Arm VAU, KOP 1, Photo 1
View of the McCloud Arm, Turntable Bay and vicinity from a home located off of Northwoods Road, west of I-5.



McCloud Arm VAU, KOP 2, Photo 2
View of Turntable Bay from the McCloud Arm of Shasta Lake.



McCloud Arm VAU, KOP 3, Photo 3
View of the Bailey Cove Boat Ramp from the Bailey Cove parking lot.



McCloud Arm VAU, KOP 4, Photo 4
View of Holiday Harbor from the Bailey Cove Day Use Area.



McCloud Arm VAU, KOP 5, Photo 5
View of Holiday Harbor from the Holiday Harbor Campground entrance.



McCloud Arm VAU, KOP 6, Photo 6
View looking south toward the McCloud Arm from the Shasta Caverns parking lot.



McCloud Arm VAU, KOP 7, Photo 7
View from the Lake View Resort caretaker residence.



McCloud Arm VAU, KOP 8, Photo 8a
View of the McCloud Arm looking south from the Lake View Resort Boat Ramp.

Photographs for Figure 19-8e, Page 1



McCloud Arm VAU, KOP 8, Photo 8b
View of the McCloud Arm looking northeast from the Lake View Resort Boat Ramp.



McCloud Arm VAU, KOP 8, Photo 8c
View of the Lake View Resort Marina from the Lake View Resort Boat Ramp.



McCloud Arm VAU, KOP 9, Photo 9
View of Lake View Resort from the McCloud Arm of Shasta Lake.



McCloud Arm VAU, KOP 10, Photo 10
View of Shasta Caverns dock on east side of lake from the McCloud Arm of Shasta Lake.



McCloud Arm VAU, KOP 11, Photo 11a
View of the McCloud Arm downstream from the Hirz Bay Boat Ramp.



McCloud Arm VAU, KOP 11, Photo 11b
View of the McCloud River Arm upstream, from the Hirz Bay Boat Ramp.



McCloud Arm VAU, KOP 12, Photo 12
View of Hirz Bay from the McCloud Arm of Shasta Lake.



McCloud Arm VAU, KOP 13, Photo 13a
View of Campbell Creek inlet looking southeast from the McCloud Arm of Shasta Lake

Photographs for Figure 19-8e, Page 2



McCloud Arm VAU, KOP 13, Photo 13b
View of Campbell Creek inlet looking east from the McCloud Arm of Shasta Lake



McCloud Arm VAU, KOP 14, Photo 14a
View of the McCloud Arm downstream, from the Dekkas Rock Campground.



McCloud Arm VAU, KOP 14, Photo 14b
View of the McCloud Arm upstream, from the Dekkas Rock Campground.



McCloud Arm VAU, KOP 15, Photo 15a
View of the McCloud River upstream, from the McCloud River Bridge.



McCloud Arm VAU, KOP 15, Photo 15b
View of the McCloud River downstream, from the McCloud River Bridge.



McCloud Arm VAU, KOP 16, Photo 16
View of the McCloud River Bridge, from the eastern approach.



McCloud Arm VAU, KOP 17, Photo 17
View of the McCloud Arm from the McCloud Bridge Campground - Space 10.



McCloud Arm VAU, KOP 18, Photo 18a
View of the McCloud Arm from open area west of Space 1, McCloud Bridge Campground.

Photographs for Figure 19-8e, Page 3



McCloud Arm VAU, KOP 18, Photo 18b
View of the McCloud Arm from open area west of Space1, McCloud Bridge Campground.



McCloud Arm VAU, KOP 18, Photo 18c
View looking west from the open area west of Space 1, McCloud Bridge Campground.

Photographs for Figure 19-8e, Page 4

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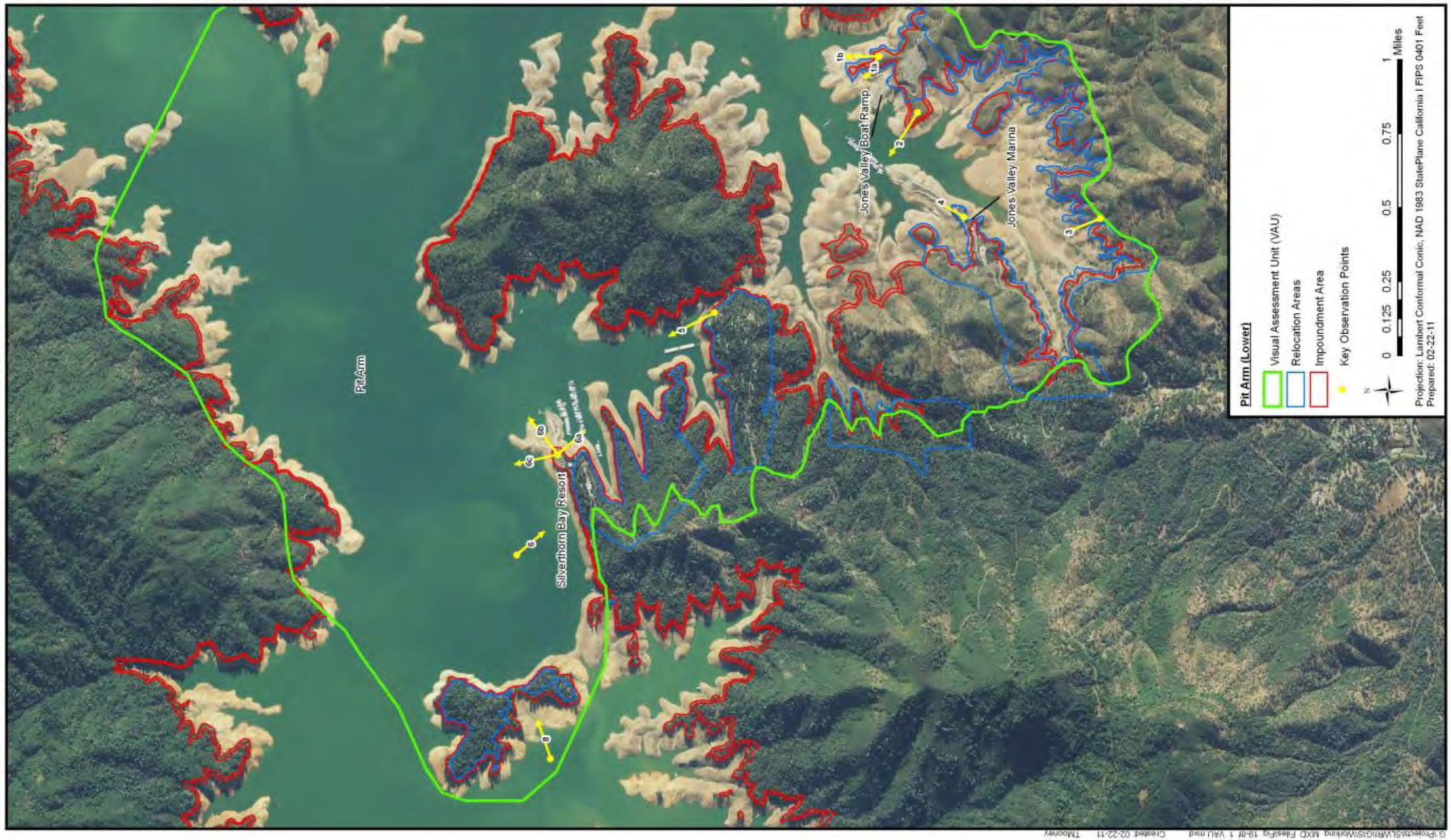


Figure 19-8f. Page 1 – Visual Assessment Unit and Key Observation Points

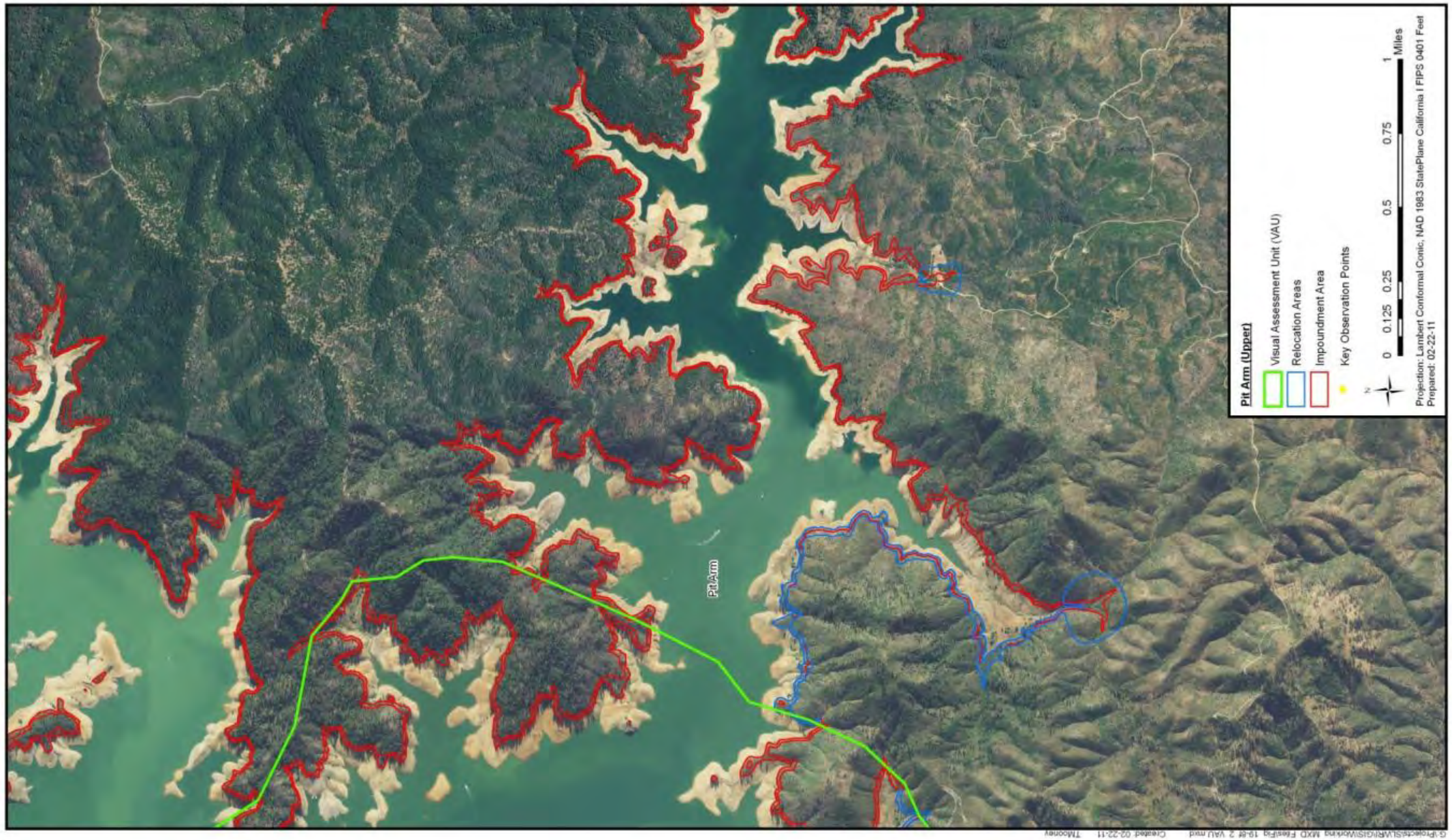


Figure 19-8f. Page 2 – Visual Assessment Unit and Key Observation Points



Pit Arm VAU, KOP 1, Photo 1a
View of the Pit Arm from the Jones Valley parking area, looking northwest.



Pit Arm VAU, KOP 1, Photo 1b
View of the Pit Arm from the Jones Valley parking area, looking northeast.



Pit Arm VAU, KOP 2, Photo 2
View of the Pit Arm from the Jones Valley parking area (west end), looking west.



Pit Arm VAU, KOP 3, Photo 3
View of the Pit Arm from the entrance to the Jones Valley Campground.



Pit Arm VAU, KOP 4, Photo 4
View of the Pit Arm looking north from the Jones Valley Resort Boat Ramp.



Pit Arm VAU, KOP 5, Photo 5
View of the Pit Arm from Juniper Drive, Silverthorn Resort.



Pit Arm VAU, KOP 6, Photo 6a
View of the Silverthorn Marina from the top of the boat ramp looking east.



Pit Arm VAU, KOP 6, Photo 6b
View of the Silverthorn Marina from the top of the boat ramp looking northeast.

Photographs for Figure 19-8f, Page 1

 **Pit Arm VAU, KOP 6, Photo 6c** View of the Silverthorn Marina from the top of the boat ramp looking north.	 **Pit Arm VAU, KOP 7, Photo 7** View of Silverthorn Marina looking south from the Pit Arm of Shasta Lake.	 **Pit Arm VAU, KOP 8, Photo 8** View of the west side of Ski Island looking east from Shasta Lake.	

Photographs for Figure 19-8f, Page 2

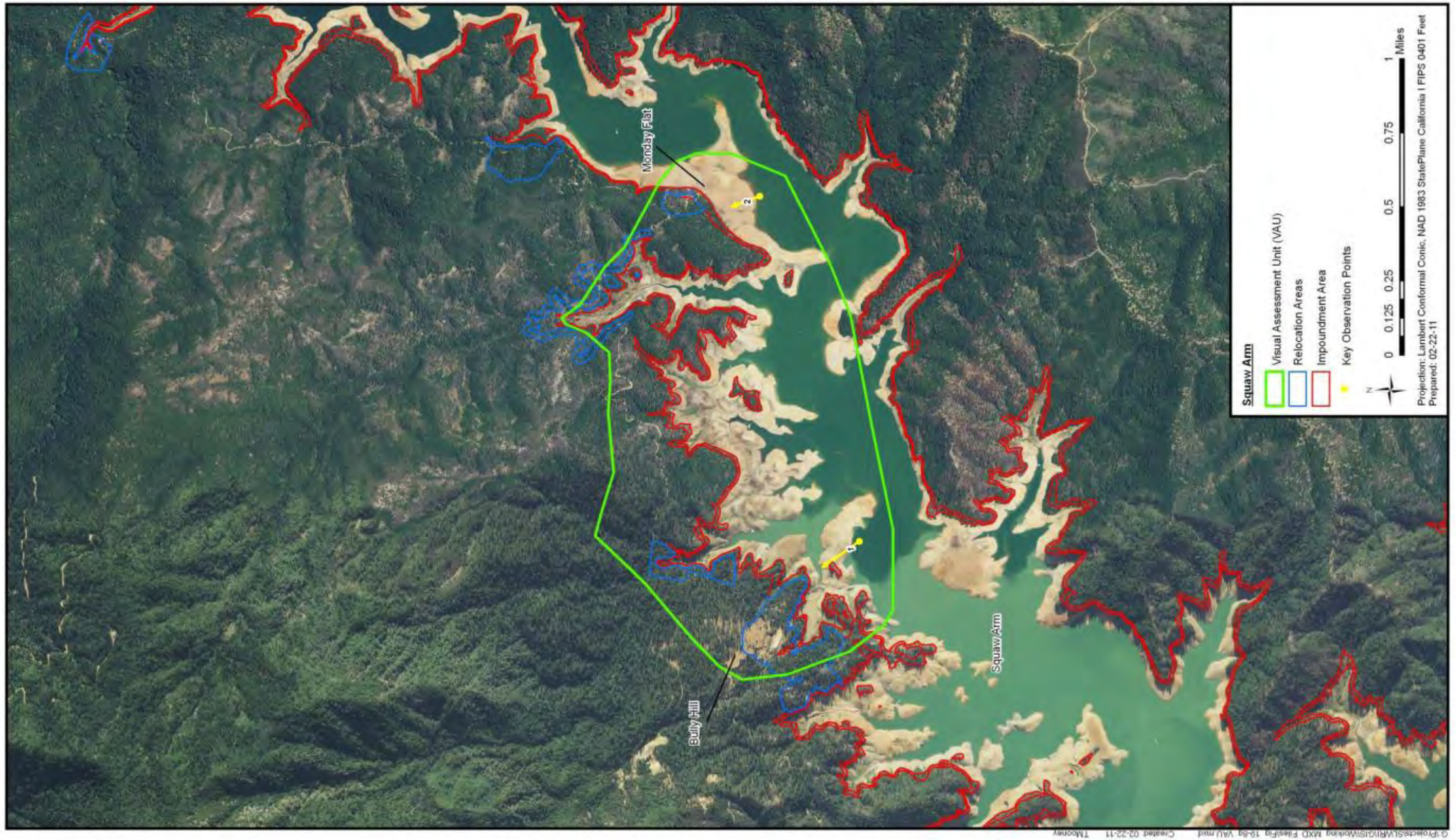


Figure 19-8g. Visual Assessment Unit and Key Observation Points

 **Squaw Arm VAU, KOP 1, Photo 1** View of Bully Hill looking north from the Squaw Arm of Shasta Lake.	 **Squaw Arm VAU, KOP 2, Photo 2** View of Monday Flat looking north from the Squaw Arm of Shasta Lake.		

Photographs for Figure 19-8g

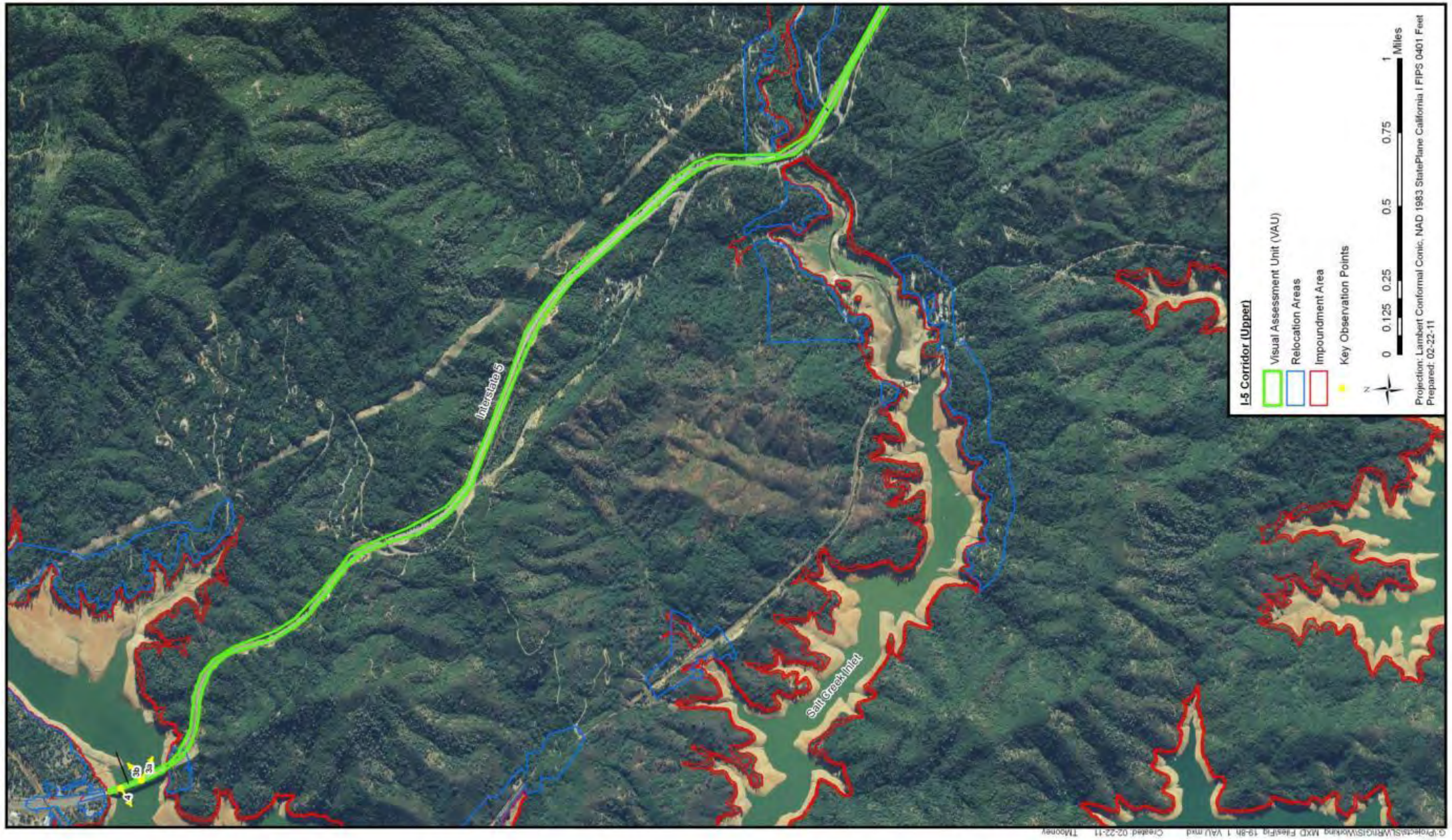


Figure 19-8h. Page 1 – Visual Assessment Unit and Key Observation Points



Figure 19-8h. Page 2 – Visual Assessment Unit and Key Observation Points

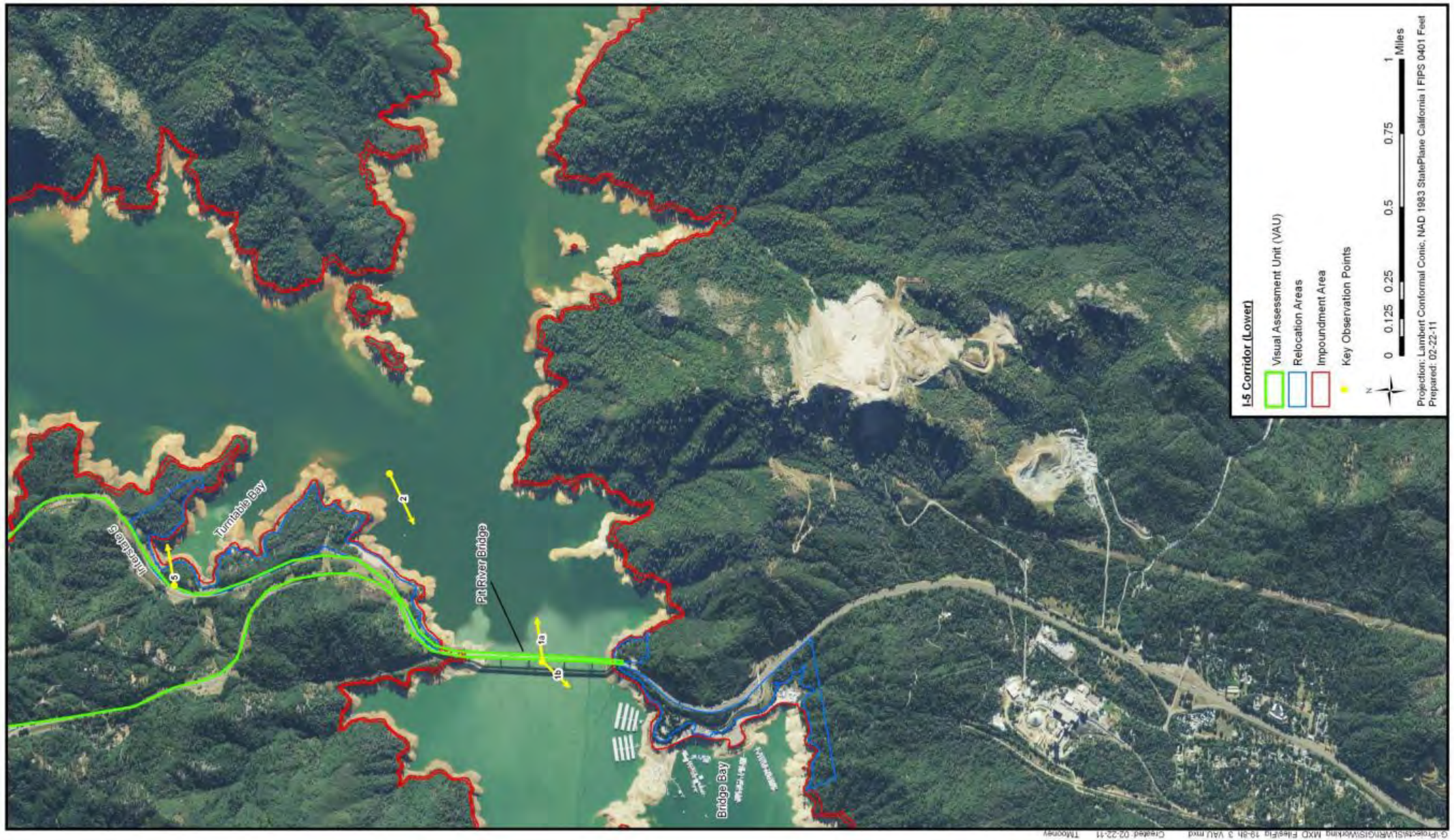


Figure 19-8h. Page 3 – Visual Assessment Unit and Key Observation Points



I-5 Corridor VAU, KOP 1, Photo 1a
View of the Pit Arm (right) and the McCloud Arm (left) from the Pit River Bridge, as seen from I-5 northbound.



I-5 Corridor VAU, KOP 1, Photo 1b
View of Bridge Bay Resort from the Pit River Bridge, as seen from I-5 southbound.



I-5 Corridor VAU, KOP 2, Photo 2
View of the Pit River Bridge looking west from the Pit Arm of Shasta Lake.



I-5 Corridor VAU, KOP 3, Photo 3a
View of the Sacramento Arm looking toward the Antlers Campground from the Antlers Bridge, as seen from I-5 northbound.



I-5 Corridor VAU, KOP 3, Photo 3b
View of the Antlers Public Boat Launch from the Antlers Bridge, as seen from I-5 northbound.



I-5 Corridor VAU, KOP 4, Photo 4
View of the Sacramento Arm west of the Antlers Bridge, as seen from I-5 southbound.



I-5 Corridor VAU, KOP 5, Photo 5
View of the McCloud Arm and vicinity at Turntable Bay, as seen from I-5 northbound.

Photographs for Figure 19-8h

The locations of VAUs were determined using the following steps:

- **Identification of Visually Sensitive Areas** – A determination of sensitivity was made by considering the level of use that a particular view receives by the public. Driving routes, recreational areas, and designated scenic corridors subject to heavy to moderate use represented the numerous sites in the primary study area that could be considered visually sensitive. Examples of visually sensitive areas include the I-5 corridor over the Pit River Bridge, the Shasta Dam Visitor Center, and Bridge Bay Resort.

- **Definition of the Landscape Character** – The landscape character is shaped by the physical, biological, and cultural attributes that combine to make a landscape identifiable or unique. The diverse terrain of the region coupled with the unique attributes of Shasta Lake and the Sacramento River are examples of the landscape character of the primary study area.

- **Identification of Visually Sensitive Observation Points** – This step was used to identify visually sensitive observation points throughout the primary study area that could be adversely affected by changes to the visual environment resulting from project implementation. Important examples of visually sensitive observation points include the vista point located on SR 151 and residences overlooking portions of Shasta Lake. Views from such points would be affected by changes in water levels, as well as the changes to infrastructure associated with raising Shasta Dam and enlarging Shasta Lake.

- **Identification of Visually Affected KOPs** – Key observation points are determined by the extent of observable visual impacts from a specific location, and would depend on the location and distance of the affected area relative to the visually sensitive observation point. The analysis of impacts at such sites considered whether or not project activities would be in the direct line of sight or would occur in the foreground (0 to 0.5 mile) or middle ground (0.5 to 4 miles) view. The distinctiveness of features begins to diminish beyond 3 miles. Key observation points represent observation points in the primary study area having a direct line of sight to, or a view of, the foreground or middle ground of affected areas. The KOPs selected for the analysis of project impacts are identified in Table 19-2 and are further described in the following section.

- **Classification of Scenic Attractiveness** – Scenic attractiveness refers to a classification system used to distinguish unique or remarkable views from those that are more mundane. As described previously, the classification system consists of the following categories: Class A “distinctive,” Class B “typical,” and Class C “indistinctive.”

Following is a discussion of the VAUs and associated KOPs that were identified for the primary study area. Because the primary study area is so large and much of it is remote, VAUs were established at locations subject to relatively high levels of use where changes to the visual environment would be most apparent.

Shasta Dam VAU The Shasta Dam VAU was established to illustrate the views of Shasta Dam from the SR 151 overlook, the Shasta Dam Visitor Center, and the Main Body of Shasta Lake. All of these locations draw numerous visitors annually and receive widespread publicity in regional tour guides. Shasta Dam and the adjacent Visitor Center provide a unique setting from which the public's visual impression of the overall impact of the project (i.e., raising of water levels, increased dam elevation) would be made. A popular attraction in the Shasta Dam VAU is to walk across the dam. (Unregulated vehicle traffic is restricted because of homeland security concerns.) In addition, boaters and other water-based recreationists have expansive views of the waterside face of the dam.

KOP 1 Views from the Shasta Dam overlook on SR 151 capture the essence of the region by offering unobstructed views of the Three Shastas (Shasta Dam in the foreground, Shasta Lake in the middle ground, and Mount Shasta in the background). Situated on the mountainside above the southeast side of the dam, the overlook offers viewers the opportunity to observe not only the Three Shastas, but also the upper Sacramento River as it flows from the dam spillway and miles of mountainous, forested terrain in most directions. The unique and outstanding scenic quality of this view makes it a Class A visual resource that also contains components of the more typical Class B views (e.g., forest, ridgelines).

KOP 1 (Photo 1a) illustrates the Class A panoramic views from the SR 151 overlook to the north/northeast. The dam, the southern end of the Main Body of the lake, and the forested landscape are prominent, with Mount Shasta, about 50 miles away, dominant in the background. Also clearly visible, but less remarkable than the dam, is the dam's infrastructure, including the powerhouse and maintenance roads. The uniqueness of the dam and its infrastructure set against a dramatic landscape of forest and mountains makes this view a Class A visual resource.

KOP 1 (Photo 1b) illustrates the limited Class B views of the upper Sacramento River channel downstream from the spillway from the SR 151 overlook. The Sacramento River, regulated by Keswick Reservoir, flows through a steep canyon and is obscured from view by topography and vegetation. The Chappie-Shasta Off-Highway Vehicle (OHV) Area, managed by the U.S. Bureau of Land Management, along with sections of County Road 5G011 (which is accessed via the dam) and an abandoned railroad line, are visible on the north side of the river, but the river channel itself is not visible from this KOP.

KOP 2 KOP 2 (Photo 2a) illustrates the Class A and B views of the southern end of the lake as seen from the center of the roadway crossing over Shasta Dam. A panoramic view of the southern end of the lake, which occupies the foreground and the middle ground with Mount Shasta on the horizon, is seen from this area. Centimudi Boat Ramp is clearly visible in the middle ground to the east (KOP 2, Photo 2c).

Turning to the west (KOP 2, Photo 2b), the Shasta Dam compound and the Sacramento River below the dam form the primary focal point from this viewpoint. The river meanders out of sight about 1 mile downstream from the dam. This spectacular view of the spillway is a Class A visual resource.

KOP 3 Downstream from the dam, on the right (north) side of the Sacramento River, the U.S. Bureau of Land Management maintains the Chappie-Shasta OHV Area. KOP 3 was established to illustrate the limited views of the downstream face of Shasta Dam from the OHV main staging area. As shown in Photo 3a (KOP 3), the middle ground of the view is dominated by a Class B view of the upper part of Shasta Dam. Vegetation and topography limit the extent of views of the dam from this location and, as illustrated by Photo 3b, also effectively block views of the river channel south toward the river from the staging area.

KOP 4 A public campground at the OHV staging area provides views for OHV recreationists. Although Shasta Dam is not visible from the campground, the Sacramento River dominates the middle ground view to the north, east, and south. KOP 4, photos 4a and 4b, respectively, show the Class B views of the river upstream and downstream.

KOPs 5, 6, 7, and 8 Approximately 0.25 mile downstream from the OHV staging area, south of the NRA boundary, is the historic mining community of Coram and the Coram Ranch, a privately owned recreation resort. KOPs 5, 6, 7, and 8 were established to illustrate the varying degrees of river views (and at one location (KOP 7, Photo 7a) a view of Shasta Dam) from the Coram Ranch cabins. Views from the River House (KOP 5, photos 5a and 5b), the Dogwood House (KOP 6, photos 6a and 6b), and the modular cabins (KOP 8, Photo 8) are considered Class B, offering views of the Sacramento River approximately 1 mile downstream from the dam. The most remarkable view of the primary study area from the ranch is the view of Shasta Dam from the ranch's main house (KOP 7, Photo 7a). Although distance places the dam in the middle ground, as seen from the main house, it is nonetheless impressive. Foreground vegetation serves to frame the dam and draw the viewer's focus to the feature. Photos 7b and 7c (KOP 7) illustrate the views of the Sacramento River from the main ranch house. The views from KOP 7 of Shasta Dam and the Sacramento River are considered to be Class A.

KOP 9 KOP 9 was established to demonstrate the view of Shasta Dam and the Sacramento River from Coram Road, upslope of the OHV staging area.

The Class A view of the river and dam from KOP 9 (Photo 9a) shows the foreground, middle ground, and background landscape. Although most of the dam is visible, its base and a portion of the right abutment (north end) are obscured by topography. The narrowing of the river channel toward the background draws the viewer's eye toward the dam and the mountains in the background. The Class B view looking downstream (Photo 9b) offers partial views of the river, limited by vegetation and topography.

KOP 10 KOP 10 was established to illustrate the view afforded motorists traveling on Lake Boulevard. Coming into the NRA from the south, approximately 0.5 mile of the extreme northern end of Lake Boulevard follows the shoreline of Shasta Lake before ending at the Visitor Center. Similar to views from SR 151 (KOP 1), the elevation of the roadway above the lake allows for expansive vistas from pullouts along the route. Photo 10a shows the Class A vista point view of the lakeside face of Shasta Dam, the Main Body of Shasta Lake in the middle ground, and the forested mountain terrain that dominates the background. Vegetation and topography in the foreground frame the view but also restrict it. The full extent of the view from KOP 10 cannot be fully appreciated by viewers unless they stop at a roadside pullout; otherwise, they will quickly pass it by when traveling on Lake Boulevard.

Views of Shasta Lake, the surrounding mountains, and Mount Shasta (in the distant background) looking north from KOP 10 (Photo 10b) are impressive but more typical of views around Shasta Lake. The Class B view of the lake and its vicinity from this location would be most noticed by motorists traveling east on Lake Boulevard, but the view would be of short duration because the road turns abruptly south away from the lake a short distance beyond this point.

KOP 11 KOP 11 (Photo 11) illustrates the panoramic view that boaters and other water-based recreationists in the Main Body of the lake have of Shasta Dam. The attractiveness of a distinctive built feature, such as the dam, in contrast to the natural character of its surroundings (e.g., water and mountains) is subjective; nonetheless, it is an impressive sight. The uniqueness of the dam set against a dramatic landscape of water and mountains makes this view a Class A visual resource.

Dry Creek Trail VAU The proximity of the Dry Creek Trail area to Shasta Dam makes it a prominent part of the landscape when viewed from the Main Body of Shasta Lake. Most of the Dry Creek Trail shoreline is not visible from the dam, the Chappie-Shasta OHV Area staging area and campground, or other areas frequented by the public because it is obstructed by topography and has limited public access. Although the Dry Creek Access Road meanders through the uplands adjacent to the shoreline, the road is primitive and used only by OHV recreationists, mountain bikers, and the occasional hiker.

KOP1 Most views of the shoreline from the road are obstructed by vegetation and distance. KOP 1 (Photo 1) shows the lakeside view, which is the

most common vantage from which visitors to Shasta Lake would see the Dry Creek Trail shoreline. This Class B view is common throughout the Shasta Lake portion of the primary study area.

Little Backbone Inlet VAU The Little Backbone Inlet VAU was established to illustrate the more typical views that boaters and other water-based recreationists would have of the western side of Shasta Lake. Much of this area has been previously disturbed by mining, wildfire, and OHV activities. Because most of the western shoreline is remote and undeveloped, few people visit the area.

KOP 1 As with much of the western shoreline, the distance from the more populated parts of the primary study area makes it difficult to discern specific details of the landscape. KOP 1 (photos 1a and 1b) illustrate the Class B views in this part of the lake.

Digger Bay VAU The Digger Bay Marina is one of the most difficult marinas on Shasta Lake to access by car. Although it is only 3 miles from the City of Shasta Lake, the road is narrow and extremely winding and the surrounding terrain is very steep. Nonetheless, this USFS-managed marina offers a variety of amenities that make it a popular destination, including the only source of gas in the western part of the lake, a small store, and boat rentals.

KOPs 1, 2, and 3 Views of Shasta Lake from the upper parking area are limited by vegetation and topography (KOP 1, Photo 1, and KOP 2, Photo 2). Similarly, views of Shasta Lake (KOP 3, Photo 3a) and the uplands adjacent to the marina (KOP 3, photos 3b and 3c) are also extremely limited by vegetation and topography. These views are a Class C, indistinctive visual resource.

Packers Bay VAU

KOP 1 Although smaller than nearby Bridge Bay Resort, Packers Bay is a popular destination for water-based recreationists. In addition to a boat ramp managed by USFS, the Packers Bay Marina features amenities such as gas, houseboat rentals, and a small store that is open on a seasonal basis in a less congested environment than at other recreational facilities around the lake. Scenery in and around the Packers Bay Marina is not terribly dramatic, but rather is typical of the region. KOP 1 (Photo 1) shows the Class B view from the Packers Bay Boat Ramp.

Bridge Bay VAU The Bridge Bay Resort and Marina is the largest and one of the most popular marinas on the lake. Its close proximity to I-5 and amenities such as a restaurant, lodging, a store, and a full-service boat marina with houseboat rentals draw a large number of visitors annually. Tourists and motorists, particularly those traveling along the I-5 corridor, are attracted to Bridge Bay by its accessibility. It is from Bridge Bay that most visitors to the region are likely to derive their initial visual perception of Shasta Lake and the surrounding area.

KOP 1 KOP 1 (Photos 1a and 1b) was established to illustrate the view of Shasta Lake from the main parking area adjacent to the Bridge Bay store. During full-pool or nearly full-pool periods, this parking area is used heavily by visitors, boat owners, and other recreationists accessing the lake from Bridge Bay. As the water recedes, marina users and other recreationists tend to follow it downslope, thus lessening the level of use received by this parking area and subsequently altering the viewing perspective. Photo 1a illustrates the Class B view of the Bridge Bay Marina as seen from KOP 1. Landscape features in this photo as well as Photo 1b, taken from the same KOP but from a slightly different perspective, are generally typical for the area—that is, positive yet common.

KOP 2 KOP 2 (Photo 2) illustrates the striking view of the I-5 Pit River Bridge and the UPRR trestle that is located on the lower deck of the bi-level bridge structure, as seen from the northern part of the Bridge Bay Marina. This view is available not only from the parking lot and northern marina, but from the resort's restaurant and hotel as well. As a result of its strong positive attributes (e.g., uniqueness, pattern, balance, mystery), the bridge, which is a Class A visual resource, dominates the middle ground of the scene.

KOP 3 South of Bridge Bay's Marina 4, which is located in the extreme southeast corner of the main body of the lake adjacent to the UPRR tracks, is the Bridge Bay Marina maintenance area. From this location there is a view of the train tunnels adjacent to the east side of the maintenance area. KOP 3, Photo 3a, shows the northern end of the southernmost tunnel, and Photo 3b (taken from the same location) shows the southern end of the northernmost tunnel. Both perspectives would be apparent only to people working in the maintenance area or those who purposely access the area to view the trains. The track and its features are set back against the hillside; therefore, distance, shadow, and topography would obscure most views of this location from the lake, and viewers passing through the primary study area on the train would not have much opportunity to view the lake. Photo 3c, taken from the same location as the previous two photos, demonstrates the distance of the tracks from the Main Body of the lake and illustrates the site's Class B view.

KOP 4 KOP 4 was established to document the initial impression that visitors accessing Bridge Bay's Marina 4 would experience from the stairway. Similar to views from KOP 1, photos 4a and 4b (KOP 4) show the Class B views of the lake from this location.

Sacramento Arm VAU The Sacramento Arm is the busiest and most developed arm of Shasta Lake. For purposes of this assessment, the Sacramento Arm VAU consists of the northern portion of the Sacramento Arm from the Sugarloaf Creek inlet north.

KOPs 1 and 2 In the Pollock area, the Sacramento Arm begins to display characteristics of a river channel more than a lake. Banks on either side of the

channel become increasingly narrow as one travels upstream. KOPs 1 and 2 were established to illustrate the limited views from Riverview Drive, a local road running parallel to the east side of I-5 that is primarily used by residents and recreationists to access Shasta Lake. Photos 1 and 2 illustrate views available to motorists traveling along Riverview Drive. Despite being less than 350 feet from the lake, the elevation of Riverview Drive and adjacent vegetation obscure most views that motorists would have from this roadway. The indistinctive views from both of these KOPs are best characterized as Class C, having low scenic quality.

KOP 3 The community of Lakeshore, which stretches along the west (right) side of the Sacramento Arm, is composed primarily of permanent and vacation homes, and a few commercial resorts. Proceeding south on Lakeshore Drive, along the western (right) shoreline, the first inlet that is crossed (Doney Creek) allows for extended views upstream and a complex view of the Sacramento Arm downstream (Photo 3). The complexity of the latter view stems from the presence of a UPRR trestle, which parallels the roadway in the foreground, and the I-5 Antlers Bridge in the middle ground. Although these structures contribute to an interesting view, neither is unique; therefore, both aspects from this KOP are best characterized as having a Class B scenic quality. Assuming a speed of 45 miles per hour (mph), motorists passing over the Doney Creek inlet would be exposed to the views on either side of the roadway for approximately 9 seconds.

KOP 4 Continuing south on Lakeshore Drive, the USFS's Lakeshore East Campground offers views of the Sacramento Arm. Although these views are somewhat obscured by trees, views both upstream and downstream from the campground's main entrance are fairly broad (KOP 4, photos 4a and 4b, respectively). Photo 4a illustrates the distance upstream that can be seen from this KOP. The features in this view, such as the Antlers Bridge in the background, are not unique or remarkable. Similarly, the downstream view (Photo 4b) is typical for the area. Thus, views of the lake from the campground entrance are best characterized as having a Class B scenic quality.

KOP 5 Lakeshore Drive crosses the lake for the second time to the south of I-5 at the Charlie Creek inlet. Similar to the views described for KOP 5, views from the Charlie Creek Bridge, both to the northwest (Photo 5a) and southeast (Photo 5b), are expansive, but common to the area (Class B scenic quality): the lake in the foreground, vegetation in the middle ground, and mountains in the background. Assuming a speed of 45 mph, motorists passing over the Charlie Creek inlet would be exposed to the views on either side of the roadway for approximately 8 seconds.

KOP 6 The Beehive Campground managed by USFS as a dispersed campground typifies the nature of the views afforded visitors to the parts of the lake west of I-5. As shown by KOP 6 (photos 6a, 6b, and 6c), views are

expansive but generally unremarkable. There are no features unique to the area to distinguish it from other nearby Class B vantage points.

KOP 7 Sugarloaf Cove is located in one of the most remote parts of the Sacramento Arm. Aside from a narrow road in the uplands that leads into the rugged Backbone Ridge region, there are no recreational improvements in the cove. Photos 7a and 7b illustrate the narrowness of the cove, where a broad bathtub ring of soils are exposed during periods of drawdown. Views in the Sugarloaf Cove area are indistinctive and are best characterized as Class C, having low scenic quality.

KOPs 8, 9, and 10 Sugarloaf Resort Marina is situated adjacent to a residential and commercial area. KOPs 8, 9, and 10 were established to show the view of the marina and its features from several aspects including homes (KOP 8, Photo 8), the marina access road (KOP 9, photos 9a through c), and the public boat ramp (KOP 10, Photo 10). The broad expanse of views from the Sugarloaf shoreline, coupled with the attributes of the marina's structure (e.g., pattern, balance, intactness), is somewhat unusual in the area but typical for Shasta Lake (thus, a Class B distinction).

KOP 11 The Tsasdi Resort, a privately owned recreation facility located on Lakeshore Drive, offers guests a variety of outdoor activities, including hiking, fishing, and boating. Cabins and other resort buildings are situated on the hillside overlooking the lake. The resort maintains its own boat dock, which is accessed from a small parking area immediately adjacent to Lakeshore Drive. The view shown in Photo 11a, looking east from this parking area, is somewhat distinctive but not unique. A railroad trestle crossing the lake in the middle ground creates diversity of pattern in the view, but because the feature is not unique, it is best characterized as having a Class B scenic quality. Similarly, the view to the south from the same KOP is fairly typical for the area and is also best described as having a Class B scenic quality.

KOP 12 Located on the uplands above the east (right) side of the lake is the Lakeshore Resort Campground. This privately owned resort is near the community of Lakeshore (less than 0.25 mile) and I-5 (approximately 0.5 mile), which makes it a popular recreation destination. Although scenic, neither the upstream view (to the east) (Photo 12a) nor the downstream view (to the southeast) (Photo 12b) is unique for the area (thus, Class B). The I-5/Antlers Bridge in the middle ground of the upstream view is prominent and creates a sense of balance between the foreground and background, but the view is not distinct (i.e., unusual, unique, or outstanding) in the context of the project area and is best characterized as having a Class B scenic quality.

KOP 13 One of the most significant inlets branching off of the Sacramento Arm is the Salt Creek Inlet. USFS campgrounds (Nelson Point and Oak Grove) and a day use area (Oak Grove) on the north (right) side of this inlet are inaccessible by boat because the water in the inlet is shallow. As shown in

Photo 13, taken from the Oak Grove Day Use Area, land-based recreation facilities are a fair distance from water (this photo was taken in May 2008). Steep topography below the ordinary high-water line significantly restricts the view from this KOP. The lake's bathtub ring dominates the Class C, indistinctive view. The quality of the view during periods in which the lake is full or nearly full would be more typical of the project area and would thus be better characterized as having a Class B scenic quality.

KOP 14 The south (left) shore of the Salt Creek Inlet supports a variety of residences, including privately owned cabins on National Forest System lands. Access via Salt Creek Lodge Road parallels much of the inlet's shoreline. KOP 14, established at the intersection of Salt Creek Lodge Road and Lower Salt Creek Road, illustrates the Class A views available to motorists, residents, and recreationists passing through the area. Features that set views from this KOP apart from the more typical views previously described for many of the KOPs in the primary study area are the presence of Mount Shasta in the background (albeit the mountain is difficult to distinguish because of haze at the time Photo 14a was taken) and the distinctiveness of the UPRR trestle in the middle ground of Photo 14b. As viewed from KOP 14, the trestle imparts a sense of mystery; its northern end draws the viewer's eye to the background, where the trestle seemingly disappears into the mountainside.

KOP 15 KOP 15 illustrates a typical view from the residential development along Lower Salt Creek Road. The area is relatively steep and densely forested. The dominance of vegetation in the foreground of photos 15a and 15b is indicative of the nature of views from residences, which have scenic quality (Class B) that is common for the region.

KOP 16 The Antlers Public Boat Ramp is located immediately east of I-5 and directly faces the Antlers Bridge, which spans the Sacramento Arm. As seen from the boat ramp, vegetation frames the bridge in the middle ground of the view (Photo 16). Built features (the boat ramp, Antlers Bridge, I-5) dominate the view, whereas unique landscape features, such as the river that meanders through the foreground and middle ground and the rugged mountains in the background, add to the uniqueness, pattern, and mystery of the view. The scenic quality of this view make it a Class A visual resource that also includes components of the more typical Class B views (e.g., forest, ridgelines).

KOP 17 KOP 17 was established to illustrate views from the Antlers Picnic Area located at the top of the Antlers Public Boat Ramp. Several picnic tables and benches allow the public the opportunity to sit and view both the upland parking area (Photo 17a) and the lake (Photo 17b). As shown by Photo 17a, the view of the public parking area is indistinctive; thus, a Class C view. The view of the lake from the picnic area (Photo 17b) is somewhat more distinctive than the view toward the parking lot, but it is fairly typical of views from the Shasta Lake shoreline. Vegetation and topography often limit views of the water. This view would be a Class B, typical visual resource.

KOP 18 KOP 18 (photos 18a through c) was established to illustrate the views that campers staying at one of the public resorts or campgrounds around Shasta Lake would typically see (in this case the Antlers Resort). Visual resources associated with the uplands (Photo 18a), lake (Photo 18b), and campground facilities (Photo 18c) are a combination of Class C indistinctive and Class B typical.

McCloud Arm VAU The McCloud Arm of Shasta Lake is notable for the towering gray limestone mountains that line the eastern shore of the arm. Large, naturally formed caverns in the limestone are popular tourist and spelunking destinations. Lake Shasta Caverns, a commercial operation, operates out of Bailey Cove and ferries visitors across the lake. In fact, boats provide the only access to the right bank of most of the McCloud Arm. Although parts of the lower reach of the McCloud Arm are visible from I-5, topography, including a gradual narrowing of the arm toward its upstream end and heavily forested uplands, limits most views to areas immediately surrounding the scattered residences, campgrounds, boat ramps, and small resorts along the arm.

KOP 1 Located near the confluence of the McCloud and Pit arms, Turntable Bay currently houses administrative facilities, including USFS boat docks. As demonstrated by KOP 1 (Photo 1), Turntable Bay and vicinity can be seen by ridgeline homes overlooking the lake. Transitory views from the area in and around Turntable Bay (such as those available to motorists and boaters) are dependent on water levels, which in turn would determine the quality of the view (i.e., Class B or, subjectively, Class C).

KOP 2 KOP 2 (Photo 2) was established near one of the most heavily used and visible areas on Shasta Lake: the confluence of the McCloud and Pit arms, on the east side of the I-5 Pit River Bridge. Boaters accessing the various arms of the lake east of Bridge Bay will pass through this area. As seen from the lake, views of the shoreline are panoramic; however, the quality of the view varies widely depending on the middle ground and background features (e.g., the presence of a distinctive built feature such as the Pit River Bridge or a snow-covered Mount Shasta). Photo 2 showing Turntable Bay is an example of the Class B typical view that is predominant around Shasta Lake. This photo also illustrates the conspicuous bathtub ring that is seen along the entire perimeter of the lake as water levels draw down.

KOPs 3 and 4 Bailey Cove is a USFS recreational facility that includes a public picnic area, campground, and boat ramp easily accessible from I-5. KOP 3 (Photo 3) shows the narrow inlet in which the boat ramp is located. From the south-facing perspective of the boat ramp and its adjoining parking lot, little of the main body of the McCloud Arm can be seen. Class B views are typical for the area. North of the boat ramp, Bailey Cove, including a portion of Holiday Harbor, can be seen from the Bailey Cove Day Use/Picnic Area. Although Bailey Cove proper is separated from the inlet into which the boat ramp extends

by the peninsular shape of the area, the quality of the views is similar. KOP 4 (Photo 4) shows the limited Class B view to the east from the picnic area.

KOP 5 Farther upstream is the Holiday Harbor Resort and Marina. This facility includes a campground, a marina, and a small store. KOP 5 (Photo 5) shows the distinctive, Class A view of the Holiday Harbor Marina as viewed from the Holiday Harbor Campground. Although the marina is nested in a small inlet, the view from this location draws the viewer's eye to the main body of the McCloud Arm framed by the limestone outcrops and the mountains in the background.

KOP 6 Lake Shasta Caverns is a popular regional tourist destination located approximately 1.5 miles east of I-5. The west (right) shore public reception area includes a parking area, a store, restrooms, a play area, and a boat dock, which houses the privately owned ferry used to transport visitors across the lake to the caverns. With the exception of the boat dock, all public areas are located in uplands, and, as shown by KOP 6 (Photo 6), the lake and eastern limestone outcrops are not readily apparent from the caverns parking lot. The aesthetic value of the lake and surrounding scenery is an important component of the experience offered by the Lake Shasta Caverns tour, which exposes visitors to a variety of Class A and B views during its various tours. Recently, the proprietor expanded the site-seeing tour options to include dinner cruises during the summer that depart from the Lake Shasta Caverns reception center.

KOPs 7 and 8 KOP 7 (Photo 7) was established to show the view of the lake and the Lakeview Marina from the Lakeview Resort's caretaker residence. This destination is one of the most remote marinas and boat ramps on the McCloud Arm, located about 3 miles east of I-5. The dramatic background of mountains and limestone outcrops rising out of the lake makes the view from KOP 7 a Class A view, although the view available to the general public from this location is somewhat blocked by the caretaker's house and surrounding vegetation. Better opportunities for public views of the lake and vicinity from the Lakeview Resort property are available farther up the shoreline at the boat ramp. As viewed from KOP 8, the boat ramp extends south into the main body of the McCloud Arm, where people are exposed to expansive views looking south toward the Pit Arm (Photo 8a). The contrast and landscape features of the foreground, middle ground, and background create Class A views of the lake from this location. Turning to the north (Photo 8b), the Class A views continue. Views from the boat ramp looking west toward the Lakeview Marina and the caretaker's residence (Photo 8c) are somewhat more common (i.e., Class B) for Shasta Lake.

KOPs 9 and 10 KOPs 9 and 10 were established to illustrate shoreline views midway along the McCloud Arm. The north/south alignment of the arm results in noticeable changes in vegetation and terrain. Although the southerly parts of the arm tend to support a more shrub-dominated habitat, views begin to become more scenic moving north up the arm as conifers and significant rocky

outcrops become more evident. The conspicuous bathtub ring that is visible along the entire perimeter of the lake as water levels draw down is just as evident in this part of the lake as it is elsewhere, and the forested mountains in the uplands in the middle ground and background settings (KOP 9, Photo 9) are relatively common Class B visual resources. However, vivid rock outcrops, such as those around Shasta Caverns (KOP 10, Photo 10), add a level of mystery to the upper part of the McCloud Arm. KOP 10 (Photo 10) shows an example of the distinctive Class A visual resources found along the McCloud Arm.

KOP 11 The McCloud Arm's trend toward the north/northeast routes it away from the I-5 corridor and into largely undeveloped, publicly managed and privately owned lands. Visually, a majority of the views of the upper reach of the McCloud Arm are limited primarily to boaters on the lake, a few homes scattered throughout the uplands adjacent to Gilman Road, and an assortment of USFS campgrounds and day use areas that extend along the increasingly narrow channel.

Hirz Bay is a boat launch and group camping facility managed by USFS on the McCloud Arm. Although Hirz Bay is approximately 10 miles from I-5, it is a popular destination for campers, boaters, and hikers. The Hirz Bay Trail, a gently sloping walking trail that extends from Hirz Bay to Dekkas Rock, is mentioned in regional travel guides as offering views of the lake and spectacular limestone outcrops (Soares 1992, Trails.com 2007).

Although views of the lake from the campground and surrounding lakeshore are limited by topography and vegetation, the boat ramp, closer to the shoreline, affords a wider expanse of views of the water. Progressive narrowing of the channel is apparent when looking from downstream to upstream (KOP 11, Photos 11a and 11b, respectively). The expansiveness of the views from Hirz Bay, although somewhat typical for the region, could be characterized as Class A bordering on Class B.

KOP 12 KOP 12 was established to illustrate views of the Hirz Bay and vicinity shoreline from Shasta Lake. As shown by Photo 12, the view looking west from the lake evokes a sense of wilderness beyond the shoreline and does not hint at the level of development that lies between the middle ground and background (i.e., I-5). Although this view is somewhat typical for the northern part of the McCloud Arm, it could be considered a Class A visual resource because of the sense of intactness it conveys.

KOP 13 Campbell Creek, located on the east shore of the McCloud Arm directly across from Hirz Bay, is a residential recreation tract consisting of 28 privately owned cabins on National Forest System lands. The only practicable access to the area is by boat. Overland access is via a primitive (at best) jeep trail. Therefore, visitors to the area would form their initial impression of the visual resources afforded by the Campbell Creek inlet from the lake. Photo 13a

looks toward the south bank of the inlet, where most of the cabins are located beyond the tree line. In many cases, the cabins are difficult to see from the lake because of their colors, which are meant to blend with the natural environment, and the dense forest that surrounds them. Similarly, a few cabins are also located on the eastern shore, but these cabins also have been designed to be unobtrusive to the natural environment (Photo 13b). The expansiveness of the views from the Campbell Creek inlet, although somewhat typical for the region, could be characterized as Class A bordering on Class B.

KOP 14 Similar to views of the lake from Hirz Bay, Class B views from Dekkas Rock Campground widen downstream and narrow upstream (KOP 14, photos 14a and 14b, respectively). Unlike the Hirz Bay camping facilities, which are located some distance from the actual shoreline, the Dekkas Rock Campground offers sites overlooking the lake and near the ordinary high-water line. KOP 14 was established to illustrate views of the progressively narrowing channel from Dekkas Rock Campground (photos 14a and 14b, respectively). Similar to views from Hirz Bay (KOP 11), views from KOP 14 could also be characterized as Class A bordering on Class B.

KOP 15 The McCloud River Bridge is located at the extreme north end of the McCloud Arm approximately 19 miles east of I-5. Despite its relative remoteness, the bridge has frequent traffic, primarily created by recreationists fishing the river, staying in the nearby campground, or exploring the back roads. KOP 15 shows that unobstructed views of the McCloud Arm are available both upstream and downstream from the bridge (photos 15a and 15b, respectively). Although topography eventually interrupts these Class A views, a relatively long stretch of the entire channel width is visible from either direction.

KOP 16 Views of the McCloud River Bridge from the west approach are partially obscured by seasonal roadside vegetation, and the alignment of the eastern approach (KOP 16, Photo 16) prevents any views of the reservoir or the bridge until the road turns onto the bridge. Thus, the indistinctive or low scenic quality of the view from this KOP is characteristic of a Class C designation.

KOPs 17 and 18 Immediately south of the McCloud River Bridge on the east side of the McCloud Arm is the USFS McCloud River Campground. Scenic views from the campground are, in general, remarkable as a result of the surrounding topography and landscape features, such as the bridge, mountains, and the upper end of the McCloud Arm. KOP 17, which is located in Campsite 10, is typical of the Class A views available from campsites in the campground. As demonstrated by KOP 18 (photos 18a through c), views from areas around the campsites broaden as the viewer moves closer to the river channel.

Pit Arm VAU

KOPs 1, 2, 3, and 4 KOPs 1 through 4 were established to illustrate the gentle shoreline topography of the Pit Arm in the vicinity of Jones Valley, upstream from Silverthorn Resort. Beyond the Jones Valley inlet, there is only

one developed campsite accessible by boat. The increasing narrowness of the arm and the potential hazard to boats posed by the remnants of standing dead trees (snags) below the lake's ordinary high-water line make the Jones Valley area a popular destination for people who want to fish or who seek a quieter, more secluded recreational experience than activities such as waterskiing offer.

Expansive views of the lake and surrounding mountains (as viewed from KOP 1, photos 1a and 1b; KOP 2, Photo 2; KOP 3, Photo 3; and KOP 4, Photo 4) are somewhat typical and common to the area and thus would be characterized as having a Class B scenic quality. Although it is not apparent because of weather conditions at the time the photo was taken (October 26, 2007) (Photo 1b), on a clear day Mount Shasta is visible in the background. This factor would enhance the quality of the view from the Jones Valley Public Boat Ramp parking lot looking north, making it a Class A scenic designation.

KOP 5 KOP 5 illustrates a typical view from the houses and cabins in the residential development adjacent to the Silverthorn Resort. The dominance of vegetation in the foreground of Photo 5 is indicative of the nature of views from area homes and cabins. The neighborhood is built on a densely vegetated and steep peninsula with residences on the north side of the ridge facing the Silverthorn Marina and Resort; however, topography and dense vegetation obscure most views of the marina and resort facilities (Photo 5). Views from KOP 5 are typical Class B. Houses and cabins on the south side of the ridge face toward undeveloped areas around Jones Valley.

KOP 6 KOP 6 (photos 6a through c) shows views of the lake from the Silverthorn Resort boat ramp. Silverthorn Resort is a full-service commercial development offering cabin rentals, restaurants, houseboat rentals, a boat ramp, and a marina. Photo 6a illustrates the Class B view of the Silverthorn Marina as seen from KOP 6. Landscape features in this photo and in photos 6b and 6c, taken from the same KOP (but from a different aspect), are generally typical for the area; that is, positive yet common.

KOP 7 As seen from Shasta Lake, it is difficult to determine the level of development associated with the Silverthorn Resort and marina (Photo 7). A peninsula obscures most of the marina and boat ramp from view, as is apparent from KOP 7. Silverthorn Resort is an example of a built feature that may not be considered particularly attractive by viewers. The surrounding environment (i.e., vegetation, topography) is fairly typical for this part of the Pit Arm and would be considered a Class B, and possibly even a Class C, visual resource.

KOP 8 Ski Island is one of the most popular destinations in the Pit Arm. Close to Silverthorn Resort, Ski Island offers primitive campsites and easy access. KOP 8 (Photo 8) was established to illustrate the view that boaters have as they approach the island from the west. The presence of mature conifers adds to the scenic attractiveness of Ski Island, making it a Class B visual resource.

Squaw Creek Arm

KOPs 1 and 2 The Bully Hill (KOP 1, Photo 1) and Monday Flat (KOP 2, Photo 2) areas in the Squaw Creek Arm of Shasta Lake are among the flatter, more easily accessible areas of the lake for boaters looking for a place to land. The bathtub-ring effect is exacerbated by the relatively flatter topography of the area. As water levels drop, a greater expanse of unvegetated shoreline is exposed than appears in many other parts of the lake, and the distance to vegetated uplands is greater than in steeper areas. Although the middle ground and background of the views in this part of the lake include a variety of patterns (water, exposed bright soils, vertical vegetation), the view is typical for the Squaw Creek Arm, making it a Class B visual resource.

I-5 Corridor VAU The Pit River Bridge (also known as the Veterans of Foreign Wars Memorial Bridge) is a nearly 3,600-foot-long bi-level structure that conveys I-5 traffic over the Pit Arm of Shasta Lake, northeast of the Bridge Bay Resort. Vehicle traffic passes across the top level of the structure, and a UPRR track is located on the lower level. Views from the bridge are restricted to motorists or those traveling via train; pedestrians are not authorized to use the bridge for safety reasons.

KOP 1 Class A views experienced by motorists from the Pit River Bridge are of relatively long duration from either direction (up to a minute at normal highway speeds of 55 mph). From the I-5 northbound lanes, the lower ends of both the Pit and McCloud arms east of the bridge are clearly visible in the foreground to middle ground, with mountains in the background (KOP 1, Photo 1a). Views from the southbound lanes look west of the bridge toward the Sacramento Arm. Some features of Bridge Bay Marina can be seen from I-5 southbound (Photo 1b). The elevation of the Pit River Bridge above the existing surface elevation of the lake (full pool and lower) makes it difficult for parts of the lake that are visible from the northbound lanes to be seen from the southbound lanes, and vice versa. Views from either lane may also be partially obstructed by the bridge railing (depending on the height of the vehicle).

KOP 2 KOP 2 was established near one of the most heavily used and visible areas on Shasta Lake: the confluence of the McCloud and Pit arms, on the east side of the I-5 Pit River Bridge. Boaters accessing the various arms of the lake east of Bridge Bay pass through this area. The panoramic view of the lake, bridge, and surrounding mountains is distinctive and unique to the area. The balance and harmony of the patterns (i.e., water in the foreground leads the viewer's eye to the bridge in the middle ground, and from there to the mountains in the background) make this a Class A visual resource.

KOPs 3 and 4 Although not as readily visible, and of far less extent and shorter in duration than those seen from I-5 over the Pit River Bridge, additional views of Shasta Lake (specifically the Sacramento Arm) are available to motorists traveling on I-5 over the Antlers Bridge, located in the community of Lakehead at the north end of the lake. The lake is constricted by topography and

is considerably narrower at this point (KOP 3, Photo 3a). Consequently, Class B views from I-5 are of fairly short duration (approximately 15 seconds assuming a speed of 65 mph). Northbound motorists will notice the Antlers Campground boat launch, which extends from the north shore downslope into the lake (KOP 3, Photo 3b). Southbound motorists have a limited view of the portion of the lake located on the west side of the bridge (KOP 4, Photo 4). Steep topography to the south of the Antlers Bridge makes it difficult to see much more than a small, open body of water and the adjacent forested shoreline.

KOP 5 Located near the confluence of the McCloud and Pit arms, Turntable Bay currently houses administrative facilities, including USFS boat docks. As demonstrated by KOP 5 (Photo 5), transitory views of Turntable Bay and vicinity can be seen from I-5 by northbound motorists. The panoramic extent of the views, although of short duration as vehicles typically pass through this part of I-5 at high speeds, is typical for the Shasta Lake area but nonetheless impressive. As seen from KOP 5, the view would be a Class B or, subjectively, a Class A visual resource.

Visual Quality Objectives The Shasta-Trinity Unit of the NRA includes lands classified as modification, partial retention, and retention. Areas designated as "modification" in the LRMP are typically developed areas, such as campgrounds, marinas, and boat launch ramps; management activities in the foreground and middle ground in these areas have a natural appearance. "Partial retention" refers to those areas in which management activities remain visually subordinate on the landscape. "Retention" areas are those where management activities are not visually evident. The acres of lands categorized under each of these classifications are provided in Table 19-1.

The LRMP also includes a series of management prescriptions for various land allocations. The primary prescription for lands in the NRA is "limited roaded motorized recreation." The objective of this prescription is to provide for semi-primitive motorized recreation opportunities, while maintaining predominately natural-appearing areas with some modifications (USFS 1995a).

Scenic Highways Many state highways are located in areas of outstanding natural beauty. California's Scenic Highway Program was created by the Legislature in 1963 to preserve and protect scenic highway corridors from changes that would diminish the aesthetic value of lands adjacent to highways. The State laws governing the Scenic Highway Program are found in the Streets and Highways Code, Section 260 et seq. A highway may be designated as "scenic," depending on how much of the natural landscape can be seen by travelers, the scenic quality of the landscape, and the extent to which development intrudes on the traveler's enjoyment of the view. The State Scenic Highway System consists of a list of highways that are either eligible for designation as scenic highways or have been so designated. Shasta County scenic highways are listed in California Department of Transportation (Caltrans) 1992 (see Chapter 28, "Bibliography").

In Shasta County, and more specifically the primary study area, I-5 north of the City of Shasta Lake is recognized as a corridor in which the natural environment is dominant. In the primary study area, both I-5 and SR 151 are designated as State routes eligible for official scenic highway designation, although they contain contrasting elements of the natural and built environment (Shasta County 1984). I-5 between Redding (at the SR 299 East intersection) and Anderson is also designated as a corridor in which natural and man-made environments contrast; however, this section of roadway is not eligible for scenic highway designation (Shasta County 1984).

Lower Sacramento River and Delta and CVP/SWP Service Areas

The extended study area offers a wide and diverse array of landscapes and features that constitute visual resources. None of these landscapes and features would be affected by activities associated with the project.

19.2 Regulatory Framework

19.2.1 Federal

Aesthetic values and scenic resources in the Whiskeytown-Shasta-Trinity NRA are managed for the conservation of scenic values that contribute to public enjoyment of the NRA. The Forest Service Manual (2380.11 – 2380.19) addresses the management of landscape aesthetics and scenery in the NFS, as well as the NRA (36 Code of Federal Regulations, part 292, subpart B). Included in this directive are standards for the protection of the natural scenic qualities of public travel routes and shoreline protections. Aesthetic values and visual resources are also generally addressed in the environmental review of Federal projects through the NEPA. Some Federal agencies, such as USFS, provide guidelines for the management of visual resources in larger management areas. In response to increasing environmental concerns, USFS developed The Visual Management System to inventory, classify, analyze, and manage its visual resources. The primary objective of the system is to maintain and enhance the natural appearance of the characteristic landscape while actively managing various resources such as timber, grazing, wildlife, and recreation. The Visual Management System measures and evaluates two main elements: the natural and built features of the land and the public's concern for scenic quality.

The following describes the regulatory setting for lands managed by USFS.

Shasta-Trinity National Forest Land and Resource Management Plan

The STNF LRMP contains goals, standards, and guidelines designed to guide the management of the STNF. The following goals, standards, and guidelines related to aesthetic issues associated with the primary study area were excerpted from the LRMP (USFS 1995a).

Visual Quality
Goals (LRMP, p. 4-5):

- Develop or expand opportunities for scenic drives and vista points.

- Maintain a diversity of scenic quality throughout the forest, particularly along major travel corridors, in popular dispersed recreation areas, and in highly developed areas.

Standards and Guidelines (LRMP, pp. 4-27 through 4-28):

- Manage activities and projects to meet adopted VQOs of (1) preservation, (2) retention, (3) partial retention, (4) modification, or (5) maximum modification. On rare occasions, the adopted VQO may not meet management's objectives (e.g., as a result of catastrophic events). Any proposed modification to an adopted VQO must go through the NEPA process and be approved by the forest supervisor.

- In the following sensitive travel corridors, the foreground portions (areas located up to ¼ to ½ mile from the road viewer) will be managed primarily to meet the adopted VQO of Retention:

  – I-5

- In the following sensitive travel corridors, the middle ground portions (areas between ¼ to ½ mile and 3 to 5 miles from the road viewer) will be managed primarily to meet the adopted VQO of Partial Retention:

  – I-5

- In the following sensitive travel corridors, the foreground portions (areas located from ¼ to ½ mile from the road viewer) will be managed primarily to meet the adopted VQO of Partial Retention:

  – Gilman Road (35N60/County 7HOI from I-5 East to McCloud River Bridge)

Management Guide for the Shasta and Trinity Units of the Whiskeytown-Shasta-Trinity National Recreation Area The Management Guide for the Whiskeytown-Shasta-Trinity NRA (USFS 1996) contains management strategies intended to achieve or maintain a desired condition. These strategies take into account opportunities, management recommendations for specific projects, and mitigation measures needed to achieve specific goals. The following strategies related to aesthetic issues associated with the primary study area were excerpted from the Management Guide.

Visual Resources (Management Guide, p. IV-19) All developments and long-term activities in the NRA will be designed with the intent of meeting VQOs. Those objectives include areas designated as retention, partial retention, and

modification. Retention is a VQO that in general means human activities are not evident to the casual forest visitor. The partial retention objective means human activities may be evident but must remain subordinate to the characteristic landscape. Modification means human activity may dominate the characteristic landscape but must follow established guidelines.

- Management activities that can be seen from developed recreation sites will meet a VQO of retention in the foreground and partial retention in the middle ground.

19.2.2 State

In 1963, the California legislature created the Scenic Highway Program to preserve and protect scenic highway corridors from changes that would diminish the aesthetic value of lands adjacent to the highways. The State regulations and guidelines governing the Scenic Highway Program are found in the Streets and Highways Code, Section 260 et seq. A highway may be designated as scenic depending on how much of the natural landscape can be seen by travelers, the scenic quality of the landscape, and the extent to which development intrudes on the travelers' enjoyment of the view.

Currently, only a short section of I-5 extending from its intersection with SR 97 in the City of Weed to its intersection with SR 89 near the City of Mount Shasta is a designated scenic highway (a part of the Volcanic Legacy Scenic Byway/All American Road). However, there has been interest in obtaining official scenic highway designation for the stretch of I-5 north of Shasta Lake to the Oregon border. Continuing efforts may be made to incorporate this segment of I-5 into the State's Master Plan for officially designated highways.

19.2.3 Regional and Local

The Scenic Highways Element of the Shasta County General Plan (Shasta County 1994) is intended to establish and protect highways (including both State and county roads) with scenic value. "Scenic highways" refers to any freeway, highway, road, street, boulevard, or other vehicular right-of-way that traverses an area of unusual scenic quality. An "official scenic highway" is a scenic highway that has been so designated by the State of California. The visible land area outside the actual right-of-way is generally described as the "viewshed" or the "scenic corridor." The corridor encompasses the land easily visible from the highway. Virtually every highway in Shasta County is a scenic highway; however, some scenic highways are more important than others, based on the visual quality of their scenic corridors, the degree to which the highways are used, and the vulnerability of the corridors to degradation of visual quality (Shasta County 1994).

19.3 Environmental Consequences and Mitigation Measures

This section identifies potential environmental effects on aesthetics and visual resources that could result from the project. Examples of proposed activities, common to all project action alternatives that could have an impact on visual resources and aesthetic values, include changes to inundation levels, raising Shasta Dam, dike construction, creation of borrow areas, abandonment and relocation of infrastructure, and vegetation clearing.

19.3.1 Methods and Assumptions

Analysis of potential impacts to aesthetic and visual resources is based on guidance provided by USFS and the significance criteria described in the CEQA Guidelines. To comply with CEQA, significance thresholds are used to evaluate the project's potential impacts on the visual character of the study areas, particularly the visual character of areas observable from KOPs. All assessments are qualitative, evaluating potential impacts of the project on the viewshed in relation to the local aesthetic context.

The fact that USFS manages a high proportion of the Federal lands above the current full pool elevation of Shasta Lake supports use of the USFS Visual Management System for this assessment. Under the USFS Visual Management System, the landscape is composed of a diversified variety of landforms, rock forms, and vegetative colors and textures. The widely diversified and unique landscape, and the setting of the study area within the NRA—designated as such in part because of its scenic quality of national importance—makes the overall scenic attractiveness a variety class "A" (see the bulleted list below for a description of the classes of scenic attractiveness). To provide some continuity with other Reclamation visual resources assessments, certain aspects of the USFS Scenery Management System are also used in this analysis, as appropriate, namely, the concepts of scenic attractiveness and primary distance zones.

A field assessment of the primary study area was conducted to identify areas of visual sensitivity and scenic resources, and to assess the character and quality of the aesthetic resources associated with the primary study area. Because no changes are anticipated to the aesthetic values and visual resources in the extended study area, a field assessment was performed only in the primary study area. This assessment emphasizes the potential relationship between the project and sensitive receptors associated with recreation areas, roadways, and commercial and residential development. Visual assessment units were mapped based on the distinct visual character of the landscape. Key observation points were identified in each VAU and photograph points were established. Despite the NRAs class A overall scenic attractiveness, the assessment of visual quality presented in this PDEIS is based on the quality of the scenic resources and the visual sensitivity of the most likely viewer group at a particular KOP. Assessment methods were applied to the project alternatives using the following steps:

- **Identify visually sensitive areas** – Areas rated highest for sensitivity are those having views seen by people driving to or from recreational activities or along routes designated as scenic corridors. Stationary views from relatively moderate- to high-use recreation areas and commercial/residential areas are also considered to be sensitive.

- **Define the landscape character** – Landscape character refers to the visual and cultural image of a geographic area. It is composed of the combination of physical, biological, and cultural attributes that make each landscape identifiable or unique. Landscape character embodies distinct landscape attributes that exist throughout an area.

- **Identify visually sensitive observation points** – Analysis of the impacts to visual resources from the implementation of any project alternative should consider both construction and postconstruction views. This step identifies visually sensitive observation points in the primary study area. Identification of visually sensitive observation points allows a comparison of existing views and areas of potential visual impact resulting from one or more alternative.

- **Identify visually affected key observation points** – Based on the location and distance of potential visual impact areas from the visually sensitive observation points, only a portion of the observation points may be significantly affected. This analysis further evaluates observation points to determine whether visual impact areas would occur (1) in the direct line of sight and (2) in the foreground (0 to 0.5 mile) and/or middle ground (0.5 to 4 miles) views. Observation points with visual impact areas in the direct line of sight or in the foreground, middle ground, or background view are referred to as KOPs, which are described in Section 19.1.

- **Classify scenic attractiveness** – Scenic attractiveness classifications are used to categorize visual features as follows: Class A “distinctive,” Class B “typical,” and Class C “indistinctive.” These classifications are described in Section 19.1.

19.3.2 Criteria for Determining Significance of Effects

An environmental document prepared to comply with NEPA must consider the context and intensity of the environmental effects that would be caused by, or result from, the proposed action. Under NEPA, the significance of an effect is used solely to determine whether an Environmental Impact Statement must be prepared. An environmental document prepared to comply with CEQA must identify the potentially significant environmental effects of a project. A “[s]ignificant effect on the environment” means a substantial, or potentially substantial, adverse change in any of the physical conditions in the area affected by the project (CEQA Guidelines, Section 15382). CEQA also requires that the environmental document propose feasible measures to avoid or substantially

reduce significant environmental effects (CEQA Guidelines, Section 15126.4(a)).

The criteria used to determine the significance of impacts for this analysis are based primarily on the CEQA Guidelines and other associated criteria, including regulatory agency standards. Federal criteria and NEPA guidance were also considered. The following significance criteria were developed based on guidance established in the CEQA Guidelines, and consider the context and intensity of the environmental effects as required under NEPA. Impacts on aesthetic values and visual resources would be significant if they would result in any of the following:

- Have a substantial adverse effect on a scenic vista
- Substantially damage scenic resources, including trees, rock outcroppings, and historic buildings adjacent to a State scenic highway
- Substantially degrade the existing visual character or quality of the project site and its surroundings
- Create a new source of substantial light or glare that would adversely affect day or nighttime views in the project area

19.3.3 Topics Eliminated from Further Consideration

No significant topics related to aesthetics and visual resources have been eliminated from discussion.

19.3.4 Direct and Indirect Effects

The McCloud River upstream from the McCloud River Bridge is eligible for listing as a Wild and Scenic River under the Federal Wild and Scenic Rivers Act. In lieu of recommending Wild and Scenic designation, USFS and other stakeholders entered into a *Coordinated Resource Management Plan* with the primary objective of managing the river to protect its pristine resources. The State Public Resources Code, Section 5093.542, established through enactment of the Wild and Scenic Rivers Act, as amended (Sections 5093.50 – 5093.70), provides protection to the reach between the McCloud Reservoir and the McCloud River Bridge. A detailed discussion of the importance of the Federal Wild and Scenic Rivers Act and State Public Resources Code protections for the McCloud River north of the McCloud River Bridge is presented in Chapter 25 in the PDEIS.

No-Action Alternative

Shasta Lake and Vicinity and Upper Sacramento River (Shasta Dam to Red Bluff)

Impact Vis-1 (No-Action): Consistency with Guidelines for Visual Resources in the STNF LRMP Under the No-Action Alternative, there would be no inconsistencies with the guidelines for visual resources provided in the STNF

LRMP because the project would not be constructed. The visual setting would remain the same as existing conditions. There would be no impact. Mitigation is not required for the No-Action Alternative.

Impact Vis-2 (No-Action): Degradation and/or Obstruction of a Scenic View from Key Observation Points Under the No-Action Alternative, scenic views would not be degraded and/or obstructed because the project would not be constructed. The visual setting would remain the same as existing conditions. There would be no impact. Mitigation is not required for the No-Action Alternative.

Impact Vis-3 (No-Action): Generation of Increased Daytime Glare and/or Nighttime Lighting Under the No-Action Alternative, daytime and/or nighttime glare would not increase because the project would not be constructed. The visual setting would remain the same as existing conditions. There would be no impact. Mitigation is not required for the No-Action Alternative.

Impact Vis-4 (No-Action): Consistency with Federal and State Scenic Highway Requirements Under the No-Action Alternative, there would be no inconsistencies with Federal and State Scenic Byway requirements because the project would not be constructed. The visual setting would remain the same as existing conditions. There would be no impact. Mitigation is not required for the No-Action Alternative.

Lower Sacramento River and Delta, and CVP/SWP Service Areas None of the landscapes and features in the extended study area would be affected by the No-Action Alternative. There would be no impact. Mitigation for this impact is not needed, and thus not proposed.

CP1 – 6.5-Foot Dam Raise, Anadromous Fish Survival and Water Supply Reliability

Shasta Lake and Vicinity and Upper Sacramento River (Shasta Dam to Red Bluff)

Impact Vis-1 (CP1): Consistency with Guidelines for Visual Resources in the STNF LRMP The effects of the construction and operational elements of CP1 would be inconsistent with some of the VQOs established by the STNF LRMP. The LRMP calls for management activities that would be visible from the I-5 corridor and SR 151 to remain visually subordinate on the landscape and not be noticeable to the casual observer (a VQO of "retention"). Foreground views from KOPs most often used by the public, such as campgrounds and boat launches, are also managed according to the VQO of retention, whereas middle ground views are managed according to the "modification" VQO (management activities in the middle ground having a natural appearance). The construction and operational elements of CP1 would be more visible from some viewpoints than others. In addition, what might be considered short-term impacts to visual resources and aesthetics for some viewer groups, such as tourists, might be considered long-term impacts for other viewer groups, such as residents. The

LRMP does not distinguish between short-term and long-term VQOs nor between classes of viewers. Therefore, this impact is considered significant.

USFS VQOs for the Shasta-Trinity Unit of the NRA allow for some active land management. The LRMP calls for a VQO of retention along the Shasta Lake shoreline and modification in developed recreation sites. Vegetation removal along the shoreline and in some developed recreation sites in CP1 would exceed the definitions of retention and modification, better fitting the VQO of "maximum modification" (management activities are dominant, but appear natural when seen as background). Although affected areas could, over time, regain the attributes of the retention or modification VQOs, noticeable changes to aesthetic values and visual resources along the shoreline and in affected developed recreation sites resulting from CP1 would be apparent during and for an undetermined period after construction.

The LRMP calls for the foregrounds and middle grounds of State- and county-designated scenic highways that pass through the Shasta-Trinity Unit of the NRA, including portions of the I-5 corridor and SR 151, to be managed for the retention VQO. However, the effects of CP1 on aesthetic values and visual resources as seen from the highways would be visible in some areas during and after project construction. The appearance of areas that are visible from these highways could become similar to existing conditions when the project is completed.

Implementation of CP1 would result in impacts to visual resources that are inconsistent with LRMP VQOs. These impacts cannot be effectively mitigated or avoided, and the CP1 would not be consistent with the LRMP VQOs without amending the STNF LRMP. This impact is considered significant and unavoidable. Mitigation for this impact is not available.

Impact Vis-2 (CP1): Degradation and/or Obstruction of a Scenic View from Key Observation Points Under CP1, the "bathtub ring" that is apparent during less than full-pool conditions would become larger. Existing scenic views of areas where utilities and infrastructure would be relocated could be obstructed or degraded. Views, including those of the renowned "Three Shastas," would be obstructed or degraded from some KOPs during construction. Throughout the primary study area, vegetation retention or removal activities (proposed activities would vary by relocation area) would also degrade scenic views. Although project-related changes to the landscape could become less visible over time, these changes would be highly visible during construction. This impact is considered significant.

Under CP1, changes to the scenic views of Shasta Lake and the surrounding landscape would be most apparent when the lake is not full. From KOPs with panoramic views of Shasta Lake, the appearance of the expanded bathtub ring would be only minimally changed, given the overall size of the affected area. As the pool fluctuates, changes to the bathtub ring may not be apparent to

transitory viewers. For some groups such as residents, however, changes to the size of the bathtub ring would be more apparent and of longer duration. For all viewer groups, the effect of leaving vegetation in-place below the inundation level or removing vegetation from the shoreline would be readily apparent in all VAUs.

Scenic views of areas where utilities and infrastructure would be relocated would be at least temporarily degraded or obstructed during and after construction. Changes to these views could be highly visible from some KOPs.

Construction activities and materials associated with CP1 could also be highly visible. In particular, views from KOPs in the Shasta Dam VAU (e.g., the SR 151 scenic overlook, the Shasta Dam Visitor Center, the Coram Ranch House, and the lake) would be highly affected by construction activities and materials, including the movement of heavy equipment and the construction of scaffolding and framing.

Implementation of CP1 would degrade and obstruct scenic views from key observation points. These impacts cannot be effectively mitigated or avoided. This impact is considered significant and unavoidable. Mitigation for this impact is not available.

Impact Vis-3 (CP1): Generation of Increased Daytime Glare and/or Nighttime Lighting The increased area of light-colored soils around the Shasta Lake shoreline that are exposed during periods of drawdown and, conversely, the increased area of water surface associated with CP1 would increase the potential for daytime glare. The relocation of roads and infrastructure could also create new sources of reflective daytime glare. In addition, construction equipment could be a temporary source of reflective daytime glare. Extensive construction activities at night requiring the use of vehicle and perimeter lighting, particularly in the vicinity of Shasta Dam, would be necessary for several years. New sources of permanent nighttime lighting would also be required for some locations, such as relocated roads and recreational facilities. This impact is considered significant.

CP1 would increase the area of bare mineral soil exposed along the Shasta Lake shoreline during periods of drawdown. The light color of these soils is a significant source of unavoidable daytime glare. Water also serves as a source of substantial glare. The increased water surface area created by a 6.5-foot dam raise would increase the potential for unavoidable daytime glare being encountered by sensitive receptors around the lake. Changes in water surface elevations, particularly water level increases, would change the refractive angle of the water surface, thus potentially exposing sensitive receptors, such as campgrounds or residences, to a new source of significant glare. The intensity and duration of daytime glare would vary with changes in the angle of the sun and the elevation of the water surface.

Relocation of roads and infrastructure could create a source of both daytime and nighttime glare. Guardrails and other roadway fixtures, such as retaining walls, safety barriers, light standards, and other structures, have the potential to be reflective under natural and artificial light. In addition, nighttime lighting may be required at some locations, including roadways and recreation facilities, for safety purposes.

Construction activities associated with CP1 would generate daytime glare at various locations in the primary study area, most noticeably in areas where equipment would be operated, such as Shasta Dam. The potential for glare caused by light reflecting off construction equipment would vary with changes in the angle of the sun. This impact is considered significant and unavoidable. Mitigation for this impact is proposed in Section 19.3.5.

Impact Vis-4 (CP1): Consistency with Federal and State Scenic Highway Requirements State Route 151 is the only State-designated Scenic Highway in the primary study area. There are no federally designated scenic roadways in the primary study area. Under CP1, project construction activities around Shasta Dam would be visible from SR 151. The distance between the SR 151 vista point, high on the mountainside overlooking Shasta Dam, and the other proposed construction/relocation areas around the lake would make it very difficult for most viewers to differentiate changes resulting from CP1. This impact is considered less than significant. Mitigation for this impact is not needed, and thus not proposed.

Lower Sacramento River and Delta and CVP/SWP Service Areas None of the landscapes and features in the extended study area would be affected by activities associated with CP1. There would be no impact. Mitigation for this impact is not needed, and thus not proposed.

CP2 – 12.5-Foot Dam Raise, Anadromous Fish Survival and Water Supply Reliability

Shasta Lake and Vicinity and Upper Sacramento River (Shasta Dam to Red Bluff)

Impact Vis-1 (CP2): Consistency with Guidelines for Visual Resources in the STNF LRMP This impact would be similar to Impact Vis-1 (CP1) for Shasta Lake and vicinity and the upper Sacramento River (Shasta Dam to Red Bluff). Construction and operational elements of CP2 would be inconsistent with some of the VQOs established by the STNF LRMP. The larger inundation area proposed under CP2 would result in an increased opportunity for management activities to be visible from the I-5 corridor, SR 151, and other areas managed according to retention and modification VQOs. This impact is considered significant and unavoidable. Mitigation for this impact is not available.

Impact Vis-2 (CP2): Degradation and/or Obstruction of a Scenic View from Key Observation Points This impact would be similar to Impact Vis-2 (CP1) for Shasta Lake and vicinity, and the upper Sacramento River (Shasta Dam to

Red Bluff). Under CP2, the "bathtub ring" that is apparent during less than full-pool conditions would become larger than what would be exposed under CP1. CP2 would also require the relocation of more utilities and infrastructure and more vegetation retention or removal than CP1. In addition, the timeframe for construction and implementation of the project would increase, which would prolong the period that scenic views are degraded by the project. Although project-related changes to the landscape could become less visible over time, these changes would be highly visible during construction. This impact is considered significant and unavoidable. Mitigation for this impact is not available.

Impact Vis-3 (CP2): Generation of Increased Daytime Glare and/or Nighttime Lighting This impact would be similar to Impact Vis-3 (CP1) for Shasta Lake and vicinity and the upper Sacramento River (Shasta Dam to Red Bluff). Under CP2, more light-colored soils would be exposed, which would expand the amount of daytime glare. Construction and implementation of the project would take place over a longer period of time, which would prolong the requirement for nighttime lighting during construction and daytime glare from construction equipment. More roads and other infrastructure would be relocated, which would increase the amount of related daytime glare and nighttime lighting. The impact is considered significant and unavoidable. Mitigation for this impact is proposed in Section 19.3.5.

Impact Vis-4 (CP2): Consistency with Federal and State Scenic Highway Requirements This impact would be similar to Impact Vis-4 (CP1) for Shasta Lake and vicinity and the upper Sacramento River (Shasta Dam to Red Bluff). Although the scale of vegetation removal and other activities associated with the construction at the proposed relocation sites would be larger under CP2 than under CP1, the distance of most construction activities from SR 151—the only designated scenic highway in the primary study area—would prevent CP2 from being inconsistent with State Scenic Highway requirements. This impact is considered less than significant. Mitigation for this impact is not needed, and thus not proposed.

Lower Sacramento River and Delta and CVP/SWP Service Areas None of the landscapes and features in the extended study area would be affected by activities associated with CP2. There would be no impact. Mitigation for this impact is not needed, and thus not proposed.

CP3 – 18.5-Foot Dam Raise, Anadromous Fish Survival and Water Supply Reliability

Shasta Lake and Vicinity and Upper Sacramento River (Shasta Dam to Red Bluff)

Impact Vis-1 (CP3): Consistency with Guidelines for Visual Resources in the STNF LRMP This impact would be similar to Impact Vis-1 (CP1) for Shasta Lake and vicinity and the upper Sacramento River (Shasta Dam to Red Bluff). Construction and operational elements of CP3 would be inconsistent with some

of the VQOs established by the STNF LRMP. The larger inundation area proposed under CP3 would result in an increased opportunity for management activities to be visible from the I-5 corridor, SR 151, and other areas managed according to retention and modification VQOs. This impact is considered significant and unavoidable. Mitigation for this impact is not available.

Impact Vis-2 (CP3): Degradation and/or Obstruction of a Scenic View from Key Observation Points This impact would be similar to Impact Vis-2 (CP1) for Shasta Lake and vicinity and the upper Sacramento River (Shasta Dam to Red Bluff). Under CP3, the "bathtub ring" that is apparent during less than full-pool conditions would become larger than what would be exposed under CP1 or CP2. CP3 would also require the relocation of more utilities and infrastructure and more vegetation retention or removal than CP1 or CP2. In addition, the timeframe for construction and implementation of the project would increase, which would prolong the period that scenic views are degraded by the project. Although project-related changes to the landscape could become less visible over time, these changes would be highly visible during construction. This impact is considered significant and unavoidable. Mitigation for this impact is not available.

Impact Vis-3 (CP3): Generation of Increased Daytime Glare and/or Nighttime Lighting This impact would be similar to Impact Vis-3 (CP1) for Shasta Lake and vicinity and the upper Sacramento River (Shasta Dam to Red Bluff). Under CP3, more light-colored soils would be exposed, which would expand the amount of daytime glare. Construction and implementation of the project would take place over a longer period of time, which would prolong the requirement for nighttime lighting during construction and daytime glare from construction equipment. More roads and other infrastructure would be relocated, which would increase the amount of related daytime glare and nighttime lighting. The impact is considered significant and unavoidable. Mitigation for this impact is proposed in Section 19.3.5.

Impact Vis-4 (CP3): Consistency with Federal and State Scenic Highway Requirements This impact would be similar to Impact Vis-4 (CP1) for Shasta Lake and vicinity and the upper Sacramento River (Shasta Dam to Red Bluff). Although the scale of vegetation removal and other activities associated with the construction at the proposed relocation sites would be larger under CP3 than under CP1 or CP2, the distance of most construction activities from SR 151—the only designated scenic highway in the primary study area—would prevent CP3 from being inconsistent with State Scenic Highway requirements. This impact is considered less than significant. Mitigation for this impact is not needed, and thus not proposed.

Lower Sacramento River and Delta and CVP/SWP Service Areas None of the landscapes and features in the extended study area would be affected by activities associated with CP3. There would be no impact. Mitigation for this impact is not needed, and thus not proposed.

CP4 – 18.5-Foot Dam Raise, Anadromous Fish Survival and Water Supply Reliability

Shasta Lake and Vicinity and Upper Sacramento River (Shasta Dam to Red Bluff)

Impact Vis-1 (CP4): Consistency with Guidelines for Visual Resources in the STNF LRMP This impact would be similar to Impact Vis-1 (CP1) and similar to Impact Vis-1 (CP3) for Shasta Lake and vicinity and the upper Sacramento River (Shasta Dam to Red Bluff). Construction and operational elements of CP4 would be inconsistent with some of the VQOs established by the STNF LRMP. This impact is considered significant and unavoidable. Mitigation for this impact is not available.

Impact Vis-2 (CP4): Degradation and/or Obstruction of a Scenic View from Key Observation Points This impact would be similar to Impact Vis-2 (CP1) and similar to Impact Vis-2 (CP3) for Shasta Lake and vicinity and the upper Sacramento River (Shasta Dam to Red Bluff) with the exception of the proposed gravel augmentation and Reading Island channel clearing and habitat restoration actions included in CP4. Although talus cones, lateral berms, and the direct placement of gravel into the river channel would initially be noticeable to viewers in the immediate vicinity of such actions, project-related changes to the landscape would become less visible over time as gravels are dispersed by natural means. Similarly, channel clearing and habitat restoration activities at Reading Island would affect the existing views of the island, but these changes would become increasingly less noticeable over time as vegetation becomes reestablished. This impact is considered significant and unavoidable. Mitigation for this impact is not available.

Impact Vis-3 (CP4): Generation of Increased Daytime Glare and/or Nighttime Lighting This impact would be similar to Impact Vis-3 (CP1) and similar to Impact Vis-3 (CP3) for Shasta Lake and vicinity and the upper Sacramento River (Shasta Dam to Red Bluff) with the exception of the proposed gravel augmentation and Reading Island channel clearing and habitat restoration actions included in CP4. Gravel is typically light colored and reflective; therefore, gravel augmentation would create a temporary source of daytime glare. Over time, as the gravel disperses along the river channel, its potential to be a source of glare would diminish. Channel clearing and habitat restoration activities proposed for Reading Island under CP4 could also create a source of temporary daytime glare by the removal of vegetation, exposure of soils, and expansion of water surface. However, the potential for vegetation removal and exposed soils to be a source of daytime glare would be temporary, fading as new vegetation becomes established. The impact is considered significant and unavoidable. Mitigation for this impact is proposed in Section 19.3.5.

Impact Vis-4 (CP4): Consistency with Federal and State Scenic Highway Requirements This impact would be similar to Impact Vis-4 (CP1) and similar to Impact Vis-4 (CP3) for Shasta Lake and vicinity and the upper Sacramento

River (Shasta Dam to Red Bluff). This impact is considered less than significant. Mitigation for this impact is not needed, and thus not proposed.

Lower Sacramento River and Delta and CVP/SWP Service Areas None of the landscapes and features in the extended study area would be affected by activities associated with CP4. There would be no impact. Mitigation for this impact is not needed, and thus not proposed.

CP5 – 18.5-Foot Dam Raise Combination Plan, Anadromous Fish Survival and Water Supply Reliability

Shasta Lake and Vicinity and Upper Sacramento River (Shasta Dam to Red Bluff)

Impact Vis-1 (CP5): Consistency with Guidelines for Visual Resources in the STNF LRMP This impact would be similar to Impact Vis-1 (CP1) and similar to Impact Vis-1 (CP3) for Shasta Lake and vicinity and the upper Sacramento River (Shasta Dam to Red Bluff). Construction and operational elements of CP5 would be inconsistent with some of the VQOs established by the STNF LRMP. This impact is considered significant and unavoidable. Mitigation for this impact is not available.

Impact Vis-2 (CP5): Degradation and/or Obstruction of a Scenic View from Key Observation Points This impact would be similar to Impact Vis-2 (CP1) and nearly similar to Impact Vis-2 (CP4) for Shasta Lake and vicinity and the upper Sacramento River (Shasta Dam to Red Bluff). Additional enhancements to relocation areas associated with CP5 could result in a slightly greater level of degradation and/or obstruction of a view from a particular KOP than might occur under CP3 or CP4. This impact is considered significant and unavoidable. Mitigation for this impact is not available.

Impact Vis-3 (CP5): Generation of Increased Daytime Glare and/or Nighttime Lighting This impact would be similar to Impact Vis-3 (CP1) and nearly similar to Impact Vis-3 (CP4) for Shasta Lake and vicinity and the upper Sacramento River (Shasta Dam to Red Bluff). Additional enhancements to relocation areas associated with CP5 could result in a slightly greater level of glare than might occur under CP3 or CP4. The impact is considered significant and unavoidable. Mitigation for this impact is proposed in Section 19.3.5.

Impact Vis-4 (CP5): Consistency with Federal and State Scenic Highway Requirements This impact would be similar to Impact Vis-4 (CP1) and similar to Impact Vis-4 (CP3) for Shasta Lake and vicinity and the upper Sacramento River (Shasta Dam to Red Bluff). This impact is considered less than significant. Mitigation for this impact is not needed, and thus not proposed.

Lower Sacramento River and Delta and CVP/SWP Service Areas None of the landscapes and features in the extended study area would be affected by activities associated with CP5. There would be no impact. Mitigation for this impact is not needed, and thus not proposed.

19.3.5 Mitigation Measures

Table 19-3 presents a summary of mitigation measures for land use.

Table 19-3. Summary of Mitigation Measures for Aesthetics

Impact		No-Action Alternative	CP1	CP2	CP3	CP4	CP5
Impact Vis-1: Consistency with Guidelines for Visual Resources in the STNF LRMP (Shasta Lake and Vicinity and Upper Sacramento River)	LOS before Mitigation	NI	SU	SU	SU	SU	SU
	Mitigation Measure	None required.	None available.				
	LOS after Mitigation	NI	SU	SU	SU	SU	SU
Impact Vis-2: Degradation and/or Obstruction of a Scenic View from Key Observation Points (Shasta Lake and Vicinity and Upper Sacramento River)	LOS before Mitigation	NI	SU	SU	SU	SU	SU
	Mitigation Measure	None required.	None available.				
	LOS after Mitigation	NI	SU	SU	SU	SU	SU
Impact Vis-3: Generation of Increased Daytime Glare and/or Nighttime Lighting (Shasta Lake and Vicinity and Upper Sacramento River)	LOS before Mitigation	NI	S	S	S	S	S
	Mitigation Measure	None required.	Vis-3: Minimize or Avoid Visual Impacts of Daytime Glare and Nighttime Lighting.				
	LOS after Mitigation	NI	SU	SU	SU	SU	SU
Impact Vis-4: Consistency with Federal and State Scenic Highway Requirements (Shasta Lake and Vicinity and Upper Sacramento River)	LOS before Mitigation	NI	LTS	LTS	LTS	LTS	LTS
	Mitigation Measure	None required.	None needed; thus, none proposed.				
	LOS after Mitigation	NI	LTS	LTS	LTS	LTS	LTS

Notes:
LOS = level of significance
LTS = less than significant
NI = no impact
S = significant
SU = significant and unavoidable

No-Action Alternative

No mitigation is required for this alternative.

CP1 – 6.5-Foot Dam Raise, Anadromous Fish Survival and Water Supply Reliability

No mitigation is available for impacts Vis-1 and Vis-2, and no mitigation is required for Impact Vis-4. Partial mitigation is provided below for Impact Vis-3.

Mitigation Measure Vis-3 (CP1): Minimize or Avoid Visual Impacts of Daytime Glare and Nighttime Lighting Reclamation will do the following to minimize or avoid potential impacts to visual resources and aesthetics from daytime glare and nighttime lighting:

- Avoid constant nighttime lighting and overly bright lighting to the extent possible. The location of lighting will respond to the anticipated use and should not exceed the amount of light actually required by users.

- Lights will be screened and directed away from residences to the highest degree possible, and the amount of nighttime light used will be minimized to the highest degree possible. Lighting will include shielding to minimize offsite light spill and glare. In addition, the following measures will apply:

  – The spacing of luminaire lamps (or comparable vandal-resistant lighting) should be the maximum allowable for traffic safety.

  – Luminaires (or comparable vandal-resistant lighting) should be cutoff-type fixtures that cast low-angle illumination to minimize incidental spillover of light onto adjacent private properties and undeveloped open space. Fixtures that project upward or horizontally will not be used.

  – Luminaire lamps (or comparable vandal-resistant lighting) will be directed toward the roadway or lighted feature (e.g., campground restrooms, sidewalks) and away from adjacent residences and open space areas.

  – Luminaire lamps (or comparable vandal-resistant lighting) will provide good color rendering and natural light qualities. Low-pressure and high-pressure sodium fixtures that are not color corrected will not be used.

  – Luminaire lamps (or comparable vandal-resistant lighting) intensity will be the minimum allowable for traffic safety.

  – Luminaire lamp (or comparable vandal-resistant lighting) mountings will be downcast and the height of the poles minimized to reduce potential for backscatter into the nighttime sky and incidental spillover of light into adjacent private properties and open space.

  – Luminaire lamp (or comparable vandal-resistant lighting) mountings will have nonglare finishes.

- Guardrails and other roadway fixtures, including retaining walls, safety barriers, light standards, and other structures, will be limited to the minimum length, height, and bulk necessary to adequately provide for the safety of the roadway user. Earthtone colors in dark shades and flat finishes will be used on all roadway fixtures. New and replacement guardrails will not have a shiny, reflective finish. (These features are typically galvanized steel, which weathers naturally to a non-glare finish, typically within a year or so.) Retaining walls and other erosion control devices or structures will be constructed of natural materials whenever possible and will, to the maximum extent possible, be designed and sited to avoid detracting from the scenic quality of the corridor. Such structures will incorporate heavy texture or articulated plane surfaces that create heavy shadow patterns.

Implementation of this mitigation measure would reduce the impacts of the project related to daytime glare and nighttime lighting, but would not reduce them to a less than significant level. The impact is considered significant and unavoidable.

CP2 – 12.5-Foot Dam Raise, Anadromous Fish Survival and Water Supply Reliability

No mitigation is available for impacts Vis-1 and Vis-2, and no mitigation is required for Impact Vis-4. Partial mitigation is provided below for Impact Vis-3.

Mitigation Measure Vis-3 (CP2): Minimize or Avoid Visual Impacts of Daytime Glare and Nighttime Lighting This mitigation measure is identical to Mitigation Measure Vis-3 (CP1). Implementation of this mitigation measure will reduce the impacts of the project related to daytime glare and nighttime lighting. However, the impact will be significant and unavoidable.

CP3 – 18.5-Foot Dam Raise, Anadromous Fish Survival and Water Supply Reliability

No mitigation is available for impacts Vis-1 and Vis-2, and no mitigation is required for Impact Vis-4. Partial mitigation is provided below for Impact Vis-3.

Mitigation Measure Vis-3 (CP3): Minimize or Avoid Visual Impacts of Daytime Glare and Nighttime Lighting This mitigation measure is identical to Mitigation Measure Vis-3 (CP1). Implementation of this mitigation measure will reduce the impacts of the project related to daytime glare and nighttime lighting. However, the impact will be significant and unavoidable.

CP4 – 18.5-Foot Dam Raise, Anadromous Fish Focus with Water Supply Reliability

No mitigation is available for impacts Vis-1 and Vis-2, and no mitigation is required for Impact Vis-4. Partial mitigation is provided below for Impact Vis-3.

Mitigation Measure Vis-3 (CP4): Minimize or Avoid Visual Impacts of Daytime Glare and Nighttime Lighting This mitigation measure is identical to Mitigation Measure Vis-3 (CP1). Implementation of this mitigation measure will reduce the impacts of the project related to daytime glare and nighttime lighting. However, the impact will be significant and unavoidable.

CP5 – 18.5-Foot Dam Raise, Combination Plan

No mitigation is available for impacts Vis-1 and Vis-2, and no mitigation is required for Impact Vis-4. Partial mitigation is provided below for Impact Vis-3.

Mitigation Measure Vis-3 (CP5): Minimize or Avoid Visual Impacts of Daytime Glare and Nighttime Lighting This mitigation measure is identical to Mitigation Measure Vis-3 (CP1). Implementation of this mitigation measure will reduce the impacts of the project related to daytime glare and nighttime lighting. However, the impact will be significant and unavoidable.

19.3.6 Cumulative Effects

Cumulative effects are the impacts on the environment that result from the incremental impacts of the project alternative when added to the impacts of other past, present, and reasonably foreseeable future actions (14 California Code of Regulation 15355[b], 40 Code of Federal Regulations 1508.7), regardless of what agency (Federal or non-Federal) or entity undertakes such other actions. These impacts can result from individually minor, but collectively significant, actions taking place over time.

The President's Council on Environmental Quality NEPA regulations and the State CEQA Guidelines require that the cumulative impacts of a project be addressed in an environmental document when the cumulative impacts are expected to be significant (40 Code of Federal Regulations 1508.25[a][2], 14 California Code of Regulation 15130[a]). When a lead agency assesses a project having an incremental effect that is not "cumulatively considerable," the lead agency need not consider that effect significant. However, the lead agency will briefly describe its basis for concluding that the incremental effect is not cumulatively considerable.

Methods and Assumptions

The analysis of cumulative impacts in this chapter addresses the cumulative impacts of the various project alternatives. According to the CEQA Guidelines, the cumulative impacts discussion "should be guided by the standards of practicality and reasonableness." The CEQA Guidelines require that a

cumulative impacts analysis identify related projects, summarize the expected environmental impacts of those related projects, and analyze the cumulative impacts of the proposed and related projects. Past, present, and reasonably foreseeable projects affecting the same viewsheds as those associated with the primary study area are too numerous to list. Because no construction activities associated with the project would occur outside of the primary study area, the geographic scope of the area examined for cumulative impacts is the primary study area identified for this project. Antlers Bridge Replacement is an example of the types of projects that may contribute to cumulative impacts associated with aesthetics and visual resources in the primary study area.

Antlers Bridge Replacement Caltrans, in cooperation with the Federal Transit Administration, is currently in the process of replacing the I-5 Antlers Bridge over Shasta Lake (in the primary study area), near the community of Lakehead. This project includes construction of a 1,942-foot, five-lane segmental bridge with deep pile foundations that are 12 feet in diameter. In addition, it includes realignment of a 0.4-mile-long segment of I-5, requiring hillside excavation, construction of a five-lane freeway section and demolition of the existing 1,500 feet of steel deck truss bridge. The new bridge is being constructed next to the existing bridge, which remains open to traffic until the new bridge is completed. Although not considered to be a significant impact on visual resources and aesthetics (Caltrans and DOT 2007), the project is highly visible from surrounding public areas (I-5 corridor, Antlers Public Boat Ramp, and Lakehead). Construction is expected to be completed in 2012.

Cumulative Effects

Past, present, and reasonably foreseeable projects such as bridge reconstructions and highway modifications along the I-5 corridor, changes to marinas and resorts, and mine reclamation on the surrounding hillsides in addition to the effects of climate change could all affect the impression that viewers have of the region. In addition, as described in the Climate Change Projection Appendix, climate change could result in reduced end-of-September carryover storage volumes, thus resulting in lower lake levels for a portion of the year. Lower lake levels would increase the period of time that the “bathtub ring” would be visible.

Most of the impacts on aesthetics and visual resources resulting from implementation of the proposed SLWRI alternatives assessed in this chapter would be significant and unavoidable. Implementation of the proposed SLWRI alternatives would result in impacts to visual resources that are inconsistent with LRMP VQOs, and would degrade or obstruct scenic views from key observation points. These impacts are considered significant and unavoidable, and when assessed with other projects that could change the character and quality of the visual resources and aesthetics in Shasta Lake and vicinity and the upper Sacramento River, would be considered cumulatively significant. Implementation of the proposed SLWRI alternatives would also generate daytime glare at construction locations, and is considered significant and

unavoidable. However, this impact is temporary in nature, and would not be considered cumulatively significant.

None of the project alternatives would have a cumulatively considerable effect on aesthetics and visual resources in the extended study area.

Chapter 20
Transportation and Traffic

20.1 Affected Environment

This section describes the existing transportation network in the primary and extended study areas – specifically those roads, highways, bridges, railroads, ports, transit, navigation, and airports that could be affected by the SLWRI project alternatives.

20.1.1 Roadways

Shasta Lake and Vicinity and Upper Sacramento River (Shasta Dam to Red Bluff)

The primary study area includes Shasta Dam, Shasta Lake, and the upper Sacramento River between Shasta Dam and Red Bluff Diversion Dam in Shasta and Tehama counties. The surface transportation network in the primary study area consists of an interstate freeway, State highways, and smaller connector roads. Traffic in the area is generally moderate to light, except that heavy traffic in the Shasta Lake Unit of the Whiskeytown-Shasta-Trinity National Recreation Area is not unusual during weekends and holidays between May 1 and Labor Day (Reclamation 2004).

Figures 1-1 and 1-2 in Chapter 1, "Introduction," show the roadways in the primary study area. Interstate 5 (I-5) is the main north-south interstate freeway in the region. Several major arterials run north-south, generally parallel to the Sacramento River. State Route (SR) 99 and SR 70 run north-south; certain sections of both of these routes are expressways. SR 273 runs north-south from Redding, generally paralleling the Sacramento River before it intersects with I-5 several miles north of the Shasta/Tehama county line.

Every 3 years, the California Department of Transportation (Caltrans) collects traffic at the I-5/Turntable Bay Road and I-5/Bridge Bay Road interchanges for an 8-day period between April and June. Table 20-1 shows the average daily traffic counts for these interchanges in 2000, 2003, and 2006. These data provide a general sense of the amount of traffic accessing the Shasta Lake area from I-5.

Table 20-1. Average Daily Traffic Volume at the I-5/Turntable Bay Road and I-5/Bridge Bay Road Interchanges

Location	Average Daily Traffic Volumes		
	2000	2003	2006
Turntable Bay Road northbound off-ramp	130	170	145
Turntable Bay Road northbound on-ramp	90	65	110
Turntable Bay Road southbound off-ramp	60	35	38
Turntable Bay Road southbound on-ramp	120	85	80
Bridge Bay Road northbound off-ramp	470	310	302
Bridge Bay Road northbound on-ramp	90	60	54
Bridge Bay Road southbound off-ramp	110	150	145
Bridge Bay Road southbound on-ramp	490	350	331

Source: Caltrans 2006

SR 299 is the major east-west route. This route traverses Trinity, Shasta, Lassen, and Modoc counties north of Shasta Dam. SR 44 is another major east-west route farther south that traverses Shasta County near the city of Redding. SR 36, which also runs generally east-west, intersects with SR 99 and I-5, and this route crosses the Sacramento River near the city of Red Bluff.

There are 317 bridges in Shasta County, 231 of which have bridge spans of 20 feet or more, making them eligible for Federal aid. Ninety-four bridges are beyond their design lives, functionally obsolete, or structurally deficient (Shasta County RTPA 2004).

Lower Sacramento River and Delta

SR 45 follows the Sacramento River north from SR 113 in Knights Landing, north of Sacramento. I-5 parallels SR 45 and the Sacramento River to the west. On the west side of the Sacramento Valley, SR 29 runs north-south through Napa and Lake counties. East-west highways include SR 20 in Lake County, SR 162 in Glenn County, and SR 36 in Tehama and Trinity counties. Major east-west routes on the east side of the Sacramento Valley include SRs 70, 49, and 88; U.S. Highway 50; and Interstate 80.

The Delta region is served by several major freeways. I-5 and SR 99 run north-south and Interstate 80 and U.S. Highway 50 run east-west through Sacramento. Other highways extend from the cities of Sacramento and Stockton to small cities and towns in the region. New roadways have facilitated growth and urbanization along their corridors and within the upper watersheds of major inflowing rivers. Local roads in the Delta are often narrow and winding; during peak travel times, traffic in this area often includes slow, oversized farm equipment.

The two major north-south freeways in the San Joaquin River area are I-5 and SR 99, which pass through the San Joaquin Valley from Sacramento through

Stockton and continue on to Bakersfield and its vicinity. SR 41 runs in a north-south direction south of Fresno. Several east-west routes traverse the San Joaquin River basin: SR 152 is an expressway that connects Los Banos and Chowchilla in Madera County, SR 180 terminates in Yosemite National Park, SR 168 is a primary east-west route in Fresno County, and SRs 190 and 198 are primary routes in Tulare County.

CVP/SWP Service Areas

Numerous freeways and expressways serve portions of the CVP and SWP service areas not discussed above. U.S. 101 extends north and south near the coast from San Luis Obispo south to Los Angeles, and I-5 runs north-south through the Central Valley to Los Angeles and on to San Diego. An extensive, intricate freeway system serves the Los Angeles area. I-10 runs east from Los Angeles to Arizona, while I-8 runs east-west from San Diego to Arizona.

20.1.2 Public Transit

Public transit service in the primary study area is provided by the Redding Area Bus Authority (RABA), which provides fixed-route and demand-responsive (paratransit) service. RABA operates 12 fixed routes within the cities of Redding, Shasta Lake, and Anderson. Shasta County contracts with RABA for a rural commuter bus service. This commuter service offers express transportation into Redding from the outlying community of Burney. The RABA demand/response system provides complimentary transportation to disabled residents of the fixed-route service area. The service area is generally within 0.75 mile of the fixed routes, complying with the minimum mandates of the Federal Americans with Disabilities Act.

Most urban areas in the extended study area provide public transit. These transit systems generally provide both fixed-route and paratransit service. Transit services in the extended study area are not discussed further because they would not be affected by any of the alternatives.

20.1.3 Railroads

Shasta Lake and Vicinity and Upper Sacramento River (Shasta Dam to Red Bluff)

The Union Pacific Railroad (UPRR) and Western Pacific Railroad both have rail lines serving the vicinity of Shasta Lake and the upper Sacramento River area. The UPRR main line follows the I-5 alignment.

Lower Sacramento River and Delta

UPRR is the main rail line serving the Sacramento River region. The UPRR alignment approximates the alignment of I-5. The Western Pacific rail lines extend farther east through the cities of Marysville and Oroville.

Rail lines serving the Delta are the UPRR, the Western Pacific Railroad, and the Atchison, Topeka, and Santa Fe Railway.

The UPRR and Atchison, Topeka, and Santa Fe lines provide primary rail service connecting the Delta region to the San Joaquin River basin. The alignments of these rail lines generally follow the I-5 alignment through the San Joaquin Valley.

CVP/SWP Service Areas

The UPRR line runs north-south near the coast, from the San Francisco Bay Area through Los Angeles, then southeast toward the Arizona/Mexico border.

20.1.4 Water Navigation

Shasta Lake and Vicinity and Upper Sacramento River (Shasta Dam to Red Bluff)

Water travel and navigation in the primary study area consists of smaller watercraft such as kayaks, canoes, and motorboats for fishing, water-skiing, and boating. Shasta Lake is a popular destination for houseboats. A 65-foot-long catamaran provides ferry service to the Shasta Caverns on the east side of the McCloud Arm of Shasta Lake. Water flows and depths in this segment of the Sacramento River limit river navigation to smaller watercraft.

Lower Sacramento River and Delta

The Port of Sacramento is located in West Sacramento in the southeastern part of Yolo County. Ship access to the port is provided from San Francisco Bay up the Sacramento River and through the Sacramento Deep Water Ship Channel. San Francisco Bay is approximately 80 nautical miles southwest of the Port of Sacramento. This route provides direct and unrestricted passage to the port (City of Sacramento 2005).

Two ports are located along the Sacramento River between Sacramento and Walnut Grove. Another commercial port is located on the Sacramento River at Isleton. A commercial port is located near Terminous and two ports are located adjacent to each other on Old and Middle rivers, northeast of Brentwood (CALFED 2000a). The Port of Stockton is on the San Joaquin River. A deep-water ship channel runs from Cache Slough in the Delta to West Sacramento, where the Port of Sacramento is located.

There are no commercial ports or shipping routes on the San Joaquin River upstream from the Port of Stockton.

CVP/SWP Service Areas

The Los Angeles-Long Beach installation on San Pedro Bay is one of the leading ports of California. The growth of Los Angeles led to the creation of its artificial harbors. Other harbors in this area serving commercial shipping are the San Luis Obispo, Santa Barbara, Carpinteria, Port Hueneme, El Segundo, Los Angeles, Long Beach, and San Diego harbors (CALFED 2000b).

20.1.5 Airports

There are four airports in the primary study area: Redding Municipal Airport, Benton Airpark, Shingletown Airport, and Fall River Mills Airport. Redding Municipal Airport, the closest airport to the project site, is located 20 miles southeast of Shasta Dam in Redding. More than 120 other airports exist in the extended study area; these airports are not relevant to the environmental analysis and thus are not discussed further.

20.2 Regulatory Framework

20.2.1 Federal

Several statutes and regulations include provisions specific to the interstate system in California and transportation projects in general. Title 23 of the U.S. Code and the Code of Federal Regulations govern highways; the laws for transportation are included in U.S. Code Title 23 and Code of Federal Regulations Title 49.

The following Federal legislative statutes may also apply to surface transportation and transportation aspects of the project:

- Federal Clean Air Act
- Federal Transit Act
- Americans with Disabilities Act
- Civil Rights Act
- Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users

The Federal Highway Administration issues directives and policy memoranda in the form of technical advisories, orders, and notices for Federally funded roadway and transit projects in California.

20.2.2 State

Caltrans plans, designs, constructs, and maintains State-owned roadways. Caltrans's standard specifications (Caltrans 2006) establish uniform design and construction procedures for California highways and local roads. The highway design criteria and policies in the standard specifications ensure minimum design, contract, and construction standards for projects.

The primary study area is in Caltrans District 2, headquartered in Redding. Caltrans Division of Transportation Planning, System Planning Branch, conducts long-range transportation plans in cooperation with local agencies to identify future highway improvements; the Division of Transportation Programming sets priorities for various Federal and State transportation funding programs.

20.2.3 Regional and Local

The circulation elements in the general plans of California cities and counties are concerned with the movement of people and goods. Section 65302(b) of the California Government Code requires that circulation elements address the general location and extent of existing and proposed major thoroughfares, transportation routes, terminals, and other local public utilities and facilities (Shasta County 2004).

Circulation elements establish goals and policies that pertain to transportation-related activities on city- or county-maintained roads. Most general plans contain circulation goals related to levels of service. Level of service describes the efficiency of road segments and intersections in terms of traffic delays. Level of service guidelines address long-term planning objectives rather than temporary conditions related to temporary, short-term traffic delays resulting from construction activities.

Counties in California classify county-maintained roads according to their intended function and linkage to land uses. Major roads are generally defined as primary carriers of intercity and intracounty travel. Collector roads are intended to provide subregional access and circulation by linking major roads with residential streets.

The Shasta County Regional Transportation Planning Agency is the congestion management agency in Shasta County. In 2004, the agency issued the *Regional Transportation Plan for Shasta County* in accordance with California Government Code Section 65080 et seq. and 23 U.S. Code 134–135 et seq. The plan discusses regional transportation issues, problems, and solutions and includes goals and objectives for each transportation mode and area of concern.

The Tehama County Transportation Commission is the regional transportation planning agency. It develops policies and allocates transportation funds in Tehama County. The commission published the 2005 *Tehama County Regional Transportation Plan* and is responsible for updating the plan.

Local agencies administer various transportation-related revenues that are sent directly to the agencies. The funds provide for the planning, design, operation, and maintenance of roadways and bridges. The Federal government provides matching funds under local assistance programs established under the Surface Transportation Improvement Program and Highway Bridge Rehabilitation and Replacement Program.

20.3 Environmental Consequences and Mitigation Measures

This section evaluates the environmental consequences of each project alternative related to traffic and transportation. The methods of evaluation are explained and the assumptions used to conduct the evaluation are listed below,

and the criteria used to determine the significance of impacts are described. Mitigation measures are recommended to avoid or reduce any potentially significant impacts to less than significant levels.

20.3.1 Methods and Assumptions

Level of service standards are typically used to evaluate long-term (operational) traffic impacts resulting from residential, employment-generating, industrial, and institutional development projects. The SLWRI is not a land use development project. Long-term operation of the project alternatives would not generate additional residential, employment-related, industrial, or institutional vehicular trips (other than a potential slight increase in trips from additional recreation use); therefore, this analysis focuses on construction-related traffic effects. Level of service standards were not used in this analysis because such standards are typically used to evaluate long-term traffic congestion resulting from operations under a proposed action.

Figures 20-1a through 20-1g (beginning on page 20-11) show the locations of transportation facilities that would be relocated under the project alternatives. Table 20-2 lists the named roads and bridges that would require relocation and identifies the map figure where the facility is shown. The facilities that would be relocated under each alternative are described with greater specificity in the associated impact evaluation that follows.

Table 20-2. Named Road and Bridge Facilities that Would Require Relocation Under the SLWRI

Roads and Bridges	Map Figure	CP1	CP2	CP3	CP4	CP5
Lakeshore Drive	20-1f	X	X	X	X	X
Doney Creek Bridge	20-1f	X	X	X	X	X
Charlie Creek Bridge	20-1f	X	X	X	X	X
Silverthorn Road	20-1c	X	X	X	X	X
Gillman Road	20-1g		X	X	X	X
Salt Creek Road	20-1d		X	X	X	X
Didallas Creek Bridge	20-1d		X	X	X	X

Source: Data compiled by AECOM in 2011

Key:
CP = Comprehensive Plan
SLWRI = Shasta Lake Water Resources Investigation

The following project-related assumptions were used in the analysis of construction-related traffic that would result from needed roadway and bridge relocations and the dam raise:

- Excluding gravel augmentation, the estimated duration of proposed construction activities would be 36 months for CP1, 48 months for CP2, and 60 months for CP3–CP5. Under CP4 and CP5, gravel augmentation would continue to occur annually for an additional 5 years, for a total construction period of 10 years.

- On average, 5,000 to 10,000 tons of gravel would be installed per year.

- Gravel would be inserted at up to three sites per year.

- Gravel would be obtained from local commercial sources in Redding.

- Construction activities would occur concurrently.

- Excluding gravel augmentation, import of fill and construction materials (aggregate, cobble, sand, and concrete) and export of construction waste would result in 58 truck trips per day, with a maximum haul route distance of up to 20 miles. Export of vegetation cleared from the primary study area would result in approximately 23 round trips per day, with a maximum haul route distance of up to 20 miles.

- Gravel augmentation would result in up to 18 truck trips per day, with a maximum haul route distance of up to 40 miles.

- Restoration at Reading Island would result in up to 25 haul trips per day.

- The estimated construction labor force for CP1–CP5 would be 350–1,350 people over the total construction period, resulting in an approximate average of 900 daily round trips.

- The increase in recreational opportunities and additional visitor days would generate an approximate average of 148 one-way trips to Shasta Lake and its tributaries under CP1, 251 one-way trips per day under CP2, and 398 one-way trips under CP3–CP5.

- No railroad bridges would require relocation because the project design includes the construction of protective dikes and fortification of railroad embankments.

- Typical construction would occur during daylight hours Monday through Friday, but the construction contractor may extend the hours and may schedule construction work on weekends if necessary to complete aspects of the work within a given time frame. The average workday would be 8 hours.

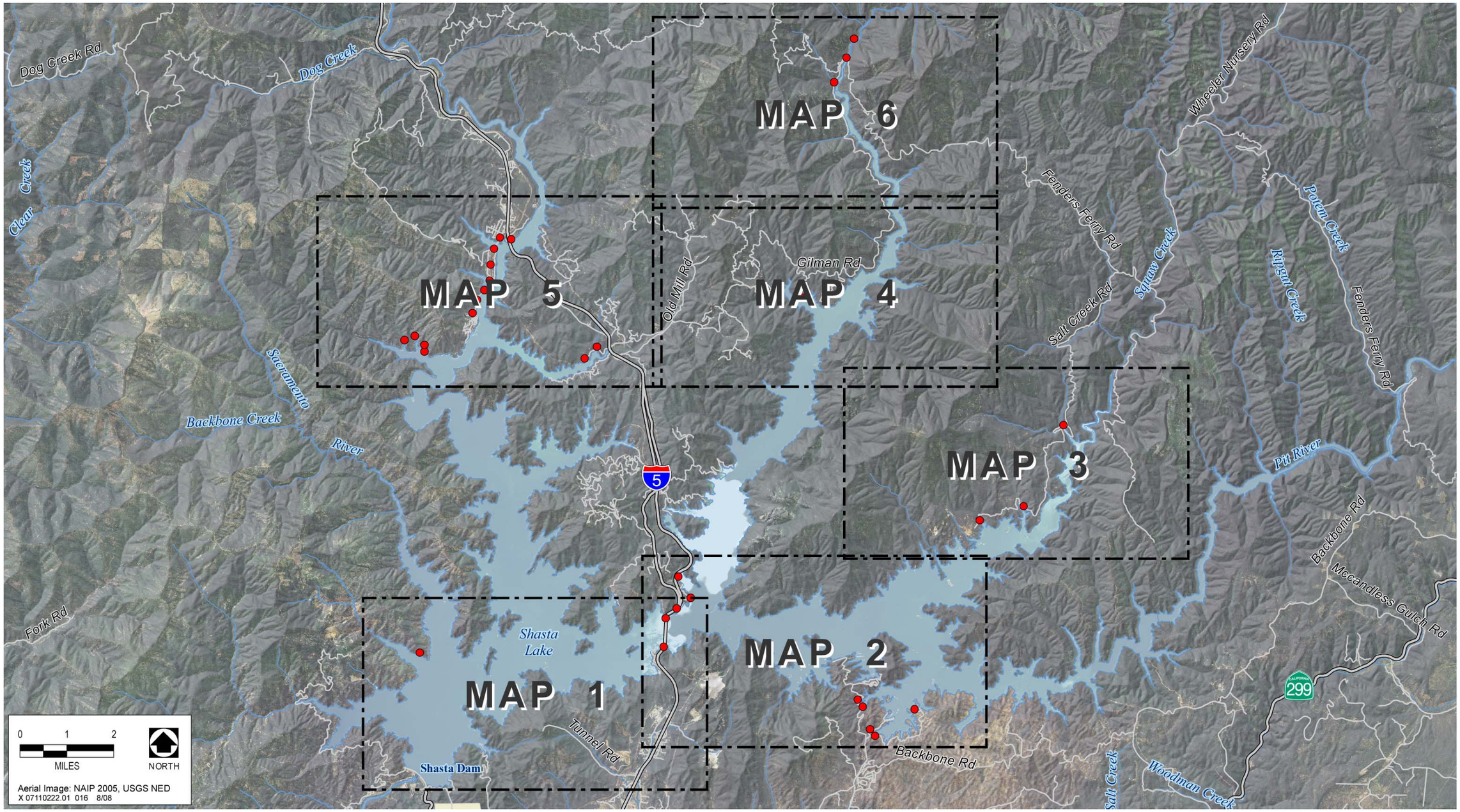


Figure 20-1a. Affected Transportation Facilities – Key to the Sheets

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Figure 20-1b. Affected Transportation Facilities – Map 1

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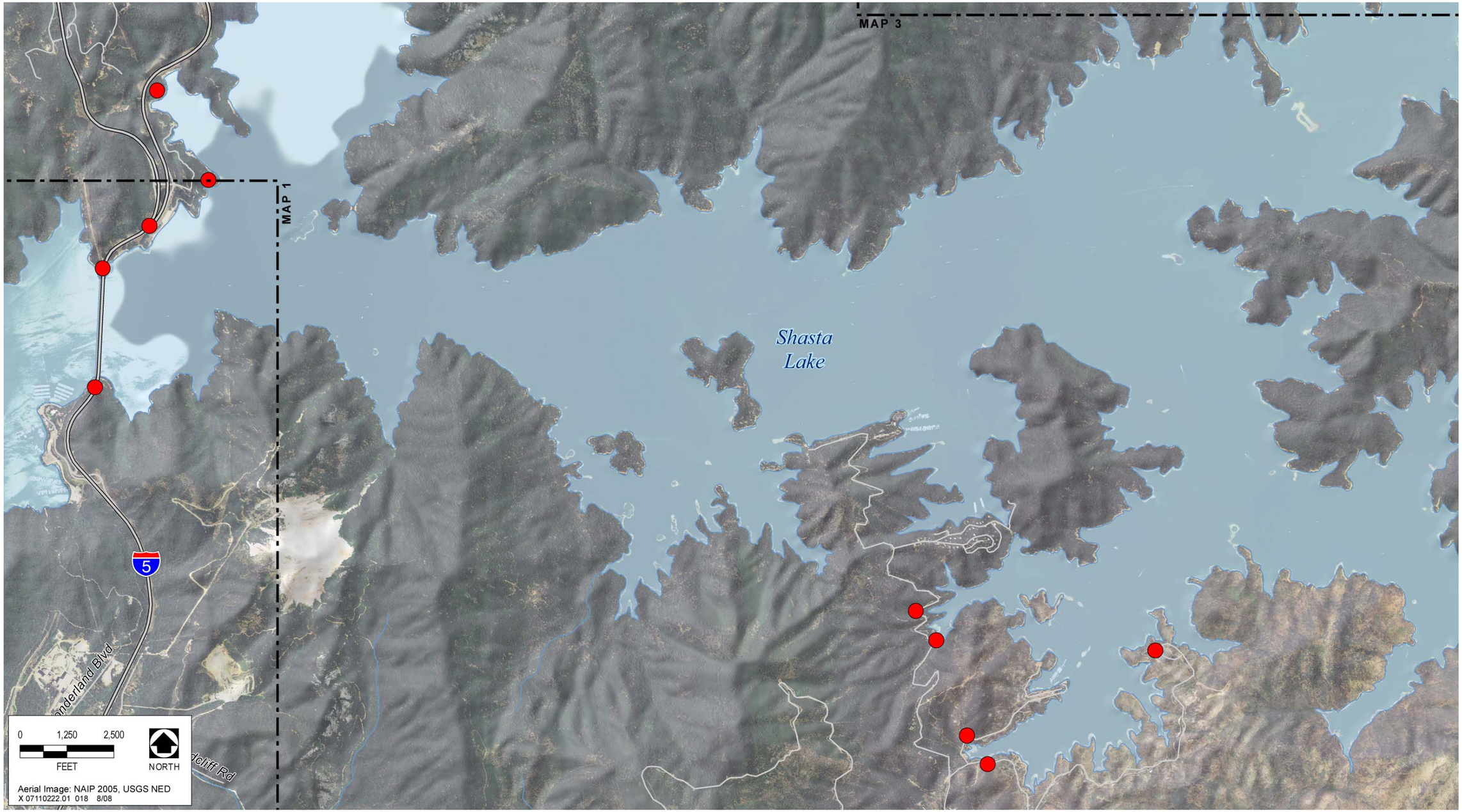


Figure 20-1c. Affected Transportation Facilities – Map 2

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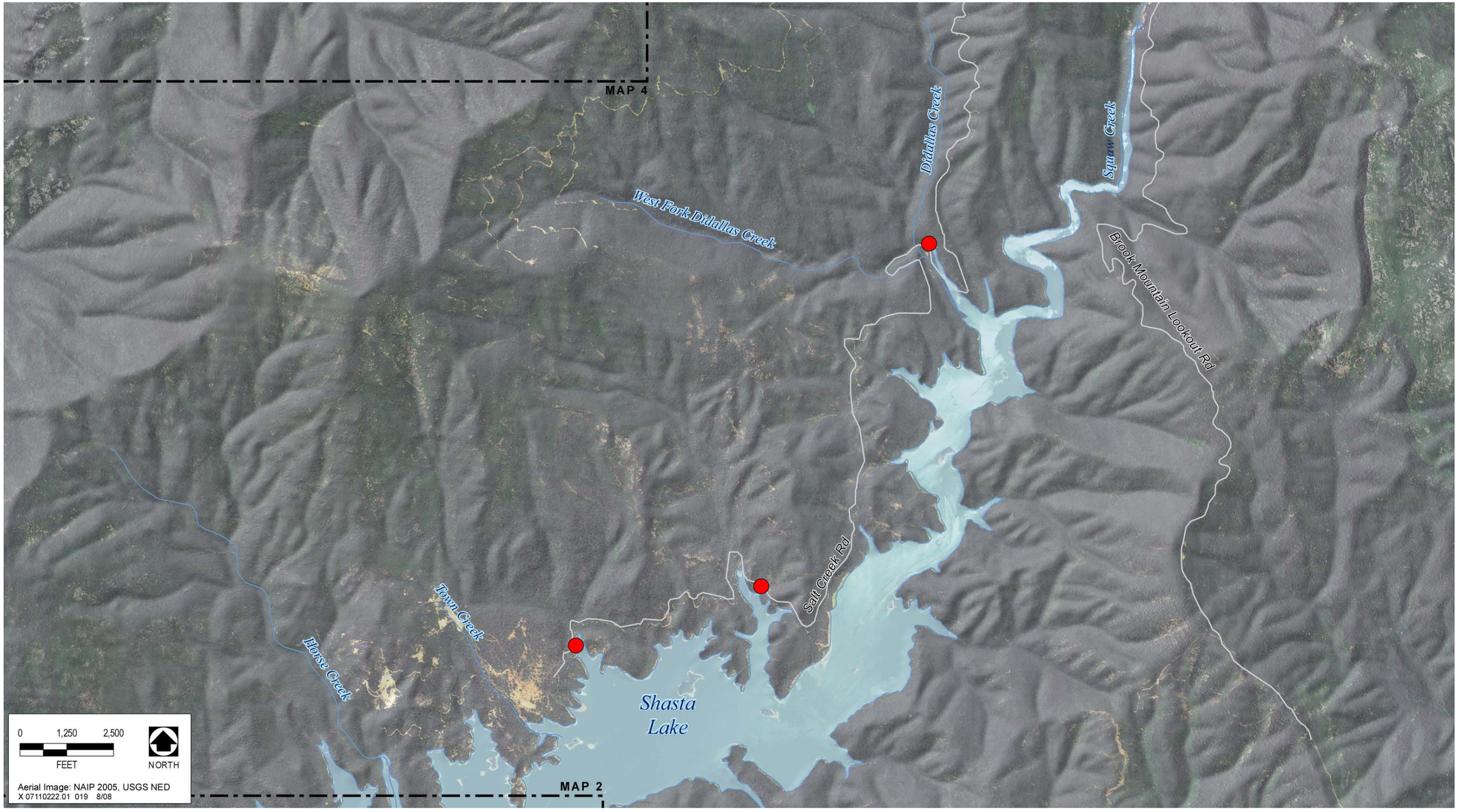


Figure 20-1d. Affected Transportation Facilities – Map 3

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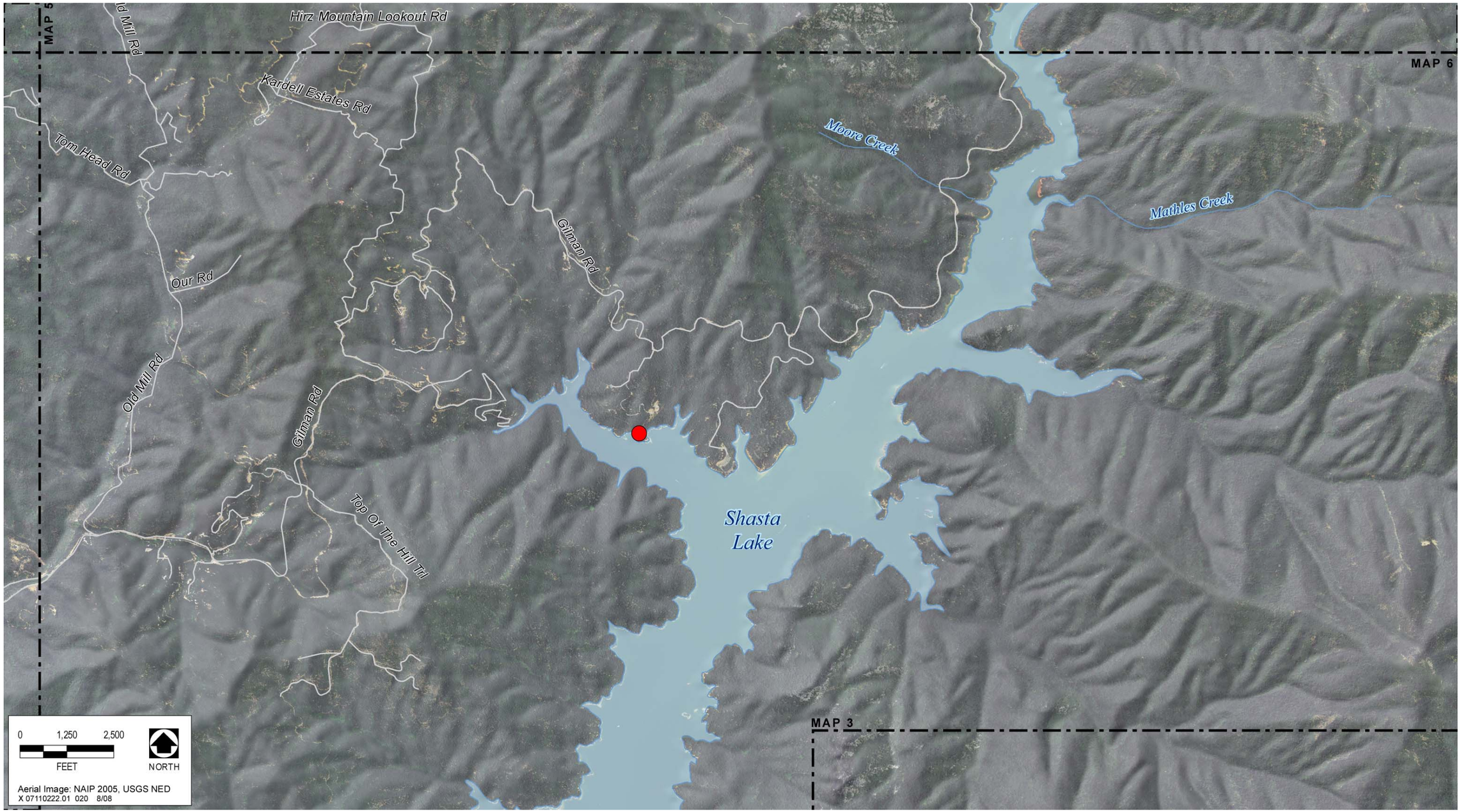


Figure 20-1e. Affected Transportation Facilities – Map 4

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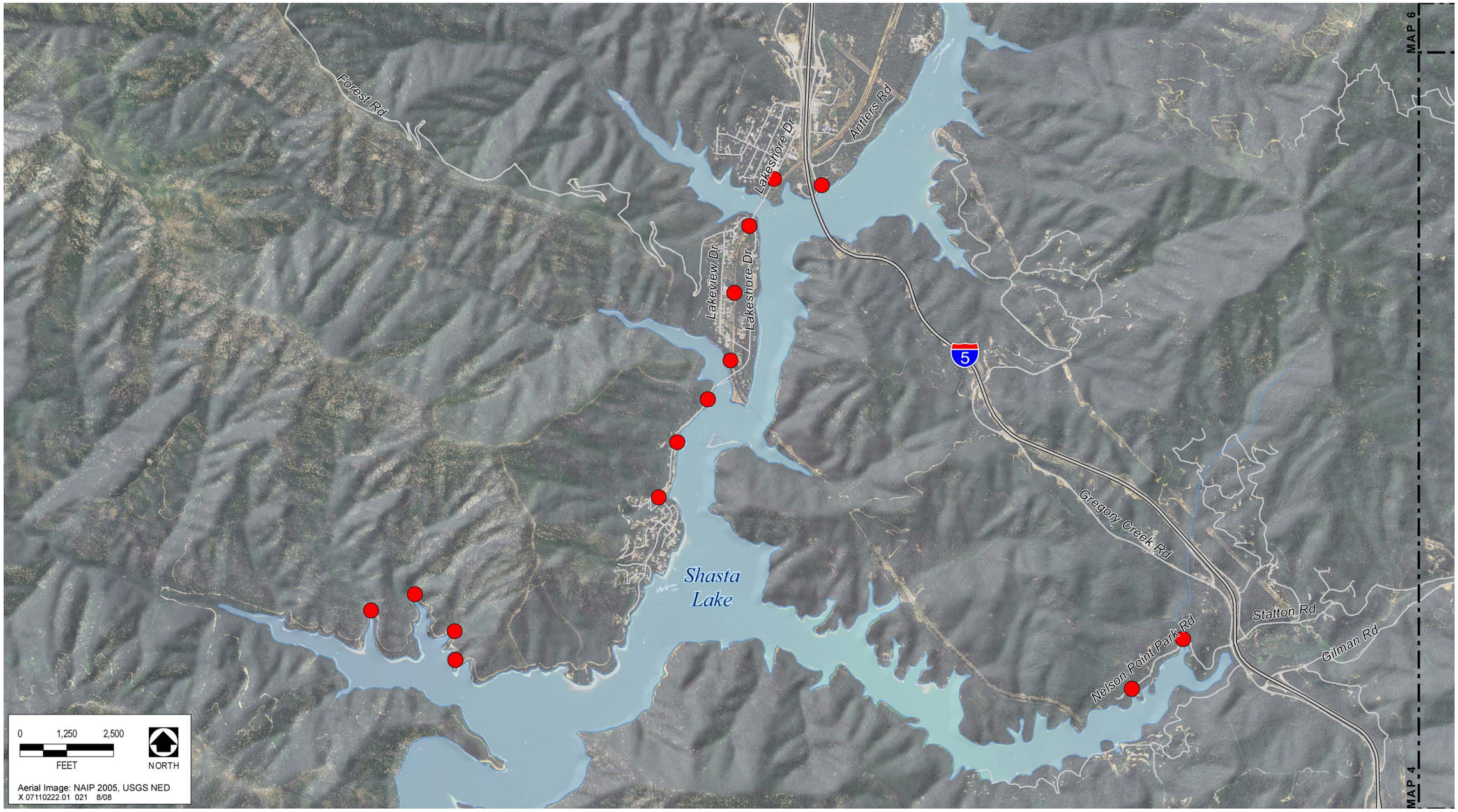


Figure 20-1f. Affected Transportation Facilities – Map 5

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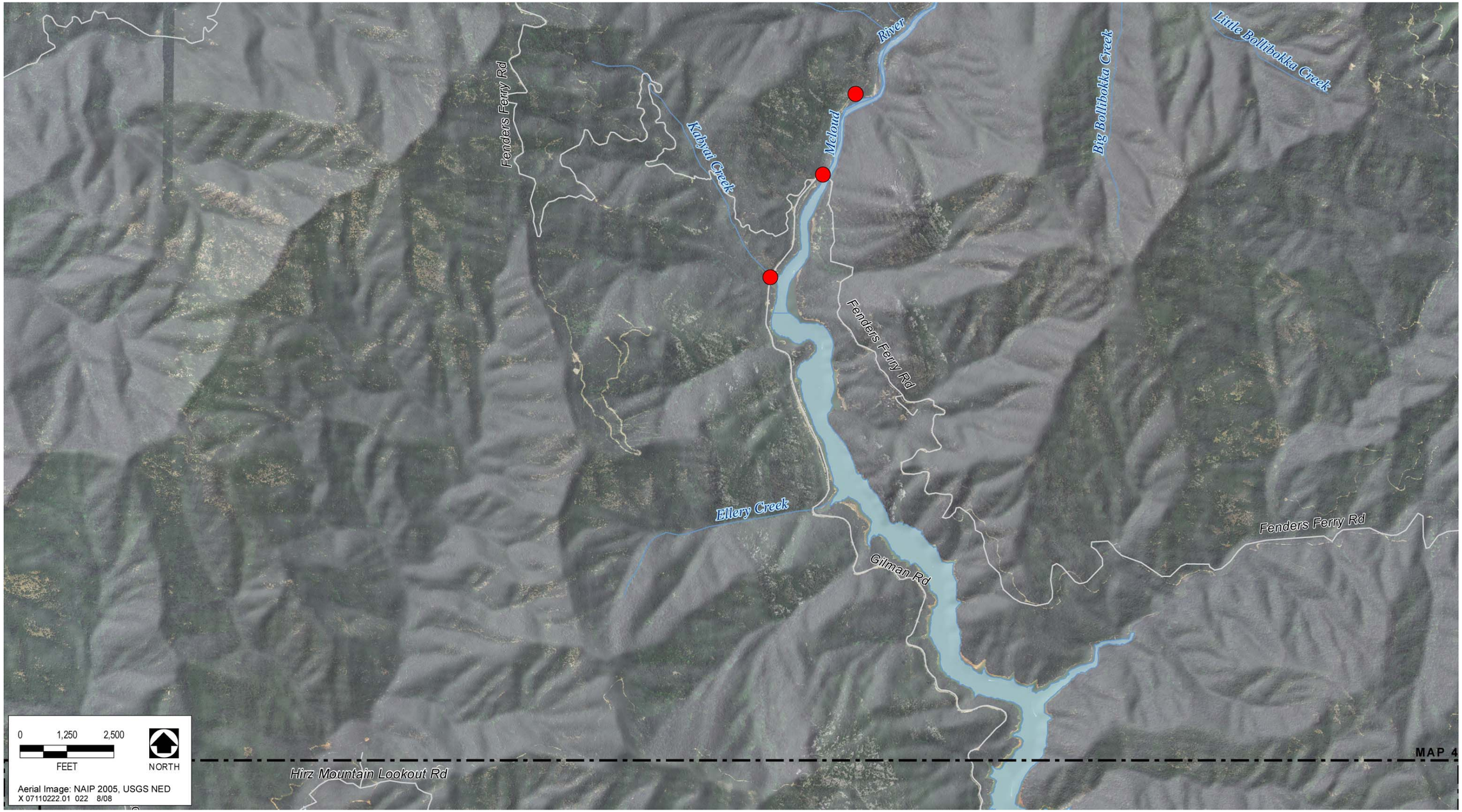


Figure 20-1g. Affected Transportation Facilities – Map 6

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20.3.2 Criteria for Determining Significance of Effects

An environmental document prepared to comply with NEPA must consider the context and intensity of the environmental effects that would be caused by, or result from, the proposed action. Under NEPA, the significance of an effect is used solely to determine whether an environmental impact statement must be prepared. An environmental document prepared to comply with CEQA must identify the potentially significant environmental effects of a proposed project. A "[s]ignificant effect on the environment" means a substantial, or potentially substantial, adverse change in any of the physical conditions within the area affected by the project" (State CEQA Guidelines, Section 15382). CEQA also requires that the environmental document propose feasible measures to avoid or substantially reduce significant environmental effects (State CEQA Guidelines, Section 15126.4(a)) to less than significant levels.

Thresholds for determining the significance of transportation and traffic effects were based on the environmental checklist form in Appendix G of the State CEQA Guidelines and Federal, State, and local guidance. These thresholds consider the context and intensity of the environmental effects as required under NEPA.

Impacts of an alternative on transportation and traffic would be significant if project implementation would do any of the following:

- Conflict with an applicable plan, ordinance, or policy establishing measures of effectiveness for the performance of the circulation system, taking into account all modes of transportation, including mass transit and nonmotorized travel and relevant components of the circulation system, including but not limited to intersections, streets, highways and freeways, pedestrian and bicycle paths, and mass transit.

- Conflict with an applicable congestion management program, including but not limited to level of service standards and travel demand measures, or other standards established by the county congestion management agency for designated roads or highways.

- Result in a change in air traffic patterns, including either an increase in traffic levels or a change in location that results in substantial safety risks.

- Substantially increase hazards as a result of a design feature (e.g., sharp curves or dangerous intersections) or incompatible uses (e.g., farm equipment).

- Result in inadequate emergency access.

In accordance with NEPA, the methods for determining the significance of effects on traffic and transportation are based on the intensity of the effect within the context of the existing transportation facility.

The following screening criterion is recommended by the Institute of Transportation Engineers (ITE) (1989) for assessing the effects of construction projects that create temporary traffic increases. To account for the large percentage of heavy trucks associated with typical construction projects, ITE recommends a threshold level of 50 or more new peak-direction trips. Therefore, an alternative would cause an increase in traffic that is substantial in relation to the existing traffic load and capacity of the street system, and thus would result in a significant effect related to traffic and transportation, if it would result in 50 or more new truck trips during the a.m. peak hours or the p.m. peak hours.

20.3.3 Topics Eliminated from Further Consideration

Several categories of effects would not result from the No-Action Alternative or any of the action alternatives. These categories are described below. An analysis of potential effects in applicable categories for the No-Action Alternative and action alternatives follows this discussion.

None of the airports (Redding Municipal, Benton Airpark, Shingletown, or Fall River Mills) in the primary study area are located near the project site; therefore, project construction and operation would not affect air traffic patterns. For this reason, air traffic patterns are not discussed further in this analysis.

None of the alternatives would interfere with RABA services or affect transit service. Therefore, transit is not discussed further in this analysis.

None of the alternatives propose any facility that is in conflict with adopted policies, plans, or programs supporting alternative transportation. Therefore, this issue is not discussed further in this analysis.

The alternatives do not propose any changes in land use; however, under the action alternatives there could be minor changes in land uses throughout the study area because of increased water supply reliability. These indirect effects would be extremely minor and spread over a wide geographic area (i.e., throughout the CVP and SWP service areas). Therefore, none of the action alternatives would increase transportation hazards because of incompatible uses. This issue is not discussed further in this analysis.

20.3.4 Direct and Indirect Effects

No-Action Alternative

Under the No-Action Alternative, no improvements to Shasta Dam would be constructed and none of the associated road and bridge relocations would be

needed. It is expected that over time, as population and traffic levels increase, roads and bridges would be maintained and improvements would be constructed throughout the study area when needed to ensure safety and meet current engineering-design requirements. Also, growth occurring under the No-Action Alternative would likely be consistent with city and county general plans, resulting in effects on California's transportation network. The effects on and impact conclusions for the primary study area and extended study area are essentially the same.

Shasta Lake and Vicinity and Upper Sacramento River (Shasta Dam to Red Bluff)

Impact Trans-1 (No-Action): Short-Term and Long-Term Increases in Traffic in the Primary Study Area in Relation to the Existing Traffic Load and Capacity of the Street System Traffic levels would not increase above levels anticipated in local general plans and regional transportation plans. This impact would be less than significant.

Traffic would be expected to increase compared to existing conditions under the No-Action Alternative. Traffic in the primary study area would increase by amounts anticipated in local general plans and regional transportation plans, and no construction-related truck trips would occur. Planned growth under the No-Action Alternative, including development of residential and recreational uses, has the potential to result in temporary, short-term increases in construction traffic. It is reasonable to assume, however, that necessary improvements to roads, bridges, and other transportation facilities would be made in response to increased traffic levels associated with increased population growth over time. Therefore, this impact would be less than significant. Mitigation is not required for the No-Action Alternative.

Impact Trans-2 (No-Action): Adverse Effects on Access to Local Streets or Adjacent Uses in the Primary Study Area Access to local streets and adjacent uses would remain generally unchanged. This impact would be less than significant.

Access to local streets and adjacent uses in the primary study area would be maintained under the No-Action Alternative. No adverse construction-related effects on access would occur. Planned growth under the No-Action Alternative has the potential to impede access to local streets and adjacent uses. It is reasonable to assume, however, that road and bridge improvements needed to maintain access would be made in accordance with city and county regulations and policies. For this reason, this impact would be less than significant. Mitigation is not required for the No-Action Alternative.

Impact Trans-3 (No-Action): Hazards in the Primary Study Area Caused by a Design Feature No design hazards or incompatible uses would be introduced. This impact would be less than significant.

No design hazards or incompatible uses would be introduced in the primary study area under the No-Action Alternative. No construction-related effects would occur. Planned growth under the No-Action Alternative has the potential to introduce design hazards or incompatible uses. It is reasonable to assume, however, that necessary actions would be taken in accordance with city and county policies and design standards. Therefore, this impact would be less than significant. Mitigation is not required for the No-Action Alternative.

Impact Trans-4 (No-Action): Adverse Effects on Emergency Access in the Primary Study Area Emergency access would remain unchanged. This impact would be less than significant.

Emergency access in the primary study area would remain unchanged under the No-Action Alternative. No construction-related effects would occur. Planned residential and recreation growth under the No-Action Alternative has the potential to affect emergency access during construction of roadway improvements to accommodate that growth. It is reasonable to assume, however, that necessary actions would be taken in accordance with city and county standards. Therefore, this impact would be less than significant. Mitigation is not required for the No-Action Alternative.

Impact Trans-5 (No-Action): Accelerated Degradation of Surface Transportation Facilities in the Primary Study Area No increase in road degradation would occur because no trucks would transport materials to and from the project site. This impact would be less than significant.

Because construction would not occur, the No-Action Alternative would not require trucks to transport construction materials to and from the primary study area. Therefore, road degradation would not increase as a result of construction. Planned growth under the No-Action Alternative has the potential to result in increased truck trips, with the secondary effect of road degradation. It is reasonable to assume, however, that necessary actions would be taken to accommodate planned growth over time. Therefore, this impact would be less than significant. Mitigation is not required for the No-Action Alternative.

Lower Sacramento River and Delta and CVP/SWP Service Areas

Impact Trans-6 (No-Action): Temporary Increase in Traffic in the Extended Study Area in Relation to the Existing Traffic Load and Capacity of the Street System Traffic levels would not increase above levels anticipated in local general plans and regional transportation plans. This impact would be less than significant.

This impact is similar to Impact Trans-1 (No-Action) for the primary study area. For the same reasons as described under Impact Trans-1 (No-Action), this impact would be less than significant. Mitigation is not required for the No-Action Alternative.

Impact Trans-7 (No-Action): Adverse Effects on Access to Local Streets or Adjacent Uses in the Extended Study Area Access to local streets and adjacent uses would remain generally unchanged because no construction would occur. This impact would be less than significant.

This impact is similar to Impact Trans-2 (No-Action) for the primary study area. For the same reasons as described under Impact Trans-2 (No-Action), this impact would be less than significant. Mitigation is not required for the No-Action Alternative.

Impact Trans-8 (No-Action): Hazards in the Extended Study Area Caused by a Design Feature No design hazards or incompatible uses would be introduced. This impact would be less than significant.

This impact is similar to Impact Trans-3 (No-Action) for the primary study area. For the same reasons as described under Impact Trans-3 (No-Action), this impact would be less than significant. Mitigation is not required for the No-Action Alternative.

Impact Trans-9 (No-Action): Adverse Effects on Emergency Access in the Extended Study Area Emergency access would remain unchanged. This impact would be less than significant.

This impact is similar to Impact Trans-4 (No-Action) for the primary study area. For the same reasons as described under Impact Trans-4 (No-Action), this impact would be less than significant. Mitigation is not required for the No-Action Alternative.

Impact Trans-10 (No-Action): Accelerated Degradation of Surface Transportation Facilities in the Extended Study Area No increase in road degradation would occur because no trucks would transport materials to and from the project site. This impact would be less than significant.

This impact is similar to Impact Trans-5 (No-Action) for the primary study area. For the same reasons as described under Impact Trans-5 (No-Action), this impact would be less than significant. Mitigation is not required for the No-Action Alternative.

CP1 – 6.5-Foot Dam Raise, Anadromous Fish Survival and Water Supply Reliability

CP1 consists of raising Shasta Dam by 6.5 feet, which would increase the surface water elevation and acreage of the inundation area. Under CP1, transportation facilities in the proposed inundation area would be relocated to sites outside that area. Transportation facilities include road infrastructure and vehicular bridges. Construction would involve installing bank fortification to preserve road segments and dike/abutment protection for bridge structures that do not require relocation. The construction period would be approximately 36 months. As shown in Table 20-2 and Figures 20-1c and 20-1f, the following

transportation facilities would need to be relocated to accommodate construction under CP1:

- Four segments of Lakeshore Drive beginning in the Lakeshore area west of I-5, extending south to the Sugarloaf Area and along the Sugarloaf Creek Inlet. Shasta County owns and maintains the first segment extending from the Lakeshore area to the Sugarloaf area, the most populated areas around the lake. The Doney Creek and Charlie Creek bridges in this segment would also require relocation. The USFS owns and maintains the segments that extend from the Sugarloaf area along Sugarloaf Creek Inlet. A total of 8,075 feet of Lakeshore Drive would require relocation. No segment of Lakeshore Drive would need to be closed during construction.

- Three road segments in the Turntable Bay area northeast of the north end of the Pit River Bridge. These road segments are owned and maintained by USFS. The segments provide access to the Shasta Yacht Club. A total of 6,190 feet of roadway would require relocation. Given the terrain along these segments, these roadways would need to be closed during construction.

- Silverthorn Road and segments of USFS roads in the Jones Valley area, on the south side of the Pit River Arm of Shasta Lake. Owned and maintained by Shasta County, Silverthorn Road provides access to a residential area composed of permanent and seasonally occupied dwelling units. A total of 1,950 feet of roadway would be relocated. These roadways would need to be closed during construction.

- Additional road segments in the primary study area totaling 229 linear feet. None of these road segments would need to be closed during construction.

Potential impacts on access roads to and internal loop roads at campsites and other recreation facilities are evaluated in Chapter 18, “Recreation and Public Access.”

Shasta Lake and Vicinity and Upper Sacramento River (Shasta Dam to Red Bluff)

Impact Trans-1 (CP1): Short-Term and Long-Term Increases in Traffic in the Primary Study Area in Relation to the Existing Traffic Load and Capacity of the Street System Construction activities would temporarily increase traffic. This short-term, temporary impact would be potentially significant. In the long term, increased recreational opportunities and visitor days would result in additional traffic on area roadways; however, the long-term impact would be less than significant.

Existing traffic in the primary study area is generated by residents living and working in the area, living in the area and working elsewhere, and living elsewhere and working in the area; and by tourists who come to visit the dam, picnic, hike, camp, fish, and go boating. Because Shasta Lake is a tourist destination, traffic is seasonally heavier from the middle of spring to the middle of fall (Reclamation 2004).

Project construction activities would require numerous truck trips to move materials to and from the project site, as well as trips in personal vehicles by construction crew members commuting to and from the site. Traffic would temporarily increase on Shasta Dam Boulevard, Lake Boulevard, Lakeshore Drive, and other roads during the CP1 construction period. Commute trips by construction workers would add vehicles to the road system during the a.m. and p.m. peak periods. Haul truck trips would increase traffic on designated haul routes during peak and off-peak hours.

Approximately 58 round-trip haul trips per day are anticipated for trucking materials to the dam site over a 36-month construction period. Approximately 23 round trips per day are anticipated for trucking materials cleared from the land over the same period. The total number of truck trips, 81 round trips per day, would not exceed the ITE threshold of 50 new truck trips in the a.m. and p.m. peak hours because the truck trips would be distributed over an 8-hour workday; approximately 10 truck trips would occur during the peak-hour period. This impact would be less than significant.

Approximately 900 round trips per day by workers are anticipated. Although specific staging areas have not been identified, the work areas are expected to be distributed throughout the primary study area. Some areas would employ greater workforces than others. The total number of worker trips may temporarily exceed the existing traffic loads and capacities on the roads where substantial numbers of workers are located at any one time. This impact would be potentially significant.

Traffic slowdowns may also result from temporary obstruction of roadway access because of lane closures or heavy equipment entering and exiting the road. Circulation patterns would change if detours were to be required during replacement of transportation facilities. Detours may add traffic that could exceed the capacity of the facility being relocated. This impact would be potentially significant.

In the long term, increased recreational opportunities and visitors would increase traffic on area roads by an estimated average of 148 one-way trips per day. This small number of additional trips would be distributed throughout the primary study area. The additional trips are not expected to exceed the existing traffic loads and capacities of the street system. Growth in the primary study area that is generated through implementation of city and county general plans would increase traffic in the area. The regional transportation planning

documents identify roadway projects needed to accommodate expected traffic increases. Therefore, the long-term impact of traffic increases on area roads would be less than significant.

In summary, in the short term, construction activities under CP1 are expected to result in a potentially significant impact on traffic; but in the long term, the impact of traffic increases resulting from expected growth and additional recreational opportunities would be less than significant. Mitigation for this short-term impact is proposed in Section 20.3.5.

Impact Trans-2 (CP1): Adverse Effects on Access to Local Streets and Adjacent Uses in the Primary Study Area Relocation of transportation facilities would require either road closures and detours or partial road closures, or a combination of both. This temporary direct impact would be potentially significant. Indirect impacts on air quality, noise, and recreation resulting from extended travel lengths, increased traffic near sensitive land uses, and limiting or restricting access to recreational facilities are evaluated in the corresponding chapters of this Environmental Impact Statement (EIS).

CP1 would raise the elevation and increase the surface acreage of Shasta Lake. Several existing roads and bridges at the lake would require relocation to avoid potential inundation as the elevation of the lake's full pool increases.

It is anticipated that most of the new roadway alignments or bridges would be constructed and connected to existing road facilities before demolition of the existing facilities in the proposed inundation area. In some cases, work in the road relocation areas may require a road closure with detours, lane closures, or a combination of both. Road closures would temporarily impede access to local connector roads and recreational land uses, affecting residents, local recreational and nonrecreational businesses, and visitors to Shasta Lake. This impact would be potentially significant. Mitigation for this impact is proposed in Section 20.3.5.

Detours and alternate routes resulting from road and bridge relocations could cause longer trip lengths and increase traffic in areas of sensitive land uses. The following potential indirect impacts are evaluated in the corresponding chapters of this EIS:

- Effects on air quality caused by extended trip lengths - Chapter 5, "Air Quality and Climate"
- Effects on sensitive receptors resulting from increased traffic on connector roads caused by detours - Chapter 8, "Noise and Vibration"
- Effects on recreation caused by restrictions to facility access - Chapter 18, "Recreation and Public Access"

Impact Trans-3 (CP1): Hazards in the Primary Study Area Caused by a Design Feature Relocated road segments and vehicular and railroad bridges would be designed to current engineering design standards. This impact would be beneficial.

Road segments, vehicular bridges, and railroad bridges must be designed to current engineering and seismic standards. Current engineering standards ensure that hazards are minimized to the maximum amount practicable. Replacing functionally and structurally obsolete bridges with functionally and structurally sound bridges is a beneficial aspect of CP1. Because relocated road segments and vehicular bridges would be designed to current engineering design standards, design features would not increase hazards but would actually decrease the potential for hazards. Because the replacement of obsolete bridges would be accelerated under CP1, this impact would be beneficial. Mitigation for this impact is not needed, and thus not proposed.

Impact Trans-4 (CP1): Adverse Effects on Emergency Access in the Primary Study Area Road closures may result in increased response times for emergency vehicles. This direct impact would be potentially significant. Indirect impacts on air quality resulting from extended driving lengths, increased emergency vehicle response times, and potential noise impacts on sensitive receptors are discussed in the respective chapters of this EIS.

As discussed under Impact Trans-2 (CP1), temporary road closures and lane closures would be needed for construction of the relocated road alignments and bridges. Road and lane closures may restrict emergency vehicle access. This impact would be potentially significant. Mitigation for this impact is proposed in Section 20.3.5.

The following potential indirect impacts are evaluated in the corresponding chapters of this EIS:

- Effects on air quality caused by extended trip lengths - Chapter 5, “Air Quality and Climate”
- Effects on sensitive receptors - Chapter 8, “Noise and Vibration”
- Effects of increased emergency vehicle response times - Chapter 22, “Public Services”

Impact Trans-5 (CP1): Accelerated Degradation of Surface Transportation Facilities in the Primary Study Area Trucks used to import fill material and export construction waste would accelerate degradation of surface transportation facilities used as haul routes. This impact would be potentially significant.

As noted in the discussion of Impact Trans-1 (CP1), CP1 would generate approximately 81 round trips per day for the length of the 36-month construction period. Degradation of road surfaces would result in a significant impact if truck trips associated with the project would substantially shorten the life of the facility so that the owner of the right-of-way would need to repair or rehabilitate the road surface before it is scheduled for repair. The significance determination is based on several factors, including the existing condition of road surfaces and the road's normal repair or rehabilitation schedule. Given the total number of anticipated trips and expected weight of the payloads, the impact of CP1 on existing road surfaces in relation to the anticipated utility of the road surfaces would be potentially significant. Mitigation for this impact is proposed in Section 20.3.5.

Lower Sacramento River and Delta and CVP/SWP Service Areas No effects on traffic or transportation are expected to occur in the lower Sacramento River and Delta or the CVP/SWP service areas; therefore, potential effects in those geographic regions are not discussed further in this PDEIS.

CP2 – 12.5-Foot Dam Raise, Anadromous Fish Survival and Water Supply Reliability

CP2 consists of raising Shasta Dam by 12.5 feet, which would result in a greater increase in the surface water elevation and acreage of inundation area than under CP1. A larger number of transportation facilities would be relocated under CP2 than under CP1. CP2 would have a 48-month construction period, compared to 36 months under CP1. As shown in Table 20-2 and Figures 20-1c, 20-1d, 20-1f, and 20-1g, the following transportation facilities would need to be relocated to accommodate construction under CP2:

- Two segments of Lakeshore Drive in addition to the four road segments that would be relocated under CP1, for a total of six segment relocations along Lakeshore Drive totaling 13,063 feet. As under CP1, no segment of Lakeshore Drive would need to be completely closed during construction.

- The same three road segments in the Turntable Bay area (with a total roadway length of 6,190 feet) that would require relocation under CP1. As under CP1, these roadways would need to be closed during construction.

  Three segments of Gillman Road that run along the west side of the McCloud River Arm of Shasta Lake, totaling 1,246 feet. Owned and maintained by Shasta County, the road is used primarily by logging trucks. Gillman Road would need to be closed during construction.

- The same segments of Silverthorn Road and other USFS roads in the Jones Valley area that would require relocation under CP1 (with a total

roadway length of 1,950 feet). As under CP1, these roadways would need to be closed during construction.

- Four segments of Salt Creek Road that run along the west side of the Squaw Creek Arm of Shasta Lake, totaling 4,325 feet. Salt Creek Road is a dirt and gravel road owned and maintained by USFS. Its primary use is for USFS access. Didallas Creek Bridge crosses one of the segments and would also require relocation under CP2. Salt Creek Road would need to be closed during construction.

- An additional two road segments besides the two other road segments that would be relocated under CP1. The total length of the four roadway segments that would be relocated under CP2 is 2,280 feet. As under CP1, none of these road segments would need to be closed during construction.

Shasta Lake and Vicinity and Upper Sacramento River (Shasta Dam to Red Bluff)

Impact Trans-1 (CP2): Short-Term and Long-Term Increases in Traffic in the Primary Study Area in Relation to the Existing Traffic Load and Capacity of the Street System Construction activities would temporarily increase traffic. This short-term, temporary impact would be potentially significant. In the long term, increased recreational opportunities and visitor days would result in additional traffic on area roadways; however, the long-term impact would be less than significant.

This impact is similar to Impact Trans-1 (CP1), but the impact would be greater than under CP1, as described below.

Approximately 58 round-trip haul trips per day are anticipated for trucking materials to the dam site over a 48-month construction period. Approximately 23 round trips per day are anticipated for trucking materials cleared from the land over the same period. The total number of truck trips, 81 round trips per day, would not exceed the ITE threshold of 50 new truck trips because the trips would be distributed over an 8-hour workday; approximately 10 truck trips would occur in the a.m. and p.m. peak hours. This is the same number of daily truck trips as under CP1, but these trips would be borne on the transportation network for a longer duration than under CP1; therefore, the impact would be greater than under CP1. Because the ITE threshold would not be exceeded, this impact would be less than significant.

Approximately 900 round trips per day by workers are anticipated over a 48-month period under CP2. Although specific staging areas have not been identified, the work areas are expected to be distributed throughout the primary study area. Some areas would employ greater workforces than others. The total number of worker trips may temporarily exceed the existing traffic loads and capacities on the roads where substantial numbers of workers are located at any

one time. The worker trips would occur over a longer construction period than under CP1; therefore, the impact would be greater than under CP1. This impact would be potentially significant.

As under CP1, traffic slowdowns also may result from temporary obstruction of roadway access because of lane closures or heavy equipment entering and exiting the road. Interference would occur over a longer period than under CP1; therefore, the impact would be greater than under CP1. This impact would be potentially significant.

In the long term, under CP2, traffic on area roads would increase by an estimated average of 251 one-way trips per day, more than under CP1; however, for the same reasons as described in CP1, this impact would be less than significant.

In summary, in the short term, construction activities under CP2 are expected to result in a potentially significant impact on traffic that would be greater than under CP1; but in the long term, the impact of traffic increases resulting from expected growth and additional recreational opportunities would be less than significant. Mitigation for this short-term impact is proposed in Section 20.3.5.

Impact Trans-2 (CP2): Adverse Effects on Access to Local Streets or Adjacent Uses in the Primary Study Area Relocation of transportation facilities would require either road closures and detours or partial road closures, or a combination of both. This temporary direct impact would be potentially significant. Indirect impacts on air quality, noise, and recreation resulting from extended travel lengths, increased traffic near sensitive land uses, and limiting or restricting access to recreational facilities are evaluated in the corresponding chapters of this EIS.

This impact would be similar to Impact Trans-2 (CP1); however, because CP2 would require more roads to be closed for a longer duration than CP1, the impact would be greater than under CP1. This impact would be potentially significant. Mitigation for this impact is proposed in Section 20.3.5. Potential indirect effects are evaluated in Chapter 5, “Air Quality and Climate;” Chapter 8, “Noise and Vibration;” and Chapter 18, “Recreation and Public Access.”

Impact Trans-3 (CP2): Hazards in the Primary Study Area Caused by a Design Feature Relocated road segments and vehicular and railroad bridges would be designed to current engineering design standards. This impact would be beneficial.

This impact would be similar to Impact Trans-3 (CP1); however, CP2 would result in a greater beneficial effect than CP1 because more obsolete bridges would be replaced under CP2 than under CP1. This impact would be beneficial. Mitigation for this impact is not needed, and thus not proposed.

Impact Trans-4 (CP2): Adverse Effects on Emergency Access in the Primary Study Area Road closures may result in increased response times for emergency vehicles. This direct impact would be potentially significant. Indirect impacts on air quality resulting from extended driving lengths, increased emergency vehicle response times, and potential noise impacts on sensitive receptors are discussed in the respective chapters of this PDEIS.

This impact would be similar to Impact Trans-4 (CP1). However, the construction period for CP2 would be 48 months, 12 months longer than the construction period for CP1. Because road closures under CP2 would occur for a longer period than under CP1, the impact would be greater under CP2 than under CP1. This impact would be potentially significant. Mitigation for this impact is proposed in Section 20.3.5. Potential indirect effects are evaluated in Chapter 5, "Air Quality and Climate;" Chapter 8, "Noise and Vibration;" and Chapter 22, "Public Services."

Impact Trans-5 (CP2): Accelerated Degradation of Surface Transportation Facilities in the Primary Study Area Trucks used to import fill material and export construction waste would accelerate degradation of surface transportation facilities used as haul routes. This impact would be potentially significant.

This impact would be similar to Impact Trans-5 (CP1). As noted in the discussion of Impact Trans-1 (CP2), CP2 would generate approximately 81 round trips per day for the length of the 48-month construction period. This is the same number of round trips per day as under CP1; however, because the construction period for CP2 would be longer than the construction period for CP1, the impact on road surfaces under CP2 would be greater than under CP1. This impact would be potentially significant. Mitigation for this impact is proposed in Section 20.3.5.

Lower Sacramento River and Delta and CVP/SWP Service Areas No effects on traffic or transportation are expected to occur in the lower Sacramento River and Delta or the CVP/SWP service areas; therefore, potential effects in those geographic regions are not discussed further in this PDEIS.

CP3 – 18.5-Foot Dam Raise, Anadromous Fish Survival and Water Supply Reliability

CP3 consists of raising Shasta Dam by 18.5 feet, which would result in a greater increase in the surface water elevation and acreage of inundation area than would occur under CP1 or CP2. A larger number of transportation facilities would be relocated under CP3 than under CP1 and CP2. CP3 would have a 60-month construction period, compared to 36 and 48 months under CP1 and CP2, respectively. As shown in Table 20-2 and Figures 20-1c, 20-1d, 20-1f, and 20-1g, the following transportation facilities would need to be relocated to accommodate construction under CP3:

- Two road segments of Lakeshore Drive in addition to the six road segments that would be relocated under CP2, for a total of eight segment relocations along Lakeshore Drive totaling 13,743 feet. As under CP1 and CP2, no segment of Lakeshore Drive would need to be completely closed during construction.

- The same three segments in the Turntable Bay area (with a total roadway length of 6,190 feet) that would require relocation under CP1 and CP2. As under CP1 and CP2, these roadways would need to be closed during construction.

- The same three segments of Gillman Road that would require relocation under CP2. As under CP2, Gillman Road would need to be closed during construction.

- An additional three road segments of Silverthorn Road and/or other USFS roads in the Jones Valley area besides the segments that would require relocation under CP1 and CP2. The total length of roadway that would be relocated under CP3 is 3,562 feet. As under CP1 and CP2, these roadways would need to be closed during construction.

- An additional road segment of Salt Creek Road that runs along the west side of the Squaw Creek Arm of Shasta Lake, besides the four roadway segments that would be relocated under CP2. The total length of roadways that would be relocated under CP3 is 5,108 feet. As under CP2, Salt Creek Road would need to be closed during construction.

- Three additional road segments besides the four other road segments that would be relocated under CP1 and CP2. The total length of the seven roadway segments that would be relocated under CP3 is 3,939 feet. As under CP1 and CP2, none of these road segments would need to be closed during construction.

Shasta Lake and Vicinity and Upper Sacramento River (Shasta Dam to Red Bluff)

Impact Trans-1 (CP3): Short-Term and Long-Term Increase in Traffic in the Primary Study Area in Relation to the Existing Traffic Load and Capacity of the Street System Construction activities would temporarily increase traffic. The short-term, temporary impact would be potentially significant. In the long term, increased recreational opportunities and visitor days would result in additional traffic on area roadways; however, the long-term impact would be less than significant.

This impact would be similar to Impacts Trans-1 (CP1) and Trans-1 (CP2), but the impact would be greater than under CP1 and CP2, as described below.

Approximately 58 round-trip haul trips per day are anticipated for trucking materials to the dam site over a 60-month construction period. Approximately 23 round trips per day are anticipated for trucking materials cleared from the land over the same period. The total number of truck trips, 81 round trips per day, would not exceed the ITE threshold of 50 new truck trips because the trips would be distributed over an 8-hour workday; approximately 10 trips would occur during the a.m. and p.m. peak hours. Although this is the same number of daily truck trips as under CP1 and CP2, these daily truck trips would occur for a longer duration than under CP1 and CP2; therefore, the impact would be greater than under CP1 and CP2. Because the number of truck trips during the peak hours would not exceed the ITE threshold, this impact would be less than significant.

Approximately 900 round trips per day by workers are anticipated over a 60-month period. Although specific staging areas have not been identified, the work areas are expected to be distributed throughout the primary study area. Some areas would employ greater workforces than others. The total number of worker trips may temporarily exceed the existing traffic loads and capacities on the roads where substantial numbers of workers are located at any one time. The worker trips would occur over a longer construction period than under CP1 or CP2; therefore, the impact would be greater than under CP1 and CP2. This impact would be potentially significant.

As under CP1 and CP2, traffic slowdowns may also result from temporary obstruction of roadway access because of lane closures or heavy equipment entering and exiting the road. Interference would occur over a longer period than under CP1 or CP2; therefore, the impact would be greater than under CP1 and CP2. This impact would be potentially significant.

In the long term, under CP3, traffic on area roads would increase by an estimated average of 398 one-way trips per day, more than under CP1 and CP2; however, for the same reasons as described in CP1, this impact would be less than significant.

In summary, in the short term, construction activities under CP3 are expected to result in a potentially significant direct impact on traffic that would be greater than under CP1 or CP2; however, the impact of traffic increases resulting from expected growth and additional recreational opportunities would be less than significant. Mitigation for this short-term impact is proposed in Section 20.3.5.

Impact Trans-2 (CP3): Adverse Effects on Access to Local Streets and Adjacent Uses in the Primary Study Area Relocation of transportation facilities would require either road closures and detours or partial road closures, or a combination of both. This temporary direct impact would be potentially significant. Indirect impacts on air quality, noise, and recreation resulting from extended travel lengths, increased traffic near sensitive land uses, and limiting

or restricting access to recreational facilities are evaluated in the corresponding chapters of this PDEIS.

This impact would be similar to Impacts Trans-2 (CP1) and Trans-2 (CP2); however, because CP3 would require more roads to be closed for a longer duration than CP1 and CP2, the impact would be greater than under CP1 or CP2. This impact would be potentially significant. Mitigation for this impact is proposed in Section 20.3.5. Potential indirect effects are evaluated in Chapter 5, "Air Quality and Climate;" Chapter 8, "Noise and Vibration;" and Chapter 18, "Recreation and Public Access."

Impact Trans-3 (CP3): Hazards in the Primary Study Area Caused by a Design Feature Relocated road segments and vehicular and railroad bridges would be designed to current engineering design standards. This impact would be beneficial.

This impact would be similar to Impacts Trans-3 (CP1) and Trans-3 (CP2); however, CP3 would result in a greater beneficial effect than CP1 or CP2 because more obsolete bridges would be replaced under CP3 than under CP1 or CP2. This impact would be beneficial. Mitigation for this impact is not needed, and thus not proposed.

Impact Trans-4 (CP3): Adverse Effects on Emergency Access in the Primary Study Area Road closures may result in increased response times for emergency vehicles. This direct impact would be potentially significant. Indirect impacts on air quality resulting from extended driving lengths, increased emergency vehicle response times, and potential noise impacts on sensitive receptors are discussed in the respective chapters of this PDEIS.

This impact would be similar to Impacts Trans-4 (CP1) and Trans-4 (CP2). However, the construction period for CP3 would be 60 months, 12 months longer than the construction period for CP2 and 24 months longer than the construction period for CP1. Because road closures under CP2 would occur for a longer period than under CP1 or CP2, the impact would be greater under CP3 than under CP1 or CP2. This impact would be potentially significant. Mitigation for this impact is proposed in Section 20.3.5. Potential indirect effects are evaluated in Chapter 5, "Air Quality and Climate;" Chapter 8, "Noise and Vibration;" and Chapter 22, "Public Services."

Impact Trans-5 (CP3): Accelerated Degradation of Surface Transportation Facilities in the Primary Study Area Trucks used to import fill material and export construction waste would accelerate degradation of surface transportation facilities used as haul routes. This impact would be potentially significant.

This impact would be similar to Impacts Trans-5 (CP1) and Trans-5 (CP2). As noted in the discussion of Impact Trans-1 (CP3), CP3 would generate

approximately 81 round trips per day for the length of the 60-month construction period. This is the same number of round trips per day as under CP1 and CP2; however, because the construction period for CP3 would be longer than the construction periods for CP1 and CP2, the impact on road surfaces would be greater under CP3 than under CP1 or CP2. This impact would be potentially significant. Mitigation for this impact is proposed in Section 20.3.5.

Lower Sacramento River and Delta and CVP/SWP Service Areas No effects on traffic or transportation are expected to occur in the lower Sacramento and Delta area or the CVP/SWP service areas; therefore, potential effects in those geographic regions are not discussed further in this PDEIS.

CP4 – 18.5-Foot Dam Raise, Anadromous Fish Focus

CP4 consists of raising Shasta Dam by 18.5 feet. The same transportation facilities would be relocated under this alternative as under CP3. CP4 would also have an approximately 60-month construction period like CP3, compared to 36 and 48 months under CP1 and CP2, respectively.

In addition to constructing the dam raise and relocating transportation facilities described for CP3, CP4 involves augmenting locations along the Sacramento River with gravel. The locations of those sites are shown in Figure 2-4 in Chapter 2, "Alternatives." As noted previously, gravel augmentation would be conducted at up to three of the identified sites annually for a 10-year period, commencing with construction of CP4. For purposes of this analysis, the following analysis evaluates, as the maximum intensity option, gravel augmentation at the three sites located the farthest from the city of Redding where gravel is known to be available from commercial sources. All other combinations of gravel augmentation sites would have lesser impacts than the combination of sites evaluated herein.

In addition to the dam construction, relocation of transportation facilities, and gravel augmentation, CP4 includes habitat and recreational resources improvements at Reading Island as described in Chapter 2, "Alternatives," and shown in Figure 2-5.

Shasta Lake and Vicinity and Upper Sacramento River (Shasta Dam to Red Bluff)

Impact Trans-1 (CP4): Short-Term and Long-Term Increases in Traffic in the Primary Study Area in Relation to the Existing Traffic Load and Capacity of the Street System Construction activities would temporarily increase traffic. This short-term, temporary impact would be potentially significant. In the long term, increased recreational opportunities and visitor days would result in additional traffic on area roadways; however, the long-term impact would be less than significant.

This impact would be similar to but greater than Impacts Trans-1 (CP1), Trans-1 (CP2), and Trans-1 (CP3) because additional haul trips would be required for gravel augmentation and habitat restoration. Using the Redding Riffle site as the maximum-intensity option in terms of haul truck trips affecting traffic, approximately 800 round trips would be made during the September and August construction term under CP4. This is based on placing 19,000 tons of gravel at the site and the capacity of the haul trucks being 25 tons per load. With a total of 44 8-hour workdays (2 months excluding weekends), the number of daily haul trips would be 18 haul trips per day. This would not exceed the ITE threshold of 50 new truck trips in the peak-hour period even if all of the truck trips occurred during the peak-hour period. Distributed over an 8-hour work day, two truck trips would occur during the a.m. peak hour period and two truck trips would occur during the p.m. peak hour period.

In addition to the haul trips for gravel augmentation, there would be haul trips for removing approximately 15,650 cubic yards of fill material from Reading Island. Haul trucks can carry 14 cubic yards. Therefore, a total of approximately 1,118 haul trips would be required to remove the fill material. With a total of 44 8-hour workdays (2 months excluding weekends), the number of daily haul trips would be 25 haul trips per day. This would add approximately three truck trips in both the a.m. and p.m. peak hour periods.

Combining the three truck trips during the peak-hour period resulting from removing the fill material from Reading Island with gravel augmentation and the 18.5-foot Shasta Dam raise and related activities, approximately 15 peak-hour trips would occur. This is substantially below the ITE threshold of 50 new truck trips during the a.m. and p.m. peak hours.

In the long term, traffic increases on area roads would be similar to CP3.

In the short term, construction activities under CP4 are expected to result in a potentially significant impact on traffic; but in the long term, for the same reasons as described in CP1, the impact of traffic increases resulting from expected growth and additional recreational opportunities would be less than significant. Mitigation for this short-term impact is proposed in Section 20.3.5.

Impact Trans-2 (CP4): Adverse Effects on Access to Local Streets and Adjacent Uses in the Primary Study Area Relocation of transportation facilities would require either road closures and detours or partial road closures, or a combination of both. This temporary direct impact would be potentially significant. Indirect impacts on air quality, noise, and recreation resulting from extended travel lengths, increased traffic near sensitive land uses, and limiting or restricting access to recreational facilities are evaluated in the corresponding chapters of this PDEIS.

This impact would be the same as Impact Trans-2 (CP3) and similar to but greater than Impacts Trans-2 (CP1) and Trans-2 (CP2) because the duration of

project construction under CP4 would be longer than under CP1 or CP2. This impact would be potentially significant. Mitigation for this impact is proposed in Section 20.3.5. Potential indirect effects are evaluated in Chapter 5, "Air Quality and Climate;" Chapter 8, "Noise and Vibration;" and Chapter 18, "Recreation and Public Access."

Impact Trans-3 (CP4): Hazards in the Primary Study Area Caused by a Design Feature Relocated road segments and vehicular and railroad bridges would be designed to current engineering design standards. This impact would be beneficial.

This impact would be the same as Impact Trans-3 (CP3) and similar to Impacts Trans-3 (CP1) and Trans-3 (CP2); however, like CP3, CP4 would result in a greater beneficial effect than CP1 and CP2 because more obsolete bridges would be replaced under CP4 than under CP1 or CP2. This impact would be beneficial. Mitigation for this impact is not needed, and thus not proposed.

Impact Trans-4 (CP4): Adverse Effects on Emergency Access in the Primary Study Area Road closures may result in increased response times for emergency vehicles. This direct impact would be potentially significant. Indirect impacts on air quality resulting from extended driving lengths, increased emergency vehicle response times, and potential noise impacts on sensitive receptors are discussed in the respective chapters of this PDEIS.

This impact would be the same as Impact Trans-4 (CP3) and similar to Impacts Trans-4 (CP1) and Trans-4 (CP2). For the same reasons as described under Impact Trans-4 (CP3), the impact would be greater under CP4 than under CP1 or CP2, and this impact would be potentially significant. Mitigation for this impact is proposed in Section 20.3.5. Potential indirect effects are evaluated in Chapter 5, "Air Quality and Climate;" Chapter 8, "Noise and Vibration;" and Chapter 22, "Public Services."

Impact Trans-5 (CP4): Accelerated Degradation of Surface Transportation Facilities in the Primary Study Area Trucks used to import fill material and export construction waste would accelerate degradation of surface transportation facilities used as haul routes. This impact would be potentially significant.

This impact would be similar to Impacts Trans-5 (CP1), Trans-5 (CP2), and Trans-5 (CP3) but greater because gravel augmentation would affect more roadways for a longer duration. For the same reasons as described under Impact Trans-5 (CP3), the impact would be potentially significant. Mitigation for this impact is proposed in Section 20.3.5.

Lower Sacramento River and Delta and CVP/SWP Service Areas No effects on traffic or transportation are expected to occur in the lower

Sacramento River and Delta or the CVP/SWP service areas; therefore, potential effects in those geographic regions are not discussed further in this PDEIS.

CP5 – 18.5-Foot Dam Raise, Combination Plan

CP5 consists of raising Shasta Dam by 18.5 feet. The same transportation facilities would be relocated under this alternative as under CP3 and CP4. CP5 would have an approximately 60-month construction period like CP3 and CP4, compared to 36 and 48 months under CP1 and CP2, respectively.

Like CP4, CP5 involves augmenting locations along the Sacramento River with gravel as shown in Figure 2-4 in Chapter 2, "Alternatives." The assumptions stated for CP4 gravel augmentation are the same for CP5.

Also like CP4, in addition to the construction of the dam raise, relocation of transportation facilities, and gravel augmentation, CP5 includes habitat and recreational resources improvements at Reading Island as described in Chapter 2, "Alternatives," and shown in Figure 2-5.

Shasta Lake and Vicinity and Upper Sacramento River (Shasta Dam to Red Bluff)

Impact Trans-1 (CP5): Short-Term and Long-Term Increases in Traffic in the Primary Study Area in Relation to the Existing Traffic Load and Capacity of the Street System Construction activities would temporarily increase traffic. This short-term, temporary impact would be potentially significant. In the long term, increased recreational opportunities and visitor days would result in additional traffic on area roadways, similar to CP3 and CP4; however, for the same reasons as described in CP1, the long-term impact would be less than significant.

This impact would be similar to but greater than Impacts Trans-1 (CP1), Trans-1 (CP2), Trans-1 (CP3), and Trans-1 (CP4) because very limited additional construction-related trips associated with enhancements to shoreline and tributary aquatic habitat and recreational trails would be needed. For the same reasons as described under Impact Trans-1 (CP3) and Trans-1 (CP4), the impact would be potentially significant. Mitigation for this impact is proposed in Section 20.3.5.

Impact Trans-2 (CP5): Adverse Effects on Access to Local Streets and Adjacent Uses in the Primary Study Area Relocation of transportation facilities would require either road closures and detours or partial road closures, or a combination of both. This temporary direct impact would be potentially significant. Indirect impacts on air quality, noise, and recreation resulting from extended travel lengths, increased traffic near sensitive land uses, and limiting or restricting access to recreational facilities are evaluated in the corresponding chapters of this PDEIS.

This impact would be the same as Impacts Trans-2 (CP3) and Trans-2 (CP4), but greater than Impacts Trans-2 (CP1) and Trans-2 (CP2) because the duration of project construction would be longer. This impact would be potentially significant. Mitigation for this impact is proposed in Section 20.3.5. Potential indirect effects are evaluated in Chapter 5, "Air Quality and Climate;" Chapter 8, "Noise and Vibration;" and Chapter 18, "Recreation and Public Access."

Impact Trans-3 (CP5): Hazards in the Primary Study Area Caused by a Design Feature Relocated road segments and vehicular and railroad bridges would be designed to current engineering design standards. This impact would be beneficial.

This impact would be the same as Impacts Trans-3 (CP3) and Trans-3 (CP4) and similar to Impacts Trans-3 (CP1) and Trans-3 (CP2); however, like CP3 and CP4, CP5 would result in a greater beneficial effect than CP1 and CP2 because more obsolete bridges would be replaced under CP5 than under CP1 or CP2. This impact would be beneficial. Mitigation for this impact is not needed, and thus not proposed.

Impact Trans-4 (CP5): Adverse Effects on Emergency Access in the Primary Study Area Road closures may result in increased response times for emergency vehicles. This direct impact would be potentially significant. Indirect impacts on air quality resulting from extended driving lengths, increased emergency vehicle response times, and potential noise impacts on sensitive receptors are discussed in the respective chapters of this PDEIS.

This impact would be the same as Impacts Trans-4 (CP3) and Trans-4 (CP4) and similar to Impacts Trans-4 (CP1) and Trans-4 (CP2). For the same reasons as described under Impact Trans-4 (CP3), the impact would be greater under CP5 than under CP1 or CP2 and would be potentially significant. Mitigation for this impact is proposed in Section 20.3.5.

Impact Trans-5 (CP5): Accelerated Degradation of Surface Transportation Facilities in the Primary Study Area Trucks used to import fill material and export construction waste would accelerate degradation of surface transportation facilities used as haul routes. This impact would be potentially significant.

This impact would be similar to Impact Trans-5 (CP4) and greater than Impacts Trans-5 (CP1), Trans-5 (CP2), and Trans-5 (CP3) because gravel augmentation would affect more roadways for a longer duration. For the same reasons as described under Impact Trans-5 (CP3), this impact would be potentially significant. Mitigation for this impact is proposed in Section 20.3.5.

Lower Sacramento River and Delta and CVP/SWP Service Areas
No effects on traffic or transportation are expected to occur in the lower

Sacramento River and Delta or the CVP/SWP service areas; therefore, potential effects in those geographic regions are not discussed further in this PDEIS.

20.3.5 Mitigation Measures

Table 20-3 presents a summary of mitigation measures for transportation and traffic.

Table 20-3. Summary of Mitigation Measures for Transportation and Traffic

Impact		No-Action Alternative	CP1	CP2	CP3	CP4	CP5
Impact Trans-1: Short-Term and Long-Term Increases in Traffic in the Primary Study Area in Relation to the Existing Traffic Load and Capacity of the Street System	LOS before Mitigation	LTS	LTS (short term), PS (long term)	LTS (short term), PS (long term)	LTS (short term), PS (long term)	LTS (short term), PS (long term)	LTS (short term), PS (long term)
	Mitigation Measure	None required.	Mitigation Measure Trans-1: Prepare and Implement a Traffic Control and Safety Assurance Plan				
	LOS after Mitigation	LTS	LTS	LTS	LTS	LTS	LTS
Impact Trans-2: Adverse Effects on Access to Local Streets or Adjacent Uses in the Primary Study Area	LOS before Mitigation	LTS	PS	PS	PS	PS	PS
	Mitigation Measure	None required.	Mitigation Measure Trans-2: Implement Mitigation Measure Trans-1: Prepare and Implement a Traffic Control and Safety Assurance Plan				
	LOS after Mitigation	LTS	LTS	LTS	LTS	LTS	LTS
Impact Trans-3: Hazards in the Primary Study Area Caused by a Design Feature	LOS before Mitigation	LTS	B	B	B	B	B
	Mitigation Measure	None required.	None needed; thus, none proposed				
	LOS after Mitigation	LTS	B	B	B	B	B
Impact Trans-4: Adverse Effects on Emergency Access in the Primary Study Area	LOS before Mitigation	LTS	PS	PS	PS	PS	PS
	Mitigation Measure	None required.	Mitigation Measure Trans-4: Implement Mitigation Measure Trans-1: Prepare and Implement a Traffic Control and Safety Assurance Plan				
	LOS after Mitigation	LTS	LTS	LTS	LTS	LTS	LTS

Table 20-3. Summary of Mitigation Measures for Transportation and Traffic (contd.)

Impact		No-Action Alternative	CP1	CP2	CP3	CP4	CP5
Impact Trans-5: Accelerated Degradation of Surface Transportation Facilities in the Primary Study Area	LOS before Mitigation	LTS	PS	PS	PS	PS	PS
	Mitigation Measure	None required.	Mitigation Measure Trans-5: Identify and Repair Roadway Segments Damaged by the Project.				
	LOS after Mitigation	LTS	LTS	LTS	LTS	LTS	LTS
Impact Trans-6 (No-Action only): Temporary Increase in Traffic in the Extended Study Area in Relation to the Existing Traffic Load and Capacity of the Street System	LOS before Mitigation	LTS	N/A	N/A	N/A	N/A	N/A
	Mitigation Measure	None required.	None needed; thus, none proposed.				
	LOS after Mitigation	LTS	N/A	N/A	N/A	N/A	N/A
Impact Trans-7 (No-Action only): Adverse Effects on Access to Local Streets or Adjacent Uses in the Extended Study Area	LOS before Mitigation	LTS	N/A	N/A	N/A	N/A	N/A
	Mitigation Measure	None required.	None needed; thus, none proposed.				
	LOS after Mitigation	LTS	N/A	N/A	N/A	N/A	N/A
Impact Trans-8 (No-Action only): Hazards in the Extended Study Area Caused by a Design Feature	LOS before Mitigation	LTS	N/A	N/A	N/A	N/A	N/A
	Mitigation Measure	None required.	None needed; thus, none iroposed.				
	LOS after Mitigation	LTS	N/A	N/A	N/A	N/A	N/A
Impact Trans-9 (No-Action only): Adverse Effects on Emergency Access in the Extended Study Area	LOS before Mitigation	LTS	N/A	N/A	N/A	N/A	N/A
	Mitigation Measure	None required.	None needed; thus, none proposed.				
	LOS after Mitigation	LTS	N/A	N/A	N/A	N/A	N/A

Table 20-3. Summary of Mitigation Measures for Transportation and Traffic (contd.)

Impact		No-Action Alternative	CP1	CP2	CP3	CP4	CP5
Impact Trans-10 (No-Action only): Accelerated Degradation of Surface Transportation Facilities in the Extended Study Area	LOS before Mitigation	LTS	N/A	N/A	N/A	N/A	N/A
	Mitigation Measure	None required.	None needed; thus, none proposed.				
	LOS after Mitigation	LTS	N/A	N/A	N/A	N/A	N/A

Key:
B = beneficial
LOS = level of significance
LTS = less than significant
N/A = not applicable
PS = potentially significant

No-Action Alternative

No mitigation measures are needed for this alternative.

CP1 – 6.5-Foot Dam Raise, Anadromous Fish Survival and Water Supply Reliability

No mitigation is needed for Impact Trans-3 (CP1). Mitigation is provided below for the remaining impacts of CP1 on traffic and transportation.

Mitigation Measure Trans-1 (CP1): Prepare and Implement a Traffic Control and Safety Assurance Plan Before construction starts, Reclamation and its primary contractors for engineering and construction will develop a coordinated construction traffic control plan to minimize the simultaneous use of roadways by different construction contractors for worker commute trips, material hauling, and equipment delivery to the extent feasible. The plan will outline phasing of activities and the use of multiple routes to and from off-site locations to minimize the daily amount of traffic on individual roadways. Reclamation will require that the construction contractors implement and enforce the plans throughout the construction periods. In addition, the plan will include the following elements:

- To the extent feasible, limit the construction work zone to a width that, at a minimum, maintains alternate one-way traffic flow past the construction zone.

- Provide flagger control at construction zones to manage traffic control and flows as necessary.

- Install temporary steel-plate trench crossings, as needed, to maintain reasonable traffic, bicycle, and pedestrian access to homes, businesses, and streets.

- Maintain access for emergency vehicles at all times. Provide advance notification to local law enforcement, fire, and emergency service providers of the timing, location, and duration of construction activities that could affect the movement of emergency vehicles on local roadways.

- Post advance warning of construction activities (for any affected roadways that would be closed or major roadways where lane closures would occur) in the local newspaper(s) and/or coordinate with the local jurisdictions to post such warnings in highly visible locations near the affected roadways.

- Post advance warnings about the potential presence of slow-moving vehicles in construction zones, where needed to reduce potential traffic hazards.

- Place and maintain barriers and install traffic control devices necessary for safety, as specified in Caltrans *Manual of Traffic Controls for Construction and Maintenance Work Zones* and in accordance with the guidance provided by the affected local jurisdictions.

- Limit the accumulation of project-generated mud or dirt on roadways adjacent to construction areas. The construction contractor will sweep the affected paved roadways (water sweeper with reclaimed water recommended) at the end of each day if substantial volumes of soil material have been carried onto adjacent paved, public roads from construction sites.

- Train construction personnel in appropriate safety measures as described in the plan.

Reclamation will also inform the community at a public hearing about the potential traffic delays and the preparation of the traffic control plan.

Implementation of this mitigation measure would reduce Impact Trans-1 (CP1) to a less than significant level.

Mitigation Measure Trans-2 (CP1): Implement Mitigation Measure Trans-1 (CP1) to Reduce Effects on Local Access Reclamation will implement Mitigation Measure Trans-1 (CP1) as described above to reduce adverse effects of road closures and detours or partial road closures on access to local streets and adjacent uses.

Implementation of this mitigation measure would reduce Impact Trans-2 (CP1) to a less than significant level.

Mitigation Measure Trans-4 (CP1): Implement Mitigation Measure Trans-1 (CP1) to Reduce Effects on Emergency Access Reclamation will implement Mitigation Measure Trans-1 as described above to reduce adverse effects of road closures on access by emergency vehicles.

Implementation of this mitigation measure would reduce Impact Trans-4 (CP1) to a less than significant level.

Mitigation Measure Trans-5 (CP1): Identify and Repair Roadway Segments Damaged by the Project The following measures will be implemented to require that Reclamation provides compensation for the repair of roadways that are degraded as a result of hauling:

- The contractor(s) responsible to Reclamation for delivery of borrow material shall identify all proposed haul routes on a map. The map will identify the owner of the rights-of-way (ROW) that are proposed for use as haul routes.

- The contractor(s) shall notify the owner of the ROW in writing and request conditional approval to use the ROW as a haul route. The contractor(s) shall submit a copy of the written request to Reclamation for Reclamation's file.

- The contractor(s) shall implement the conditions of approval for use of the haul route ROW. Conditions may include constructing repairs to damaged lengths of roadway or the payment of fees to compensate for roadway wear resulting from truck trips. Before commencement of hauling activities, the contractor(s) shall submit a copy of the ROW owner's conditional approval to Reclamation for Reclamation's file.

- Within 90 days after hauling activities are completed (that is the haul route is no longer in use for the project term), the contractor(s) shall submit a project close-out report to Reclamation to document compliance with the conditions of approval. Reclamation will keep the project close-out report on file.

Implementation of this mitigation measure would reduce Impact Trans-5 (CP1) to a less than significant level.

CP2 – 12.5-Foot Dam Raise, Anadromous Fish Survival and Water Supply Reliability

No mitigation is needed for Impact Trans-3 (CP2). Mitigation is provided below for the remaining impacts of CP2 on traffic and transportation.

Mitigation Measure Trans-1 (CP2): Implement Mitigation Measure Trans-1 (CP1): Prepare and Implement a Traffic Control and Safety Assurance Plan This mitigation measure is identical to Mitigation Measure Trans-1 (CP1). Implementation of this mitigation measure would reduce Impact Trans-1 (CP2) to a less than significant level.

Mitigation Measure Trans-2 (CP2): Implement Mitigation Measure Trans-1 (CP1) to Reduce Effects on Local Access This mitigation measure is identical to Mitigation Measure Trans-1 (CP1). Implementation of this mitigation measure would reduce Impact Trans-2 (CP2) to a less than significant level.

Mitigation Measure Trans-4 (CP2): Implement Mitigation Measure Trans-1 (CP1) to Reduce Effects on Emergency Access This mitigation measure is identical to Mitigation Measure Trans-1 (CP1). Implementation of this mitigation measure would reduce Impact Trans-4 (CP2) to a less than significant level.

Mitigation Measure Trans-5 (CP2): Identify and Repair Roadway Segments Damaged by the Project This mitigation measure is identical to

Mitigation Measure Trans-5 (CP1). Implementation of this mitigation measure would reduce Impact Trans-5 (CP2) to a less than significant level.

CP3 – 18.5-Foot Dam Raise, Anadromous Fish Survival and Water Supply

No mitigation is needed for Impact Trans-3 (CP3). Mitigation is provided below for the remaining impacts of CP3 on traffic and transportation.

Mitigation Measure Trans-1 (CP3): Implement Mitigation Measure Trans-1 (CP1): Prepare and Implement a Traffic Control and Safety Assurance Plan This mitigation measure is identical to Mitigation Measure Trans-1 (CP1). Implementation of this mitigation measure would reduce Impact Trans-1 (CP3) to a less than significant level.

Mitigation Measure Trans-2 (CP3): Implement Mitigation Measure Trans-1 (CP1) to Reduce Effects on Local Access This mitigation measure is identical to Mitigation Measure Trans-1 (CP1). Implementation of this mitigation measure would reduce Impact Trans-2 (CP3) to a less than significant level.

Mitigation Measure Trans-4 (CP3): Implement Mitigation Measure Trans-1 (CP1) to Reduce Effects on Emergency Access This mitigation measure is identical to Mitigation Measure Trans-1 (CP1). Implementation of this mitigation measure would reduce Impact Trans-4 (CP3) to a less than significant level.

Mitigation Measure Trans-5 (CP3): Identify and Repair Roadway Segments Damaged by the Project This mitigation measure is identical to Mitigation Measure Trans-5 (CP1). Implementation of this mitigation measure would reduce Impact Trans-5 (CP3) to a less than significant level.

CP4 – 18.5-Foot Dam Raise, Anadromous Fish Focus

No mitigation is needed for Impact Trans-3 (CP4). Mitigation is provided below for the remaining impacts of CP4 on traffic and transportation.

Mitigation Measure Trans-1 (CP4): Implement Mitigation Measure Trans-1 (CP1): Prepare and Implement a Traffic Control and Safety Assurance Plan This mitigation measure is identical to Mitigation Measure Trans-1 (CP1). Implementation of this mitigation measure would reduce Impact Trans-1 (CP4) to a less than significant level.

Mitigation Measure Trans-2 (CP4): Implement Mitigation Measure Trans-1 (CP1) to Reduce Effects on Local Access This mitigation measure is identical to Mitigation Measure Trans-1 (CP1). Implementation of this mitigation measure would reduce Impact Trans-2 (CP4) to a less than significant level.

Mitigation Measure Trans-4 (CP4): Implement Mitigation Measure Trans-1 (CP1) to Reduce Effects on Emergency Access This mitigation

measure is identical to Mitigation Measure Trans-1 (CP1). Implementation of this mitigation measure would reduce Impact Trans-4 (CP4) to a less than significant level.

Mitigation Measure Trans-5 (CP4): Identify and Repair Roadway Segments Damaged by the Project This mitigation measure is identical to Mitigation Measure Trans-5 (CP1). Implementation of this mitigation measure would reduce Impact Trans-5 (CP4) to a less than significant level.

CP5 – 18.5-Foot Dam Raise, Combination Plan

No mitigation is needed for Impact Trans-3 (CP5). Mitigation is provided below for the remaining impacts of CP5 on traffic and transportation.

Mitigation Measure Trans-1 (CP5): Implement Mitigation Measure Trans-1 (CP1): Prepare and Implement a Traffic Control and Safety Assurance Plan This mitigation measure is identical to Mitigation Measure Trans-1 (CP1). Implementation of this mitigation measure would reduce Impact Trans-1 (CP5) to a less than significant level.

Mitigation Measure Trans-2 (CP5): Implement Mitigation Measure Trans-1 (CP1) to Reduce Effects on Local Access This mitigation measure is identical to Mitigation Measure Trans-1 (CP1). Implementation of this mitigation measure would reduce Impact Trans-2 (CP5) to a less than significant level.

Mitigation Measure Trans-4 (CP5): Implement Mitigation Measure Trans-1 (CP1) to Reduce Effects on Emergency Access This mitigation measure is identical to Mitigation Measure Trans-1 (CP1). Implementation of this mitigation measure would reduce Impact Trans-4 (CP5) to a less than significant level.

Mitigation Measure Trans-5 (CP5): Identify and Repair Roadway Segments Damaged by the Project This mitigation measure is identical to Mitigation Measure Trans-5 (CP1). Implementation of this mitigation measure would reduce Impact Trans-5 (CP5) to a less than significant level.

20.3.6 Cumulative Effects

The majority of the current and reasonably foreseeable projects are related to SLWRI through operations of Shasta Dam. The projects in the extended study area are not evaluated further because construction of the SLWRI would not affect transportation facilities. Projects that could influence the local transportation network where SLWRI could contribute include implementation of the *Shasta-Trinity National Forest Land and Resource Management Plan, Iron Mountain Mine Restoration Plan, and Mendocino National Forest Land and Resource Management Plan*; development of the *Turntable Bay Master Development Plan*, and construction of the Antlers Bridge Replacement. The geographic scope of the management plans is vast while the geographic scopes

of Turntable Bay and Antlers Bridge are relatively limited. Individually and combined, none of these projects would result in significant haul trips that would occur during the peak-hour period. The ITE threshold of 50 trips during the peak-hour period on any particular route is not expected because the actions would be distributed throughout a large study area. Another reason that the ITE threshold would not be exceeded is that the forest and mine management and restoration actions and *Turntable Bay Master Plan* would take place over a long period and the Antlers Road Bridge would be completed in 2014. Consequently, no significant cumulatively adverse effects on traffic and transportation would occur in the primary study area.

Potential impacts of the project alternatives (CP1–CP5) are related to construction activities and increased vehicle trips resulting from increased recreational opportunities at Shasta Lake and its tributaries. Construction impacts would be temporary and short term, and recreational vehicle trips would be permanent and long term.

For the following reasons, implementation of any of the project alternatives (CP1–CP5), when combined with construction traffic for present and reasonably foreseeable actions, would not result in a considerable contribution to a significant cumulatively adverse condition on localized traffic and circulation. Under CP5, the maximum-intensity option, approximately 12 truck trips would be added to the a.m. and p.m. peak hours. These truck trips would not occur simultaneously on the haul routes. They would be distributed throughout the shoreline region of the lake, gravel augmentation sites (the sites that would change annually), and at Reading Island. The truck trips for the gravel augmentation and Reading Island would occur during a 2-month period, while the eight peak-hour trips upstream from Shasta Dam would occur over a much longer portion of the construction year. To result in a cumulatively adverse effect on traffic and circulation, the present reasonably foreseeable future projects would need to generate 38 trips during the a.m. or p.m. peak hour. Because of the large geographic scope and length of time for implementing the present and reasonably foreseeable future projects, it is reasonable that they would not generate peak-hour truck trips that would be 68 percent more than the peak-hour truck trips that would be generated by CP5. Furthermore, the cumulative peak-hour truck trips would not be concentrated at any one road segment or intersection.

For the reasons set forth for adverse effects of construction traffic on localized traffic and circulation problems, construction traffic under any of the project alternatives (CP1–CP5) would not result in a considerable contribution to a significant cumulatively adverse effect on emergency access.

For potential accelerated degradation of roadways from construction traffic, none of the construction alternatives (CP1–CP5) would result in cumulatively adverse effects. The reason is that the mitigation measure for these alternatives requires physical repair of damaged roadways, thereby eliminating the adverse

effects of the alternatives. Implementation of Mitigation Measure Trans-5 (CP1) would ensure that the roadways would be in better condition than under preproject conditions. In addition, roads and bridges that would be relocated under any of the project alternatives would be better than existing facilities and could replace functionally or structurally obsolete facilities before they were scheduled to be replaced by the local transportation agencies.

In conclusion, with implementation of any of the project alternatives (CP1–CP5) no significant cumulatively adverse effects on traffic and circulation, emergency access, or transportation facilities would occur.

Chapter 21
Utilities and Service Systems

21.1 Affected Environment

This chapter describes the affected environment related to utilities and service systems for the dam and reservoir modifications proposed under SLWRI.

Because of the potential influence of the proposed modification of Shasta Dam, and subsequent water deliveries over a large geographic area, the SLWRI includes both a primary and an extended study area. The primary area has been further divided into Shasta Lake and vicinity and upper Sacramento River (Shasta Dam to Red Bluff). The extended study area has been further divided into the lower Sacramento River and Sacramento–San Joaquin River Delta Delta and the CVP/SWP service areas.

The utilities and service systems addressed are water supply in the Shasta Lake and vicinity portion of the primary study area, wastewater infrastructure, stormwater drainage and infrastructure, solid waste management, electrical service and infrastructure, natural gas service and infrastructure, and telecommunications infrastructure. Hydropower generation, public services (e.g., fire protection law enforcement, emergency services), roadways and bridges, and recreation are addressed in separate chapters.

The utilities and service systems setting for the Shasta Lake and vicinity portion of the primary study area consists of the portion of Shasta County above Shasta Dam and includes the Shasta Unit of the Whiskeytown-Shasta-Trinity National Recreation Area (NRA). Utilities and service systems are influenced by rugged, mountainous terrain, lakeside communities, and Shasta Lake. The utilities and service systems setting for the upper Sacramento River portion of the primary study area consists of Shasta County below Shasta Dam and Tehama County. Two incorporated cities, Redding and Red Bluff, necessitate urban utilities and service systems needs in the otherwise rural upper Sacramento Valley, which is characterized by rolling hills with mountains to the north, east, and west.

The utilities and service systems setting for the extended study area consists of 21 counties downstream from the Red Bluff Diversion Dam and encompasses all areas served by the CVP and the SWP. A discussion of project impacts on CVP/SWP water supply and overall CVP and SWP management and operations is provided in the PDEIS Chapter 6, “Hydrology, Hydraulics, and Water Management” and in the *Hydrology, Hydraulics, and Water Management Technical Report*.

21.1.1 Water Supply

Shasta Lake and Vicinity

Water supplies for the Shasta Lake and vicinity portion of the primary study area are provided in one of three ways: by a community service area (CSA) run by Shasta County, by a mutual water company, or by an individual or group well. CSA #2 provides water for the Sugarloaf community, and CSA #6 provides water for the Silverthorn community. Fifteen mutual water companies serve the Shasta Lake and vicinity portion of the primary study area. Mutual water companies are cooperative or mutual associations that furnish water to resorts and other developments (Reclamation 2007) (Figure 21-1).

Upper Sacramento River (Shasta Dam to Red Bluff)

Provided below are descriptions of each entity in Shasta County that currently relies on Reclamation to provide a portion of its water supply and the associated Shasta and Trinity River diversions and facilities. This information was taken from the Final Environmental Assessment for the Long-Term Contract Renewal Shasta and Trinity River Divisions (Reclamation 2005).

City of Redding (Sacramento River, Spring Creek, Toyon) Before 1941, water service for the City of Redding was provided by the California Water Service Company, which had water rights to the Sacramento River dating from 1886. The City of Redding acquired the local facilities and water rights of the company in 1941 and filed for an additional appropriative water right of 5 cubic feet per second in 1944. Subsequent annexations to the City of Redding's service area include the Buckeye County Water District, the Cascade Community Services District, and the Enterprise Public Utility District in 1967, 1976, and 1977, respectively.

The Buckeye zone service area includes two City of Redding pressure zones: Buckeye and Summit City. Approximately half of the Buckeye zone is located within the Redding city limits, and the other half is in an unincorporated area of Shasta County. Approximately one-quarter of the Summit City zone is in an unincorporated area of Shasta County, and three-quarters is in the City of Shasta Lake. The City of Redding currently receives water to its Buckeye zone under a long-term CVP contract with Reclamation (the water comes from Whiskeytown Lake via the Spring Creek tunnel). There are no known groundwater resources within the Buckeye zone service area. During peak demand periods, supplemental water is pumped from the Sacramento River, then treated and delivered into the Buckeye zone service area. The municipal and industrial (M&I) connections in the Summit City zone are supplied exclusively by water diverted from Shasta Lake via the Toyon pipeline. The water is treated by the City of Shasta Lake and delivered to the Summit City zone.

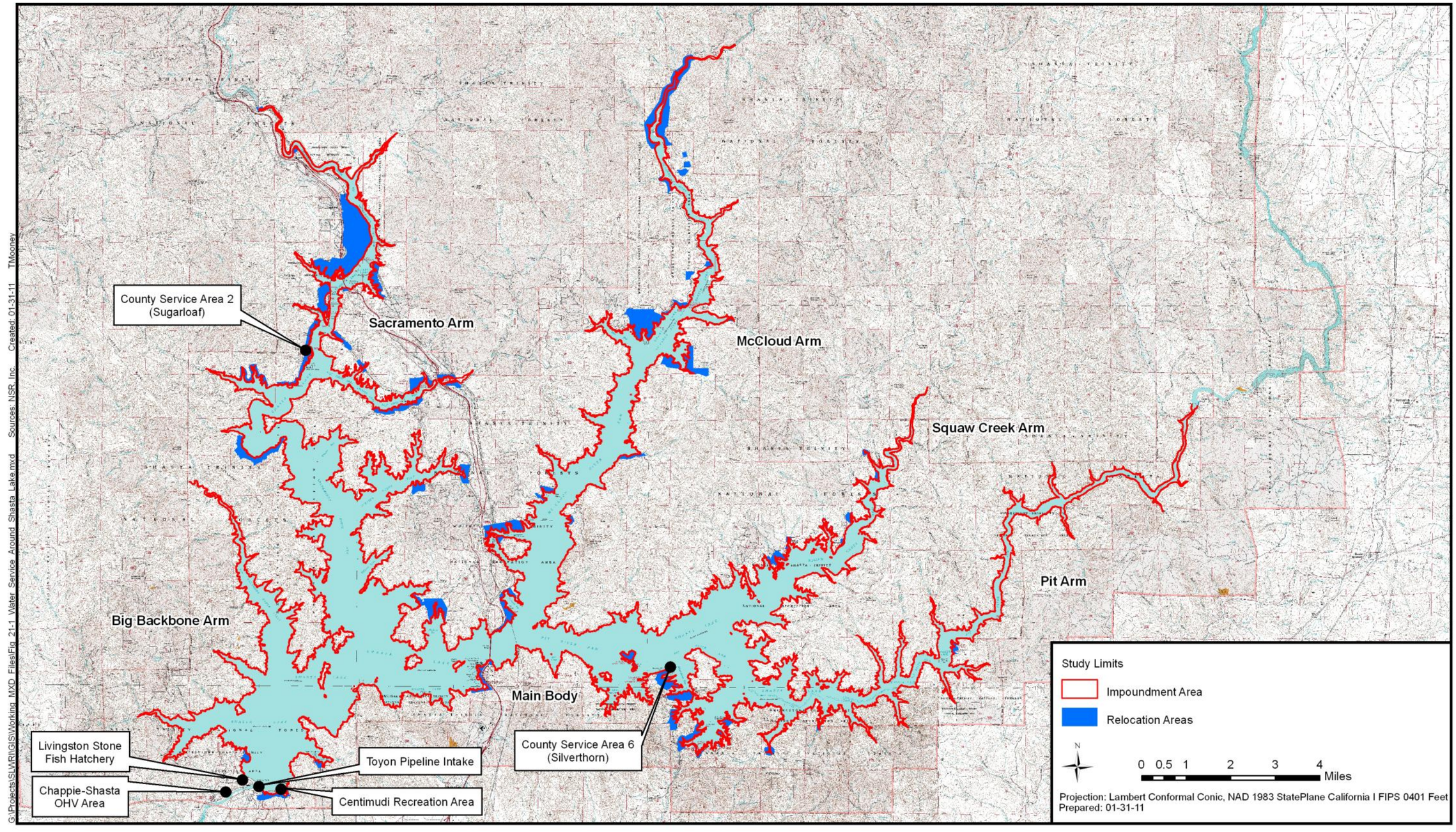


Figure 21-1. Water Service Around Shasta Lake

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The City of Redding has one additional water contract with Reclamation. Redding's 1966 Settlement Contract with Reclamation specifies a base supply and a project water supply. In 2003, the maximum base supply was set at 17,850 acre-feet per year, and the project water supply was set at 3,150 acre-feet per year; since 1995, project water supply entitlements have been increased by 45 acre-feet annually.

Redding's surface-water supply comes from the Sacramento River and Whiskeytown Lake. Sacramento River water is treated at the 24 million gallons per day (mgd) Foothill Water Treatment Plant, and Whiskeytown Lake water is treated at the 7 mgd Buckeye Water Treatment Plant. Redding supplements its surface-water supply with well production capacity from the Redding groundwater basin primarily during peak demand periods. Currently, 14 wells are operational, providing a total capacity of up to 12 mgd.

Redding provides CVP and non-CVP water service to about 24,709 connections. Connections provide water primarily for M&I uses and a small number of agricultural uses. The city administers 4,179 connections in the Buckeye zone and 58 M&I connections in the Summit City zone.

City of Shasta Lake Water for the City of Shasta Lake comes from Shasta Lake via a pump station at Shasta Dam that has a maximum diversion of 5.0 mgd. Water is pumped from an intake in the face of Shasta Dam to a storage/treatment facility immediately east of the Shasta Dam compound. From there it is delivered to the City of Shasta Lake. An interim contract with Reclamation (Contract No. 4-7-20-W1134-IR10) provides an allocation of 4,400 acre-feet per year from this source. Reclaimed water is also available for industrial and landscaping use. Groundwater use is limited because of low aquifer yields.

Prior to incorporation, the community water supply and utility services were provided by the Shasta Dam Area Public Utilities District (PUD), which was formed in 1945 to provide a reliable water supply for an area of 3.5 square miles. Originally, the PUD service area was a residential area established to house workers who were constructing Shasta Dam. Reclamation constructed a water transmission pipeline from Shasta Lake to the PUD in 1948, and the PUD concurrently constructed water storage and distribution systems. The Summit City PUD was annexed in 1978. Before annexation, water was supplied by a series of wells with low and unreliable yields.

The City of Shasta Lake provides water service to 3,800 connections for primarily urban and residential uses, although industrial use has increased over the past decade. The City of Shasta Lake also provides water service to Reclamation's Northern California Area Office.

Bella Vista Water District The Bella Vista Water District (BVWD) is a publicly owned water agency formed in 1957 to serve agricultural irrigation

demands (California Water Code Division 13, Sections 34000 through 38501). The BVWD service area is located generally east of Redding and south of Shasta Lake. The service area includes the rural communities of Bella Vista and Palo Cedro.

BVWD's primary water source is the Sacramento River. The BVWD supply system consists of the Wintu Pump Station on the Sacramento River and five wells. Water pumped from the river is treated at the district's treatment plant, which provides inline filtration. Distribution facilities include a network of transmission and distribution pipelines, three storage tanks, nine booster pump stations, and pressure-reducing facilities. The major distribution piping was initially constructed by Reclamation but has been expanded over time. The main supply system is still Federally owned, but it was constructed solely for use by BVWD. Both domestic and agricultural users are served through the same distribution system, so all water is treated to meet the higher water quality standards for domestic use. The CVP water that BVWD purchases from the Shasta County Water Agency (SCWA) is described below.

BVWD's original contract allows for up to 24,000 acre-feet per year, which is supplemented with 578 acre-feet per year of CVP water purchased through SCWA. Both of these allotments are subject to reduction during dry years. In the severe drought years of 1991 and 1992, water supplies for M&I were reduced by 25 percent and water for agricultural uses was reduced by 75 percent. Available surface water was supplemented with groundwater from wells located near the southern boundary of the district. These reductions in supply caused severe drought restrictions to be imposed, which have had a continuing impact on district water sales. The supplementary water provided by the wells constitutes about 10 percent of the supply normally available from the Sacramento River and about 15 percent to 20 percent of the reduced supply during a severe drought year. The aquifers in the district have limited yield, so it is not practical to greatly increase the production of wells in the district.

Agricultural and irrigation still represent 70 percent to 80 percent of the district's water demand. However, most of the service connections are now either domestic or rural residential. BVWD currently has 4,538 residential connections and 615 agricultural connections. Urban uses predominate in the southeast portion of the district where sewage disposal facilities are available. Residential uses, with lot sizes between 1 and 5 acres, are dispersed across the rest of the district. Agricultural uses are almost exclusively confined to the fertile soil along Stillwater Creek and Cow Creek. Pasture represents the bulk of agricultural use, although there is a broad range of other crops.

Centerville Community Services District The Centerville Community Services District (CCSD) was originally formed in September 1959 to supply water for domestic use, irrigation, sanitation, industrial use, fire protection, and recreation (California Government Code, Division 3, Community Services Districts, Section 61000, et seq.). The CCSD service boundary encompasses

11,278 acres in the unincorporated area of Shasta County immediately west of Redding.

The source of the district's water supply is Whiskeytown Lake, a key feature of the Trinity River Division of the CVP. This reservoir covers about 3,250 acres at maximum capacity and provides water storage of about 241 thousand acre-feet. The reservoir regulates the flows of the Clear Creek watershed and the imported flows from the Trinity River, which discharge through the Carr Powerhouse into the reservoir.

Designed and constructed by Reclamation, the district's water system dates back to 1967. Water is diverted to the district through two intakes in Whiskeytown Dam, one at an elevation of 1,110 feet and the other at an elevation of 965 feet. The ability to select the depth of the diverted water gives CCSD the capacity to draw less turbid water. The water is treated at a 30 mgd capacity plant located at the base of Whiskeytown Dam. CCSD shares the inline treatment facility with the Clear Creek Community Services District (CCCSD).

Treated water is distributed to the district through an aqueduct that begins at Whiskeytown Dam and terminates at a 250,000-gallon control tank about 8.5 miles south of the dam. This aqueduct, commonly called the Muletown Aqueduct (also Muletown Conduit), consists of about 27,500 feet of 45-inch pipe and 17,400 feet of 42-inch pipe buried along Muletown Road, paralleling Clear Creek. The steel pipe, lined and coated in coal tar, was installed in 1965.

CCSD has a contract with CCCSD that allocates CCSD a 25 percent share of the capacity. CCSD holds two contracts with Reclamation for a total allocation of 3,800 acre-feet per year. The first contract, entered into on April 11, 2001, is an assignment contract. This contract permanently assigned 2,900 acre-feet per year of CVP water from SCWA's 5,000 acre-feet per year contract with Reclamation. This contract carries with it those terms and conditions defined in SCWA's contract, which also includes a binding agreement for early renewal. The second contract, entered into on August 11, 2000, is an exchange contract. This contract with Reclamation for 900 acre-feet per year was intended to provide CCSD with substitute project water for its pre-1914 water rights on Clear Creek. The district does not have access to a groundwater supply source.

CCSD currently provides M&I water to 1,125 metered connections that serve a population of approximately 2,850.

Clear Creek Community Services District CCCSD was formed in 1961 and encompasses about 14,314 acres. The facilities were designed and constructed by Reclamation, and CCCSD began operating in 1967. CCCSD is located approximately 10 miles southwest of Redding and 6 miles west of Anderson in southern Shasta County. The district's service area includes the rural areas known as Olinda and Cloverdale. The general area served by the district is commonly known as Happy Valley.

The source and treatment of CCCSD water is the same as CCSD water; water from Whiskeytown Lake is treated and diverted to service connections via the Muletown Aqueduct. The distribution system within the district's boundaries consists of approximately 75 miles of pipe ranging in size from 2 inches to 45 inches. Title to the distribution line system was transferred to CCCSD on May 29, 2001.

CCCSD has one storage tank along the aqueduct with a capacity of 1 million gallons. A control tank with a 250,000-gallon capacity regulates pressure at the upper elevation of the district. A 32,000-gallon storage tank is located outside of the district boundary at the booster station facility.

The district has developed the first of three planned wells, and it has installed 13,800 feet of 18-inch pipeline to connect a groundwater supply to the distribution system. The first well attached to the distribution system (Well #1) became operational in October 1992. Well #1 and the two proposed wells are intended for use only when surface supplies are inadequate to meet emergency demands.

CCCSD currently provides service for approximately 5,817 acres of irrigated agricultural land and approximately 4,000 acres of rural residences receiving M&I water. Approximately 4,497 acres in the district are undeveloped. The majority of the developed agricultural property in the district is ditch or flood irrigated. The balance of irrigation is done by overhead and drip systems.

Shasta Community Services District The Shasta Community Services District (SCSD), located west of Redding, was formed in 1959 to supply water for domestic use and fire protection for the City of Shasta Lake and adjacent developed areas of the district (Community Services District Laws: California Governmental Code, Sections 61000 through 61934). Congress authorized a water system for the area as part of the Trinity River Division of the CVP. Bonds that were issued by SCSD to finance construction of the transmission and distribution systems have been repaid.

A long-term CVP water service contract provides up to 1,000 acre-feet annually. Water is supplied by gravity from Whiskeytown Lake via a turnout on the Spring Creek conduit. The Spring Creek conduit is the only source of supply, and there are only 0.30 million gallons of storage located near the source. Downstream from the turnout, a single transmission main serves as the backbone of the distribution system and most mains are not looped. Historically, SCSD has been vulnerable to disruptions in supply from its Reclamation contract. During the 1991 drought, Reclamation reduced SCSD's allotment by 25 percent to 750 acre-feet per year.

The district currently serves 630 connections. Virtually all of the active land use is residential or municipal, consisting primarily of ranchettes. Wells are not feasible because the district does not lie over an aquifer.

Shasta County Water Agency SCWA was formed in 1957 to develop water resources for Shasta County (Shasta County Water Agency Act (Legislative Act 7580)). SCWA evolved from the Shasta County Department of Water Resources, which organized Shasta County efforts in conjunction with the Trinity River Division of the CVP.

SCWA has assisted with the creation of BVWD, CCSD, CCCSD, and SCSD and helped create CSAs for water and sewer services in Shasta County. The agency also acts as staff to the Redding Area Water Council, a group that works to preserve the quality and quantity of water in the Redding groundwater basin. Funding for SCWA comes from Shasta County property taxes.

Other Shasta and Trinity River Divisions CVP Contractors Three smaller water districts (see below) are served by either the Shasta or Trinity River division of the CVP. The three districts constitute about 1 percent of the CVP long-term contract water supply to the divisions.

Keswick County Service Area The Keswick County Service Area (KCSA), located west of Redding, was formed in 1990 (California Government Code Sections 25210.1 through 25250). Previously, KCSA operated as the Keswick Community Services District, which was formed in the early 1960s to supply water for domestic use and fire protection for the town of Keswick and adjacent developed areas (California Government Code Sections, 61000 et seq.). The district boundary encompasses Keswick Dam and the Spring Creek Diversion Dam; however, these facilities are not served by the district.

Congress authorized a water system for the Keswick area as part of the Trinity Project Act (69 Stat. 719), and the facilities were constructed in 1965. A repayment schedule was established whereby the Federal government would be reimbursed by KCSA for delivery system construction costs. On completion of repayment, ownership of all project facilities were to remain with the Federal government.

The water source for KCSA is Whiskeytown Lake. Water is transported by gravity flow to a turnout on the Spring Creek conduit that is located upstream from the Spring Creek powerhouse. Two storage tanks provide 0.2 million gallons of storage.

A CVP water service contract provides for up to 500 acre-feet annually. KCSA serves about 195 connections, which are concentrated in the town of Keswick. Land served by KCSA is exclusively rural residential properties.

Mountain Gate Community Services District The Mountain Gate Community Services District (MGCSD) was initially formed in 1956 to provide water service for a 2-square-mile area north of the City of Shasta Lake (California Government Code, Sections 61000 et seq.). The water source for MGCSD is Shasta Lake. The distribution system consists of 29 miles of pipelines that serve

3,750 acres in MGCSD and Bridge Bay Resort (located between the Sacramento and McCloud arms of Shasta Lake on U.S. Forest Service land).

A CVP water service contract provides 350 acre-feet annually. District water supplies are supplemented by a contract with SCWA that provides 1,000 acre-feet annually. MGCSD also operates three wells that take water from a local aquifer. The wells supply nearly half of MGCSD's total needs. There is no water storage in the district.

MGCSD provides water service to 593 connections and fire protection services for its service area. Although the MGCSD primarily provides water for residential uses, it also serves municipal and industrial customers.

U.S. Forest Service The Toyon Pipeline, a Reclamation facility constructed by the USFS, originates from the left abutment of Shasta Dam and diverts water to a point near Government Camp at Toyon (west of the City of Shasta Lake). USFS operates and maintains the water diversion system, which includes pipelines, pumps, and meters (Figure 21-1).

USFS diverts water for the Centimudi Recreation Area located east/southeast of Shasta Dam. A memorandum of agreement between USFS and Reclamation provided USFS with up to 10 acre-feet of municipal, industrial, and domestic water diverted from the Toyon Pipeline before it reaches the City of Shasta Lake to supply the Centimudi Recreation Area. The Centimudi facilities continue to receive water under this memorandum of agreement.

Livingston Stone National Fish Hatchery The Livingston Stone National Fish Hatchery is located near the foot of Shasta Dam and is managed by the USFWS. The hatchery receives its water from the penstocks of Shasta Dam. Water flows through pipes fitted with pressure-reducing valves that pierce manhole covers near the bases of the penstocks. Then the water is routed via a buried pipeline to the hatchery, where it passes through a degassing device, flows through the hatchery, and then returns to the Sacramento River.

Other Users of Lake Water No other entities draw water directly from Shasta Lake for domestic or industrial uses. However, some marinas draw raw water from the lake for washing out boats. Return water drains back into the lake.

Shasta County Water supplies in Shasta County are provided by CVP, surface water diversions, and groundwater wells. The City of Redding uses groundwater wells for 40 percent of its water supply to supplement CVP water sources described in the preceding section. Maximum available groundwater production is approximately 19,000 acre-feet per year. Most city groundwater comes from 10 wells located near Redding Municipal Airport, within the Redding groundwater basin. These wells supply a maximum of 16.5 mgd. Four additional wells in the county supply a maximum of 0.7 mgd.

Tehama County Water supplies in Tehama County are provided by CVP, local surface water diversions, and groundwater wells. The recent trend in the county is a shift from reliance on CVP water supplies to groundwater supplies. There are more than 10,000 wells designated for domestic, irrigation, municipal, monitoring, and other uses in the county. CVP deliveries provide 21,300 acre-feet per year; local stream diversions provide 106,300 acre-feet in a normal water year; and groundwater provides approximately 382,000 acre-feet per year, which represents two-thirds of the county's irrigated water supply.

Red Bluff The City of Red Bluff obtains all of its water from 14 wells. It maintains a 3-million-gallon storage tank used for equalizing storage, fire flow, and emergency storage. The City of Red Bluff is in the process of seeking funding for an additional storage tank similar to the first. The wells produce between 500 and 2,500 gallons per minute, with the majority producing between 800 and 1,000 gallons per minute. Well depths range from 150 to 250 feet.

Other Nearby Uses The Chappie-Shasta Off-Highway Vehicle Area and residential and commercial uses in the community of Coram draw water from local groundwater wells.

Lower Sacramento River and Delta and CVP/SWP Service Areas The overall CVP/SWP water supply discussion describes the environmental setting for water supply for the extended study area. Other water supplies come from local surface water diversions and wells, which serve domestic, irrigation, municipal, and commercial uses. A detailed discussion of the overall CVP and SWP management and operations is provided in the PDEIS Chapter 6, "Hydrology, Hydraulics, and Water Management" and in the *Hydrology, Hydraulics, and Water Management Technical Report*.

21.1.2 Wastewater Infrastructure

Shasta Lake and Vicinity

Wastewater is treated and returned to the natural environment using one of several technical methods with either community or individual onsite disposal systems. Most residential, commercial, and recreational developments located in the Shasta Lake and vicinity portion of the primary study area use on-site septic tank/leachfield systems for wastewater treatment. Typically, individual homes, cabins, or businesses are routed to individual septic systems. Large resorts route septic from several buildings to a single tank/leachfield system. Campgrounds and public restrooms use either septic tank/leachfield systems or vault/pit toilets (Reclamation 2007). Marinas also use booster pumps to lift gray water to upslope leachfield areas. No large wastewater collection or treatment systems are located near Shasta Lake.

The highest concentrations of wastewater facilities near Shasta Lake are located in the Lakeshore and Sugarloaf areas, with a substantial number of facilities in

the Bridge Bay, Holiday Harbor, Salt Creek, Campbell Creek, Silverthorn, Jones Valley, Tsadi Resort, and Digger Bay Marina areas (Figure 21-2). The Utilities and Miscellaneous Minor Infrastructure Technical Memorandum shows detailed maps of the wastewater facilities in the ancillary areas near Shasta Lake (Reclamation 2007).

Upper Sacramento River (Shasta Dam to Red Bluff)

Many areas scattered throughout Shasta and Tehama counties are serviced by individual septic systems. The remaining wastewater treatment systems are a form of community collection, treatment, and disposal. The most common form of community system is the treatment plant, which discharges treated effluent to a storage and irrigation system (land disposal) or, diluted, to a surface watercourse.

Below Shasta Dam, a number of community wastewater systems are operated by the cities of Anderson, Redding, Red Bluff, and the City of Shasta Lake. Several unincorporated communities have community wastewater systems that are operated by CSAs.

Redding operates both the Clear Creek Wastewater Treatment Plant (WWTP) and Stillwater WWTP, both of which discharge treated effluent year around to the Sacramento River. The Clear Creek WWTP is currently permitted by the Central Valley Regional Water Quality Control Board to discharge up to 8.8 mgd of average dry-weather flow into the Sacramento River. The wastewater receives advanced secondary treatment. The Stillwater WWTP receives an average of 2.0 mgd of wastewater, approximately one-third of its design capacity of 6 mgd for average dry-weather flow. The Anderson WWTP discharges year around into the Sacramento River at a location approximately 0.25 mile from the Stillwater WWTP.

The City of Shasta Lake operates a large community wastewater system that is permitted to seasonally discharge treated effluent to surface water, namely Churn Creek; a major goal of the city's capital improvement plan has been to significantly reduce these discharges. Churn Creek eventually discharges to the Sacramento River about 0.5 mile upstream from the Stillwater WWTP.

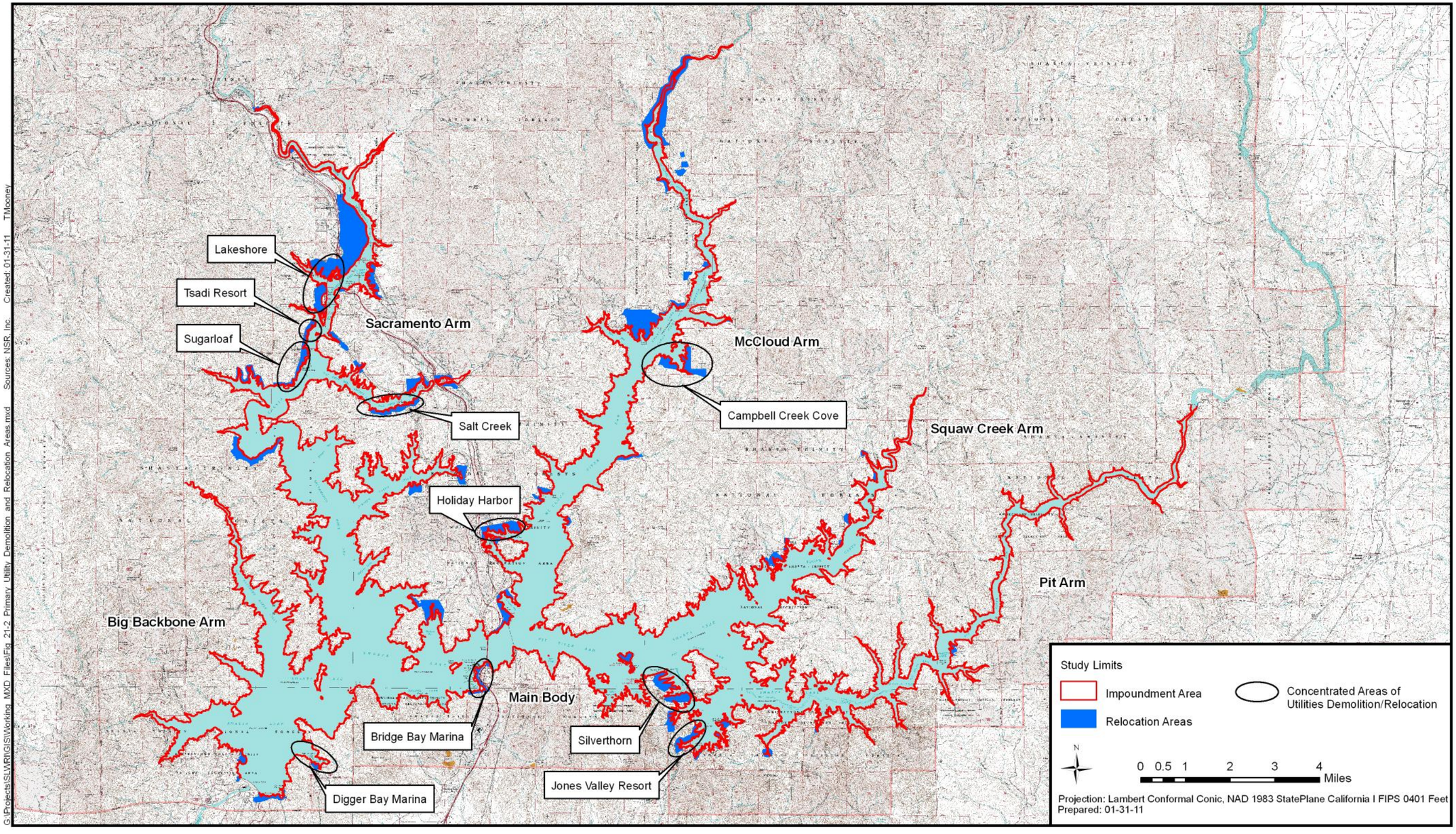


Figure 21-2. Primary Utility Demolition and Relocation Areas

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The Red Bluff WWTP has a treatment capacity of 4.8 mgd and discharges tertiary treated wastewater by gravity into the Sacramento River at approximately 1.4 mgd. The City of Red Bluff operates a wastewater treatment system at the south end of the city. The Rio Alto Water District provides wastewater treatment services for some portions of the community of Cottonwood. Septic/leachfield systems or seepage pits are used in areas not served by these systems.

Lower Sacramento River and Delta and CVP/SWP Service Areas

Wastewater systems in the extended study area are similar to those discussed for the primary study area. Community wastewater service systems are provided through a collection network of gravity and force main sewer lines operated primarily by local utility agencies. Pump stations and lift stations augment sewer line networks. These conveyance systems terminate at wastewater treatment plants that discharge treated effluent to storage and irrigation systems (land disposal) or to surface watercourses where the treated effluent is diluted. Individual on-site wastewater treatment methods are also used where the land is able to accommodate a leachfield/septic tank system.

21.1.3 Stormwater Drainage and Infrastructure

Shasta Lake and Vicinity

Stormwater drainage is primarily a function of the precipitation and runoff characteristics of a watershed. About 6.5 percent (5.8 million acre-feet) of all surface runoff in the state of California originates in Shasta County, representing a substantial portion of the total surface runoff in the Sacramento River system. Runoff in the Shasta Lake and vicinity portion of the primary study area is discharged to the McCloud River, the Sacramento River, and the Pit River, which drain into Shasta Lake. Numerous creeks and small local tributaries also drain into Shasta Lake.

The California Department of Transportation maintains a stormwater drainage system along the Interstate 5 (I-5) corridor. Drainage facilities in developed communities include gutters, swales, ditches, culverts, storm drain inlets, catch basins, storm drainage pipes, and detention basins. Roads also channel stormwater drainage from residences, commercial, and industrial land uses to adjacent lands and stormwater drains.

Upper Sacramento River (Shasta Dam to Red Bluff)

Runoff in the upper Sacramento River portion of the primary study area is discharged to the Sacramento River directly and indirectly via numerous major creeks and small local tributaries in rural and urban areas. Stormwater drainage in undeveloped portions of Shasta and Tehama counties generally consists of natural swales and topographic features.

Stormwater collection systems are present in urban areas and developed communities. Drainage facilities in urban areas include gutters, swales, ditches,

culverts, storm drain inlets, catch basins, storm drainage pipes, canals, detention basins, and pump stations. Roads also channel stormwater drainage from residences and commercial and industrial land uses to adjacent lands and stormwater drains. The cities of Redding, Anderson, and Red Bluff and the City of Shasta Lake each operate municipal storm drainage systems in the city limits. The California Department of Transportation I-5 stormwater drainage system continues along I-5 in the upper Sacramento River area.

Lower Sacramento River and Delta and CVP/SWP Service Areas

Stormwater systems in the extended study area are similar to those discussed for the primary study area. Various storm drainage facilities and collection/conveyance systems are located throughout the extended study area. Stormwater facilities and infrastructure are operated primarily by local districts and road departments, and include gutters, swales, ditches, culverts, storm drain inlets, catch basins, storm drainage pipes, canals, detention basins, and pump stations. Treated stormwater is often discharged to rivers, tributaries, and major creeks throughout the extended study area.

21.1.4 Solid Waste Management

Shasta Lake and Vicinity

Contractors, under the auspices of Shasta County, provide solid waste disposal services for the private sector. The Shasta-Trinity National Forest (STNF), Reclamation, and California Department of Transportation use contractors to provide disposal services for facilities on public lands. A number of sites are used to collect solid waste and recyclables, which are later transferred to landfills or recycling centers in the extended study area, primarily in Shasta County.

Upper Sacramento River (Shasta Dam to Red Bluff)

The Shasta County Department of Public Works is responsible for providing solid waste management in unincorporated areas of the county. Three landfills (West Central Landfill, Anderson Landfill, and Twin Bridges Landfill) and 11 collection/transfer stations are currently operating in Shasta County. Shasta County generated 187,909 tons of solid waste in 2006; however, 307,568 tons of solid waste were disposed of in the county during the same period (CIWMB 2008).

In 2006, the 1,200-acre West Central Landfill received approximately 417 tons per day (CIWMB 2008) of nonhazardous waste from residential, commercial, industrial, and agricultural sources. This Class III landfill has a permitted capacity of 7,078,000 cubic yards and a storage area of 107 acres. In 2001, the State of California estimated that the landfill had a remaining capacity of 6,606,000 cubic yards (CalRecyle 2010). Under existing State permits, the landfill has sufficient capacity to accommodate the disposal of solid waste at least until the year 2019. In 2006, the 246-acre Anderson Landfill, a Class III landfill and asbestos-containing waste disposal site, received approximately 426

tons of solid waste per day (CIWMB 2008). This landfill has a permitted capacity of 16,840,000 cubic yards, and in 2008 the State of California estimated that the landfill had a remaining capacity of 11,914,000 cubic yards (CalRecycle 2010). The estimated year of closure is 2055. The Twin Bridges Landfill is a Class II landfill that has ceased accepting solid waste and is undergoing closure (CIWMB 2008).

Tehama County operates the 102-acre Tehama County/Red Bluff Sanitary Landfill, located approximately 2.5 miles northwest of Red Bluff. This landfill, a Class III facility, has a maximum permitted daily capacity of 400 tons (CIWMB 2008). This landfill has a permitted capacity of 5,097,000 cubic yards, and in 2008 the State of California estimated that the landfill had a remaining capacity of 2,149,000 cubic yards (CalRecycle 2010). The estimated year of closure is 2040. The landfill is owned by the Tehama County Sanitary Landfill Association, a joint-powers authority composed of Tehama County and the cities of Red Bluff, Corning, and Tehama. The Tehama County/Red Bluff Landfill Management Agency oversees daily landfill operations at the Tehama County/Red Bluff Landfill and at the Material Recovery Facility. Tehama County/Red Bluff Landfill Management Agency is another joint-powers authority and is composed of Tehama County and the City of Red Bluff. This agency is also responsible for maintaining permits and monitoring environmental compliance at the landfill.

In addition to the landfill and material recovery facilities, Tehama County operates two household hazardous waste facilities, in Corning and Red Bluff, and four transfer stations in the outlying rural areas of Manton, Payne's Creek, Mineral, and Rancho Tehama. There are no facilities authorized to accept commercial hazardous waste within the primary study area.

Lower Sacramento River and Delta and CVP/SWP Service Areas

Solid waste services and infrastructure in the extended study area are similar to those discussed for the primary service area. Urban centers in the extended study area may generate more solid waste than the population centers in the primary study area; however, the mechanisms used for transfer and disposal of the waste are similar. Solid waste facilities, including landfills and transfer stations, provide pickup and disposal services. There are three commercial hazardous waste disposal facilities authorized to accept various types of commercial hazardous waste in the extended study area. These facilities are located in Kings, Kern, and Imperial counties. Only the facility in Kings County is certified to accept materials that contain polychlorinated biphenyls.

21.1.5 Electrical Service and Infrastructure

Shasta Lake and Vicinity

Pacific Gas and Electric Company (PG&E) provides electrical service to Shasta Lake and vicinity. This service area is part of a larger PG&E territory, which encompasses 70,000 square miles in northern and central California, from

Eureka in the north to Bakersfield in the south. Power transmission facilities serving the Shasta Lake and vicinity portion of the primary study area have developed mostly parallel to I-5 and adjacent to developed communities.

Currently, PG&E is capable of providing three-phase power parallel to the I-5 corridor, north to Bridge Bay and south from Lakehead to Turntable Bay. Power lines around Shasta Lake are typically routed overhead on utility poles or towers, although a portion of the lines serving individual businesses, homes, and cabins are routed underground. Power lines serving the Shasta Lake and vicinity portion of the primary study area are frequently attached to bridges when routed over rivers and lake inlets. The voltage of local distribution lines is typically 12 kilovolts (kV), whereas the voltage of high-voltage power transmission lines is typically 60 kV to 230 kV. Service to individual homes and businesses is typically 120 volts to 480 volts.

The highest concentrations of electrical service facilities near Shasta Lake are in the Lakeshore and Sugarloaf areas, with a substantial number of facilities in the Bridge Bay, Holiday Harbor, Salt Creek, Campbell Creek, Silverthorn, Jones Valley, Tsadi Resort, and Digger Bay Marina areas (Figure 21-2). The Utilities and Miscellaneous Minor Infrastructure Technical Memorandum shows detailed maps of the electrical service facilities in the ancillary areas near Shasta Lake (Reclamation 2007).

Upper Sacramento River (Shasta Dam to Red Bluff)

Electrical service and related infrastructure in the upper Sacramento River portion of the primary study area are similar to those discussed for the Shasta Lake and vicinity portion. The City of Shasta Lake, city of Anderson, outlying rural areas of Shasta County, and Tehama County (Red Bluff and Corning) receive electrical service from PG&E.

The City of Redding owns and operates a looped 115 kV system, which delivers energy to 11 115/12 kV distribution substations that step the voltage down to 12 kV for delivery to the city's customers. The system is managed by the Redding Electric Utility. In total, Redding's distribution system has 67.3 miles of 115 kV local transmission lines and approximately 610 miles of overhead and underground 12 kV distribution lines. Delivery of all power from outside the city is made to the Redding Municipal Airport 230/115 kV transmission substation and to the Keswick Dam switch yard. Redding jointly owns the airport substation with the Western Area Power Administration. The Western Area Power Administration owns and operates the Keswick switching substation and an electrical transmission line that runs north and south along the western side of the City of Redding and the City of Shasta Lake.

Lower Sacramento River and Delta and CVP/SWP Service Areas

Electrical services and infrastructure in the extended study area are similar to those discussed for the primary study area. Power generation and transmission facilities have developed parallel to population centers, power, natural gas,

nuclear, oil, hydroelectric, wind, solar, and other technologies used for power production.

Infrastructure in the Sacramento River basin downstream from the Red Bluff Diversion Dam, the American River basin, and the San Joaquin River basin consists primarily of natural gas–fired and hydroelectric generating facilities, transmission lines, substations, and distribution lines. In the Sacramento–San Joaquin River Delta, PG&E and the Western Area Power Administration have developed power transmission lines across Delta islands and waterways. Many of the corridors are within the periphery of the Delta upland areas, including several natural gas–fired plants. There are no power-generating facilities in the central Delta. In other portions of the CVP and SWP service areas, a complex system of electrical generating facilities, substations, and transmission infrastructure exists.

21.1.6 Natural Gas Service and Infrastructure

Shasta Lake and Vicinity and Upper Sacramento River (Shasta Dam to Red Bluff)

PG&E is responsible for providing natural gas service to the primary study area. Gas is delivered to customers below Shasta Dam, including residents of the cities of Redding, Anderson, and Red Bluff and the City of Shasta Lake. Although the study area is bisected by a large PG&E natural gas pipeline, service varies based on PG&E's distribution system. No natural gas facilities are present in the Shasta Lake and vicinity portion of the primary study area.

A number of rural residences and businesses in the primary study area rely on propane for various purposes. Propane is supplied by various local providers to individual on-site tanks. Propane tanks for homes and businesses are portable and are typically leased (Reclamation 2007).

Lower Sacramento River and Delta and CVP/SWP Service Areas

Natural gas services and infrastructure are located throughout the extended study area and are supplied by various energy providers. Pipelines, storage areas, and compressor stations are located in the Sacramento River and San Joaquin River valleys and in the CVP/SWP service areas. Natural gas discovered in the Delta region has been developed into a significant supply source and depot for underground storage. Gas fields, pipelines, and related infrastructure have been developed throughout the CVP/SWP service areas. Natural gas infrastructure is owned by oil and gas companies, public utilities, and various independent leaseholders.

21.1.7 Telecommunications

Shasta Lake and Vicinity and Upper Sacramento River (Shasta Dam to Red Bluff)

Landline telephone service in the primary study area is provided by various commercial communications companies. The majority of the landline facilities

are located in county- or city-owned rights-of-way and on private easements. Telecommunications lines are either copper wire or fiber optic cable and are routed overhead on utility poles and underground. Telephone lines are frequently attached to bridges when routed over rivers and lake inlets. There are no transcontinental fiber optic lines in the Shasta Lake and vicinity portion of the primary study area.

In addition to landline service, a large number of communications towers have been constructed throughout the primary study area for cellular phone service. Cellular towers have been erected along major travel corridors to meet emergency service objectives. Cellular service is available, to varying degrees, throughout the service area.

Lower Sacramento River and Delta and CVP/SWP Service Areas

Telecommunications systems in the extended study area are similar to those discussed for the primary study area and are supplied by various providers. Associated infrastructure is located throughout the extended study area and consists of underground fiber optic cable, telephone transmission lines (overhead and underground), and cellular towers owned or leased by telecommunications service providers.

21.2 Regulatory Framework

21.2.1 Federal

Reclamation Act

The 1902 Reclamation Act authorized the Federal government to finance and build water supply projects. The act set up the Reclamation Fund to finance single-purpose irrigation projects in the western United States. Since that time, water supply projects and the financing needed to construct and maintain infrastructure have grown substantially. The act has been amended several times, most recently in 1982 with the passage of the Reclamation Reform Act.

Safe Drinking Water Act

The Safe Drinking Water Act (SDWA) was passed to protect public health by regulating the nation's drinking water supply. The law requires many actions to protect drinking water and its sources: rivers, lakes, reservoirs, springs, and groundwater wells. Originally, the SDWA focused on water treatment as the primary means to provide safe drinking water at the tap. In 1996, amendments to the SDWA expanded the act to include source water protections.

The U.S. Environmental Protection Agency (EPA) is responsible for administering the act. EPA establishes National Primary Drinking Water Regulations for contaminants that may cause adverse public health effects. These regulations set maximum contaminant levels and nonenforceable health

goals (called Maximum Contaminant Level Goals) for recognized contaminants.

The SDWA does not regulate private wells that serve fewer than 25 people. However, the act does apply to all public water systems. A public water system is one that provides water for public consumption that regularly serves at least 25 people or has at least 15 service connections. This includes facilities such as resorts and marinas.

Clean Water Act

The objective of the Clean Water Act is to restore and maintain the chemical, physical, and biological integrity of the nation's waters by preventing point and nonpoint pollution sources, providing assistance to publicly owned treatment works for the improvement of wastewater treatment, and maintaining the integrity of wetlands. The act regulates discharges of pollutants into the waters of the United States. EPA is responsible for administering waste discharge permits under the National Pollutant Discharge Elimination System. M&I wastewater facilities that discharge effluent into surface waters are required to obtain National Pollutant Discharge Elimination System permits. Large and medium storm sewer systems also require a National Pollutant Discharge Elimination System permit. The stormwater permits often require implementation of a pollution prevention plan to prevent contaminants from reaching surface waters.

Resource Conservation and Recovery Act

The Resource Conservation and Recovery Act (RCRA) is designed to provide "cradle to grave" control of hazardous waste by imposing management requirements on generators and transporters of hazardous wastes and on owners and operators of treatment, storage, and disposal facilities. The RCRA also applies to the management of nonhazardous solid waste through the municipal solid waste landfill. EPA is responsible for administering the RCRA.

Shasta-Trinity National Forest Land and Resource Management Plan

The STNF Land and Resource Management Plan (LRMP) identifies goals, standards, and guidelines related to utilities and service systems in the Shasta-Trinity National Forest. The following public services goals, standards, and guidelines related to the project area were excerpted from the LRMP (USFS 1995).

Facilities Goals:

- Provide and maintain those administrative facilities that effectively and safely serve the public and Forest Service workforce.

Facilities Standards and Guidelines:

- Manage, construct, and maintain buildings and administrative sites to meet applicable codes and to provide the necessary facilities to support resource management.

Lands Goals:

- Provide for continued use and new development of hydroelectric facilities.

Lands, Special Uses Standards and Guidelines:

- Do not approve special use applications if such use can reasonably be accommodated on private land.
- Bury new telephone lines and new or reconstructed power distribution lines less than 35 kV, unless:
- Visual quality objectives (VQO) can be met without burying,
- Geologic conditions make burying infeasible, and
- Burying will produce greater long-term site disturbance.

Whiskeytown-Shasta-Trinity National Recreation Area Management Plan

- Road construction will be restricted to that which is compatible with the purpose of the NRA and to provide essential private land access.
- Road closures will be implemented as opportunities arise in order to decrease road density and associated wildlife disturbance.
- No additional roads will be constructed for timber harvest.
- Any timber harvest must be consistent with NRA goals and objectives.
- All developments and long-term activities in the NRA will be designed with the intent of meeting VQOs. Those objectives include areas designated as retention, partial retention, and modification.
- Management activities that can be seen from within developed recreation sites will meet a VQO of retention in the foreground and partial retention in the middle ground.
- Best management practices and soil quality standards apply to all management activities.
- Riparian reserve standards and guidelines apply to all management activities within riparian reserves.

21.2.2 State

California Water Plan

The California Water Plan provides a framework for water supply planning for the state. It identifies and evaluates existing and proposed statewide demand, water supply programs, and projects to address the state's water supply needs.

DWR is responsible for the preparation of the California Water Plan and the management of the state's surface water and groundwater resources. DWR also oversees California's SWP and the regulation and protection of dams, assists local agencies in preparing urban water management plans, and reviews the plans to ensure compliance with the Urban Water Management Act.

The State Water Resources Control Board (SWRCB) has broad authority over water rights and regulations for the state. SWRCB and its nine regional water quality control boards administer water rights and enforce pollution control standards throughout the state. SWRCB is responsible for granting water rights through an appropriation process following public hearings and requisite environmental review by applicants and responsible agencies. In granting water rights permits, SWRCB must consider all beneficial uses, including water for downstream human and environmental needs.

Water suppliers must obtain a permit from the Department of Public Health, Office of Drinking Water, for a community water system, defined as a "public water system that serves at least 15 service connections used by year-round residents or regularly serves at least 25 year-round residents of the area served by the system" (42 Code of Federal Regulations Section 300f).

Water Quality Control Plan for the Sacramento and San Joaquin River Basins

The Water Quality Control Plan for the Sacramento and San Joaquin River Basins (Basin Plan) provides guidance for wastewater and stormwater facilities and development that could affect water quality in the basins. Basin Plan objectives are incorporated into county and city general plans, zoning ordinances, building codes, and subdivision ordinances. Central Valley Regional Water Quality Control Board is responsible for issuing and enforcing waste discharge requirements, including discharge prohibitions and user reuse requirements for wastewater reclamation projects.

Nonhazardous Solid Waste Disposal Standards

Title 14, Chapter 3, of the California Code of Regulations provides minimum standards for solid waste handling and disposal in California and pertains to nonhazardous solid waste management. The California Department of Resources Recycling and Recovery is a new department in the California Natural Resources Agency that administers the programs formerly managed by the California Integrated Waste Management Board, including the regulation of nonhazardous solid waste facilities in the state.

Hazardous Waste Control Act

The California Hazardous Waste Control Act governs hazardous waste management and cleanup in California (Health and Safety Code, Ch. 6.5–6.98). The act mirrors the RCRA and imposes a "cradle to grave" regulatory system for handling hazardous waste in a manner that protects human health and the environment. County Environmental Health Departments and California

Environmental Protection Agency Certified Unified Program Agencies assume responsibility for enforcing local hazardous waste reporting requirements. Sites that store, handle, or transport specified quantities of hazardous materials are inspected annually. California Environmental Protection Agency, Department of Toxic Substances Control, regulates the generation, transportation, treatment, storage, and disposal of hazardous waste under the RCRA and the State Hazardous Waste Control Act.

California Public Utilities Code

The California Public Utilities Code has broad regulatory authority over public utilities in California, which include electrical utilities, mutual water companies, private energy producers, telephone corporations, and railroad corporations. The California Public Utilities Commission is the government body that administers the California Public Utilities Code. The California Public Utilities Commission issued Order-95 to provide safety standards for construction of power transmission facilities.

21.2.3 Regional and Local

City and County General Plans

The general plans for the counties and cities in the primary and extended study areas contain policies regarding utilities and services systems. Water supply, wastewater treatment, solid waste disposal, and utilities are subjects covered in the general plans and are considered essential public services required by all types and densities of development.

21.3 Environmental Consequences and Mitigation Measures

21.3.1 Methods and Assumptions

Evaluation of potential utility and services system impacts was based on a review of planning documents pertaining to the primary and extended study areas, including the STNF LRMP, Department of Toxic Substances Control databases, and the general plans for the cities of Redding and Red Bluff, the City of Shasta Lake, and Shasta and Tehama counties. The analysis also uses an inventory of utilities and service system infrastructure in the primary study area as it relates to the SLWRI.

Effects on water supply in the Shasta Lake and vicinity portion of the primary study area were evaluated based on construction and operational activities that would result from project implementation. It was generally assumed that construction activities associated with modifying Shasta Dam could result in short-term effects on the delivery of local water supplies if the surface elevation of the reservoir were lowered to accommodate construction. A long-term effect would result if project operation would create a substantial disruption or reduction in the distribution or quantity of water supply.

Impacts on utilities and service systems were evaluated based on the duration and extent to which such services would be affected, as well as the ability of the service provider to continue to provide a level of service that could meet the needs of the public. The evaluation compares the duration of the effect with the service provided, taking into account the ability of the provider to maintain necessary services through alternative means.

21.3.2 Criteria for Determining Significance of Effects

An environmental document prepared to comply with NEPA must consider the context and intensity of the environmental effects that would be caused by, or result from, the proposed action. Under NEPA, the significance of an effect is used solely to determine whether an Environmental Impact Statement must be prepared. An environmental document prepared to comply with CEQA must identify the potentially significant environmental effects of a proposed project. A "[s]ignificant effect on the environment" means a substantial, or potentially substantial, adverse change in any of the physical conditions within the area affected by the project (CEQA Guidelines, Section 15382). CEQA also requires that the environmental document propose feasible measures to avoid or substantially reduce significant environmental effects (CEQA Guidelines, Section 15126.4(a)).

The following significance criteria were developed based on guidance provided by State CEQA Guidelines and consider the context and intensity of the environmental effects as required under NEPA. An alternative was determined to result in a significant effect related to utilities and service systems if it would result in any of the following:

- Not comply with published local, State, or Federal statutes, regulations, or standards relating to solid waste
- Exceed permitted landfill capacity with waste generated by the project
- Degrade the level of service of a public utility or services system
- Require relocating utility infrastructure
- Exceed wastewater treatment requirements of the applicable SWRCB
- Exceed water supplies available to service the project from existing entitlements and resources, such that new or expanded entitlements would be needed
- Disrupt utilities service to create a public health hazard or extended service disruption

- Require substantial improvements to the infrastructure or level of staffing of a utility or services system to maintain its existing level of service

- Require or result in the construction of new water treatment, wastewater treatment, or stormwater drainage facilities, or the expansion of such existing facilities, the construction of which could cause significant environmental effects

21.3.3 Topics Eliminated from Further Consideration

The action alternatives would increase availability of water supply for water users on the Sacramento River and Delta. Increased water supplies might increase demand for new or expanded wastewater plants that discharge to the Sacramento River or Delta. SWRCB has review, approval, and permitting authority over operation of new or expanded wastewater treatment plants, and the environmental effects of approving wastewater treatment plants must be evaluated under CEQA. If approved, wastewater treatment plants must operate within the limits established in the waste discharge requirements issued by SWRCB. Although increased water supplies might increase demand for new or expanded wastewater plants that discharge to the Sacramento River or Delta, it is speculative to assume that SWRCB would approve new or expanded wastewater treatment plants. Therefore, increased discharge of treated wastewater into the Sacramento River or Delta that is not currently authorized as a result of this project (and that has not already been evaluated under CEQA) is not reasonably foreseeable and is eliminated from further consideration.

21.3.4 Direct and Indirect Effects

Utilities and service system impacts in the Shasta Lake and vicinity and upper Sacramento River (Shasta Dam to Red Bluff) of the primary study area caused by project construction and operation are described below. Only minimal, if any, project-related impacts to utilities and service systems are expected to occur downstream from Red Bluff Diversion Dam or in the remainder of the extended study area.

No-Action Alternative

Shasta Lake and Vicinity, Upper Sacramento River (Shasta Dam to Red Bluff), Lower Sacramento and Delta, and CVP/SWP Service Areas The impact discussion for the No-Action Alternative addresses all three study areas together, because this alternative would not impact utilities in either of the three study areas.

Impact Util-1 (No-Action): Damage or Disruption of Public Utility and Service Systems Infrastructure Under the No-Action Alternative, no new facilities would be constructed and no existing facilities would be altered, expanded, or demolished. Therefore, no damage to public utilities infrastructure or temporary disruption of services in the vicinity of Shasta Lake would occur from

implementing the No-Action Alternative. There would be no impact. Mitigation is not required for the No-Action Alternative.

Impact Util-2 (No-Action): Utility Infrastructure Relocation or Modification Under the No-Action Alternative, no new facilities would be constructed and no existing facilities would be altered, expanded, or demolished. Therefore, relocation or modification of existing utilities infrastructure in the vicinity of Shasta Lake would not occur from implementing the No-Action Alternative. There would be no impact. Mitigation is not required for the No-Action Alternative.

Impact Util-3 (No-Action): Short-Term Increase in Solid Waste Generation Under the No-Action Alternative, no new facilities would be constructed and no existing facilities would be altered, expanded, or demolished. Therefore, no solid waste would be generated as a result of implementing the No-Action Alternative. There would be no impact. Mitigation is not required for the No-Action Alternative.

Impact Util-4 (No-Action): Increases in Solid Waste Generation from Increased Recreational Opportunities Under the No-Action Alternative, no new facilities would be constructed and no existing facilities would be altered, expanded, or demolished. Therefore, no solid waste associated with increased recreational opportunities would be generated as a result of implementing the No-Action Alternative. There would be no impact. Mitigation is not required for the No-Action Alternative.

Impact Util-5 (No-Action): Increased Demand for Water Treatment and Distribution Facilities Resulting from Increases in Water Supply Under the No-Action Alternative, no new facilities would be constructed and no existing facilities would be altered, expanded, or demolished. Therefore, increased demand for water treatment and distribution facilities related to increases in water supply would not occur from implementing the No-Action Alternative. Mitigation is not required for the No-Action Alternative.

CP1 – 6.5-Foot Dam Raise, Anadromous Fish Survival and Water Supply Reliability

Utilities and service systems impacts would occur primarily in the Shasta Lake and vicinity portion of the primary study area. The majority of impacts identified would be short-term impacts resulting from the abandonment and relocation of utilities and service systems. Individual utilities or service systems are discussed where project detail is available. However, stormwater, wastewater, solid waste management, and water supply systems are also referred to as service systems when a general reference to all of the systems would be appropriate; and electrical service and infrastructure, natural gas service and infrastructure, and telecommunications service and infrastructure are referred to as utilities when a general reference to all of the utilities would be appropriate.

Shasta Lake and Vicinity and Upper Sacramento River (Shasta Dam to Red Bluff) The impact discussion for CP1 addresses the Shasta Lake and Vicinity and Upper Sacramento River study areas together, because impacts from construction activities would affect both study areas.

Impact Util-1 (CP1): Damage or Disruption of Public Utility and Service Systems Infrastructure Project construction activities could damage public utility and service systems infrastructure, which could result in short-term disruptions of service. Construction activities would occur in areas proposed for utilities or service systems abandonment and relocation. Project implementation could require disruption of public utilities or service systems to accommodate construction activity. This impact would be potentially significant.

The quantity of utility and service systems infrastructure relocation varies for the developed areas in the general vicinity of Shasta Lake. The bulk of the work would be done along the shores of the Sacramento Arm, the most developed portion of Shasta Lake. Utility abandonment and relocation would take approximately 36 months. Some service systems construction would occur in the upper Sacramento River portion of the primary study area, primarily at the Shasta Dam compound. Disruptions of utilities service in the upper Sacramento River area could result from project implementation and are discussed below.

Project construction activities associated with abandonment and relocation of utilities and service systems infrastructure could damage existing public utility lines. Excavation activities, vegetation clearing, and heavy equipment operations could accidentally damage utility lines or service system pipes/ditches, which could result in a disruption of public utilities or service systems.

Reclamation inventoried utilities and service systems on lands surrounding Shasta Lake that could be inundated by an increased reservoir elevation. Based on Reclamation's inventory, a 6.5-foot raise in the level of Shasta Lake would require abandonment and relocation of approximately 31,000 feet (5.8 miles) of power lines and 35,000 feet (6 miles) of telecommunications lines. Power and telecommunications facilities that could be inundated and that would require relocation include transmission towers, power poles, underground power and telecommunications lines, above-ground power and telecommunications lines, and cable lines. Approximately 20 percent of the power transmission facilities that could be inundated would consist of high voltage power lines; the remaining 80 percent would consist of low voltage power lines. Numerous individual onsite wastewater systems and stormwater systems (primarily adjacent to roads) would be relocated to areas that would not be affected under CP1 (Figure 21-2). The Utilities and Miscellaneous Minor Infrastructure Technical Memorandum shows detailed maps of the utilities in the ancillary areas that would need to be demolished or relocated (Reclamation 2007).

Disruptions in services resulting from damage to utility lines would likely be localized because the majority of power and telecommunication lines that would require relocation serve the local population around Shasta Lake. Reclamation or project contractors would likely repair potential infrastructure damage immediately after discovery of the damage. Therefore, disruptions of public utilities in the Shasta Lake and vicinity portion of the primary study area would not continue for extended periods of time. However, periodic service disruptions could occur throughout the 36-month construction period, which could inconvenience the local population.

Project construction activities associated with raising Shasta Dam could damage existing public utilities infrastructure and result in disruptions of public utilities service in the primary study area. Activities that could damage public utilities at the dam and result in disruptions of service include drilling activities, heavy equipment operations, and other worksite accidents. As explained above, infrastructure damage would be repaired immediately. If hydropower generation is interrupted at Shasta Dam, repair time could be extended and there would be prolonged impacts to the upper Sacramento River portion of the primary study area.

Public utilities or service systems could be disrupted during construction activities that require a temporary shut-off for safety or mechanical purposes. This effect would be most likely to occur in the Shasta Lake and vicinity portion of the primary study area because of the amount of project construction in that area relating to local utilities and service systems relocation activities. Occasional disruptions of public utilities could also occur in the upper Sacramento River area because of construction activities at Shasta Dam that require temporary power outages. Construction activities in the immediate vicinity of the Shasta Dam compound could occasionally impact the treatment and delivery of water to the City of Shasta Lake. This impact would be short term and would continue intermittently until project construction activities were completed. Construction would take approximately 36 months.

To minimize potential disruption of service and damage to the utilities and service systems infrastructure, project contractors would follow local, State, and Federal regulations pertaining to utilities and service systems location and construction. However, the magnitude of the project and number of utilities and service systems requiring relocation make it likely that utilities or service systems could be damaged or services disrupted. Therefore, this impact would be potentially significant. Mitigation for this impact is proposed in Section 21.3.5.

Impact Util-2 (CP1): Utility Infrastructure Relocation or Modification Project implementation would require relocation or modification of utilities infrastructure, which could result in localized impacts on vegetation, land use, transportation, wildlife, noise, air quality, water quality, and utilities service. This impact would be potentially significant.

In general, short-term impacts that could result from relocation of utilities infrastructure would be localized (Shasta Lake and vicinity) and could include disruptions caused by noise, traffic, and dust associated with construction activities. Relocation of utilities infrastructure could result in localized long-term impacts related to visual quality, land use, vegetation, transportation, water quality, air quality, noise, and wildlife in the Shasta Lake and vicinity portion of the primary study area; these impacts are discussed in separate Environmental Impact Statement/Environmental Impact Report chapters. Some utilities infrastructure would also be modified in the upper Sacramento River portion of the primary study area, particularly in the general vicinity of the Shasta Dam compound.

As discussed in Impact Util-1 (CP1), project construction and operation would result in relocation and/or modification of utilities infrastructure at Shasta Dam and in communities in the Shasta Lake and vicinity portion of the primary study area (Figures 21-1 and 21-2). The infrastructure components include water and wastewater service and electrical infrastructure, telephone lines, and cable lines. Proposed infrastructure relocation was based on (1) whether utilities components would be inundated by an increased lake elevation and (2) whether the inundation would warrant relocation or permanent abandonment.

The largest potentially impacted residential developments near Shasta Lake are in the Lakeshore and Sugarloaf areas. Recreational facilities (e.g., campgrounds and marinas) would also change substantially. The quantity of services and utilities infrastructure reconstruction varies around Shasta Lake with an emphasis on the Sacramento, McCloud, and Pit arms as well as the Main Body. Abandonment and relocation of utilities infrastructure would take 36 months. The Utilities and Miscellaneous Minor Infrastructure Technical Memorandum shows detailed maps of the utilities in the ancillary areas that would need to be demolished or relocated (Reclamation 2007).

Consistent with Shasta County Development Standards, septic systems within 200 feet of the new full pool waterline or 100 feet downslope of the new full pool waterline would be demolished. Wastewater pipes, septic tanks, vaults/pits, and leachfields would be abandoned in place, and restroom buildings and contents would be removed and taken to an approved landfill. Relocation of septic systems in the project area would be done in one of two ways: (1) construct new septic systems on the property of the impacted home or facility, where feasible, or (2) define a possible localized wastewater treatment plant alternative for homes that do not meet Shasta County requirements for septic system separation from the lake. The general wastewater treatment plant would include a pressurized sewer collection system to transport wastewater flows to several centralized package wastewater treatment plants. Localized wastewater treatment plants would likely be constructed to serve the areas of Salt Creek, Sugarloaf/Tsadi Resort, Lakeshore (possibly several plants), Antlers Campground, Campbell Creek Cove, Bridge Bay Marina, Silverthorn Resort, and Jones Valley.

Wastewater treatment plant operation can result in undesirable environmental effects. For example, discharge of treated wastewater could impact the water quality of Shasta Lake, pump stations could generate unwanted noise, and the treatment process could generate undesirable odors. The environmental impacts of constructing and operating wastewater treatment facilities are evaluated in the pertinent technical chapters of the Environmental Impact Statement/Environmental Impact Report.

Power lines and telecommunications lines usually follow parallel alignment and typically use the same power pole. Some of the utility lines serving individual houses, businesses, government facilities, and cabins are routed underground. All transmission towers, power poles, underground power lines, and telecommunications lines that would be inundated under CP1 would need to be removed and relocated.

Low-voltage power lines, telecommunications lines, or power poles located within 50 feet of the CP1 maximum lake elevation would be considered threatened by inundation, and high voltage power lines and towers located within 100 feet would be considered inundated. Relocation of utilities infrastructure would be consistent with applicable local, State, and Federal requirements.

CP1 would inundate 31,060 feet (approximately 5.8 miles) of power lines and 35,000 feet (about 6 miles) of telecommunications lines near Shasta Lake. All associated transmission towers, power poles, underground power lines, telecommunications lines, and cable lines that would be inundated under CP1 would need to be removed and relocated.

Relocation of infrastructure would include vegetation removal, which would result in project impacts. Clearing of vegetation would be required to provide space for utilities structures and to create a safety buffer. Reclamation would clear the appropriate space for utilities infrastructure as provided by local, State, and Federal regulations. Additional space could be cleared to provide the highest level of safety for project operation and maintenance. In addition, Reclamation would apply the National Electric Safety Code, a voluntary safety code followed by the utilities industry, to ensure that relocated infrastructure would operate as safely or safer than existing utilities. Widths of vegetation clearance would range from 40 to 75 feet. Cleared areas could be wider, depending on site-specific conditions, such as on steep slopes or when tall trees are nearby.

Impacts resulting from vegetation clearing associated with relocation of utilities infrastructure would be minimized where possible. When possible, Reclamation would locate utilities corridors in sites that are not heavily forested to minimize vegetation clearing. Where heavily forested areas cannot be avoided for relocation of utilities infrastructure, Reclamation would coordinate vegetation removal with USFS and other landowners/managers to minimize impacts.

Relocation of utilities infrastructure would require additional roads for construction and maintenance of the new facilities. Roads would be constructed in the rights-of-way of the cleared utility lines and would be constructed according to the appropriate jurisdiction's standards (i.e., USFS or Shasta County). New roads serving relocated utilities infrastructure would be located and designed to prevent erosion and avoid geologic hazards.

As discussed in Chapter 20, "Transportation and Traffic," some work in the road relocation areas could require a road closure with detours, lane closures, or a combination of both. Road closures would temporarily impede access to local connector roads and recreational land uses, affecting residents, local recreational and nonrecreational businesses, and visitors to Shasta Lake.

To minimize potential impacts resulting from relocation of utilities infrastructure, Reclamation and project contractors would follow local, State, and Federal regulations pertaining to installation of utilities infrastructure, the STNF LRMP standards and guidelines, and the Shasta County General Plan and zoning guidance. Before vacating a street or public service easement, the Shasta County Board of Supervisors must consider applicable consistency with the general plan. Shasta County Streets and Highways Code Section 8313 and Public Utilities Code Section 12808.5 require cities and counties approving electrical transmission and distribution lines of municipal utilities districts to make a finding concerning the consistency of the lines with the general plan.

Reclamation is committed to funding the demolition and relocation of existing infrastructure and construction of replacement infrastructure, including localized wastewater treatment plants that might replace some individual septic systems. Reclamation is also committed to facilitating establishment of community services districts and transferring plant ownership to the districts, which would be responsible for long-term operation and management.

Project implementation would result in relocation or modification of utilities infrastructure. The extent of relocation of utilities infrastructure and/or modification that would be necessary could result in short-term impacts on noise, traffic, and utilities services; and project implementation could result in long-term impacts on land use, wildlife, water quality, and soils. Therefore, this impact would be potentially significant. Mitigation for this impact is proposed in Section 21.3.5.

Impact Util-3 (CP1): Short-Term Increase in Solid Waste Generation Project implementation would result in a short-term increase of solid waste generation during construction activities. The project would not generate construction waste materials that would exceed the capacity of local landfills. This impact would be less than significant.

Demolition and construction activities would generate waste materials, including concrete, metal, and other materials from the dam renovation;

structural metal, concrete, and wood from demolished bridges and buildings; concrete and asphalt from relocated boat launch facilities; unusable recreation equipment from relocated campgrounds and picnic areas; cables, pumps, wiring, and power towers from utility relocations; and scrap material generated as a byproduct of construction. Demolition and construction waste for CP1 would total about 176,627 cubic yards. Reclamation's contractors will take measures to recycle or reuse demolished materials, such as steel or copper wire, where practical. Therefore, some of the demolition and construction waste would be brought to nearby recycling facilities. Hazardous materials (e.g., asbestos, if found) would be brought to an approved hazardous waste landfill for disposal. Much of the underground utilities and service systems proposed for abandonment would be abandoned in place and would not be removed to a landfill or recycling facility.

Table 21-1 provides a summary of project-generated solid waste for the five action alternatives.

Table 21-1. Waste Generated by Project Construction

Feature	Estimated Volume (cubic yards)		
	CP1	CP2	CP3, CP4, CP5
Vehicle bridge replacements	10,700	10,700	10,700
Doney Creek UPRR bridge replacement	4,718	4,718	7,334
Sacramento River UPRR second crossing	15,558	15,558	15,558
Pit River Bridge piers 3 and 4 protection	0	0	0
Railroad realignment	2,420	2,420	2,420
Major road relocations	10,980	20,659	23,516
Reservoir area utilities (removals/relocations)	1,364	3,251	4,070
Reservoir area recreation (removals/relocations)	99,240	102,076	105,220
Main dam	2,263	1,553	1,553
Outlet works	388	388	388
Spillway	18,305	16,590	12,765
Temperature control device modification	20	20	20
Powerplant and penstocks	0	0	0
Right wing dam	531	511	511
Left wing dam	8,630	8,630	8,630
Visitor Center Replacement	1,510	1,510	1,510
Reservoir area dikes	0	0	0
Pit 7 modifications	0	0	0
Total	176,627	188,584	194,195

Key:
CP = Comprehensive Plan
UPRR = Union Pacific Railroad

Two landfills are currently operational in Shasta County: the West Central Landfill and the Anderson Landfill. The West Central Landfill, in the City of Redding, is the closest facility to Shasta Dam and would likely receive the majority of solid waste generated during construction. This landfill has sufficient permitted capacity to accommodate solid waste disposal needs during construction of the project. CP1 would generate roughly 176,627 cubic yards of solid waste; however, the West Central Landfill has a remaining capacity of approximately 5,000,000 cubic yards, and the Anderson Landfill has a remaining capacity of approximately 11,000,000 cubic yards. Recycling of demolition and construction waste materials would further reduce the volume of waste disposed at landfills.

Three commercial hazardous waste landfills operate in Southern California. Utilities poles, materials containing asbestos or lead-based paints, and transformers containing polychlorinated biphenyls would be sent to one of these landfills or to another EPA-permitted hazardous waste facility.

Solid waste generated by the project would be a short-term impact. Furthermore, accepting the project waste would not impair solid waste facilities that would serve the project. Therefore, the impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact Util-4 (CP1): Increases in Solid Waste Generation from Increased Recreational Opportunities Project implementation could result in more recreationists in and around Shasta Lake, on streams near Shasta Lake, and along the upper Sacramento River, which could cause incremental increases in the amount of solid waste generated. However, multiple landfills are located throughout the region with adequate capacity for disposal of solid waste generated from implementation of the project. Therefore, this impact would be less than significant.

Implementation of the project could increase and enhance recreational opportunities in and around Shasta Lake, on streams near Shasta Lake, and along the upper Sacramento River. Additional recreationists could incrementally increase the amount of solid waste generated. Multiple landfills, including the West Central Landfill, the Anderson Landfill, and the Tehama County/Red Bluff Landfill, are located in the project region and have a substantial amount of available capacity. Private transfer stations are located throughout the region as well. These multiple facilities have adequate capacity for disposal of solid waste generated by implementation of the project (CIWMB 2008). Therefore, this impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact Util-5 (CP1): Increased Demand for Water Treatment and Distribution Facilities Resulting from Increases in Water Supply It is reasonable to assume that the increased water supply expected under this alternative would increase demand for construction and operation of water treatment and distribution

facilities within the CVP service area. No information is currently available about future water facilities that might be built in response to the expected increase in water supply. Therefore, it is not possible to evaluate the environmental effects of building and operating such facilities. Such an evaluation would be remote and speculative and, therefore, is not provided in this document. Mitigation for this impact is not needed, and thus not proposed.

Lower Sacramento River and Delta and CVP/SWP Service Areas
Impact Util-6 (CP1): Damage or Disruption of Public Utility and Service Systems Infrastructure Construction would not occur outside of the primary study area; therefore, there would be no impact related to temporary disruption of utilities during construction in the extended study area. Mitigation for this impact is not needed, and thus not proposed.

Impact Util-7 (CP1): Utility Infrastructure Relocation or Modification
Construction would not occur outside of the primary study area; therefore, there would be no impact related to relocation or modification of utilities infrastructure in the extended study area. Mitigation for this impact is not needed, and thus not proposed.

Impact Util-8 (CP1): Short-Term Increase in Solid Waste Generation
Construction would not occur outside of the primary study area; therefore, there would be no impact related to increases in solid waste generation from construction activities in the extended study area. Mitigation for this impact is not needed, and thus not proposed.

Impact Util-9 (CP1): Increases in Solid Waste Generation from Increased Recreational Opportunities Increased recreational opportunities resulting from project implementation would not occur outside of the primary study area; therefore, no impacts related to increases in solid waste generation from increased recreational opportunities would occur in the extended study area. Mitigation for this impact is not needed, and thus not proposed.

Impact Util-10 (CP1): Increased Demand for Water Treatment and Distribution Facilities Resulting from Increases in Water Supply It is reasonable to assume that the increased water supply expected under this alternative would increase demand for construction and operation of water treatment and distribution facilities within the extended study area. No information is currently available about future water facilities that might be built in response to the expected increase in water supply. Therefore, it is not possible to evaluate the environmental effects of building and operating such facilities. Such an evaluation would be remote and speculative and, therefore, is not provided in this document. Mitigation for this impact is not needed, and thus not proposed.

CP2 – 12.5-Foot Dam Raise, Anadromous Fish Survival and Water Supply Reliability

Shasta Lake and Vicinity and Upper Sacramento River (Shasta Dam to Red Bluff) The impact discussion for CP2 addresses the Shasta Lake and Vicinity and Upper Sacramento River study areas together, because impacts from construction activities would affect both study areas.

Impact Util-1 (CP2): Damage or Disruption of Public Utility and Service Systems Infrastructure Project implementation could damage public utilities and service systems infrastructure, which could result in short-term disruptions of service. The potential exists for construction activities to damage or interfere with utilities and service systems infrastructure and, thus, service, during construction operations. Construction activities would occur in areas proposed for abandonment of utilities or service systems, and implementation of relocation projects could require disruption of public utilities or services to accommodate construction activity. This impact would be potentially significant.

This impact would be similar to Impact Util-1 (CP1). An increase in the height of the dam could result in a larger area of inundation and additional infrastructure and service systems construction activities. Construction activities for CP2 would take longer than for CP1 and would extend the duration of impacts resulting from CP2. CP2 would require the relocation of approximately 5,000 more feet of power lines, about 2,000 more feet of telecommunications lines, and take approximately 12 more months than CP1. Additional service systems would need to be demolished and/or relocated for CP2.

Project implementation could damage public utilities and service systems infrastructure, or result in short-term disruption of utilities and service systems service. Therefore, this impact would be potentially significant. Mitigation for this impact is proposed in Section 21.3.5.

Impact Util-2 (CP2): Utility Infrastructure Relocation or Modification Project implementation would require relocation or modification of utilities infrastructure, which could result in localized impacts on vegetation, land use, transportation, wildlife, noise, water quality, and utility service. This impact would be potentially significant.

This impact would be similar to Impact Util-2 (CP1). An increase in the height of the dam could result in a larger area of inundation, which would result in additional relocation or modification of utilities infrastructure compared to Util-1 (CP1). Construction activities for CP2 would take longer than for CP1 and would extend the duration of impacts resulting from CP2. CP2 would require the relocation of approximately 5,000 more feet of powers lines and associated transmission facilities, relocation of about 2,000 more feet of telecommunications lines and associated facilities, and take approximately 8

more months than CP1. Additional vegetation clearing would also be required to accommodate relocation of infrastructure.

Project implementation could result in localized impacts on vegetation, land use, transportation, wildlife, noise, water quality, and utilities service. Therefore, this impact would be potentially significant. Mitigation for this impact is proposed in Section 21.3.5.

Impact Util-3 (CP2): Short-Term Increase in Solid Waste Generation Project implementation would result in a short-term increase of solid waste generation during construction activities. The project would not generate construction waste materials that would exceed the capacity of local landfills. This impact would be less than significant.

This impact would be similar to Impact Util-3 (CP1). An increase in the height of the dam would result in a larger area of inundation, which could result in a greater potential for generation of construction waste materials compared to Impact Util-1 (CP1). CP2 would generate roughly 188,584 cubic yards of solid waste (see Table 21-1). Similar to CP1, the anticipated increase in the amount of solid waste generated during construction of this alternative would still be sufficiently handled by the three local landfills and permitted hazardous waste landfills. Therefore, this impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact Util-4 (CP2): Increases in Solid Waste Generation from Increased Recreational Opportunities Project implementation could result in more recreationists around Shasta Lake, on streams near Shasta Lake, and along the upper Sacramento River, in which could cause incremental increases in the amount of solid waste generated. However, multiple landfills are located throughout the region with adequate capacity for disposal of solid waste generated from implementation of the project. Therefore, this impact would be less than significant.

This impact would be similar to Impact Util-4 (CP1). An increase in the height of the dam could result in a larger area of inundation, which could result in more recreationists and greater potential for generation of solid waste materials than with Impact Util-1 (CP1). The anticipated increase in the amount of construction waste generated during long-term operation of this alternative is expected to be sufficiently handled by the three local landfills, which have a substantial amount of available capacity. Therefore, this impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact Util-5 (CP2): Increased Demand for Water Treatment and Distribution Facilities Resulting from Increases in Water Supply Similar to CP1, it is reasonable to assume that the increased water supply expected under CP2 would increase demand for construction and operation of water treatment and distribution facilities. However, evaluation of the environmental effects of

building and operating such facilities would be remote and speculative and, therefore, is not provided in this document. Mitigation for this impact is not needed, and thus not proposed.

Lower Sacramento River and Delta and CVP/SWP Service Areas
Impact Util-6 (CP2): Damage or Disruption of Public Utility and Service Systems Infrastructure Construction would not occur outside of the primary study area; therefore, there would be no impact related to temporary disruption of utilities service during construction in the extended study area. Mitigation for this impact is not needed, and thus not proposed.

Impact Util-7 (CP2): Utility Infrastructure Relocation or Modification Construction would not occur outside of the primary study area; therefore, there would be no impact related to relocation or modification of utilities infrastructure in the extended study area. Mitigation for this impact is not needed, and thus not proposed.

Impact Util-8 (CP2): Short-Term Increase in Solid Waste Generation Construction would not occur outside of the primary study area; therefore, there would be no impact related to increases in solid waste generation from construction activities in the extended study area. Mitigation for this impact is not needed, and thus not proposed.

Impact Util-9 (CP2): Increases in Solid Waste Generation from Increased Recreational Opportunities Increased recreational opportunities resulting from project implementation would occur only in the primary study area; therefore, no impacts related to increases in solid waste generation from increased recreational opportunities would occur in the extended study area. Mitigation for this impact is not needed, and thus not proposed.

Impact Util-10 (CP2): Increased Demand for Water Treatment and Distribution Facilities Resulting from Increases in Water Supply Similar to CP1, it is reasonable to assume that the increased water supply expected under CP2 would increase demand for construction and operation of water treatment and distribution facilities within the extended study area. However, evaluation of the environmental effects of building and operating such facilities would be remote and speculative and, therefore, is not provided in this document.

CP3 – 18.5-Foot Dam Raise, Anadromous Fish Survival and Water Supply
Shasta Lake and Vicinity/Upper Sacramento River (Shasta Dam to Red Bluff) The impact discussion for CP3 addresses the Shasta Lake and Vicinity and Upper Sacramento River study areas together, because impacts from construction activities would affect both study areas.

Impact Util-1 (CP3): Damage or Disruption of Public Utility and Service Systems Infrastructure Project implementation could damage public utilities and service systems infrastructure, which could result in short-term disruptions

of service. The potential exists for construction activities to damage or interfere with utilities and service systems infrastructure and, thus, service during construction operations. Construction activities would occur in areas proposed for abandonment and relocation of utilities or service systems. Project implementation could require disruption of public utilities or services to accommodate construction activity. This impact would be potentially significant.

This impact would be similar to Impact Util-1 (CP1). An increase in the height of the dam could result in a larger area of inundation and additional infrastructure and service systems construction activities. Construction activities for CP3 would take longer than for CP1 and would extend the duration of impacts resulting from CP3. CP3 would require the relocation of approximately 7,500 more feet of power lines and about 5,000 more feet of telecommunications lines and take approximately 24 more months than CP1. Additional service systems would need to be demolished and/or relocated for CP3 to prevent inundation.

Project implementation could damage public utility and service systems infrastructure, or result in short-term utility and service systems service. Therefore, this impact would be potentially significant. Mitigation for this impact is proposed in Section 21.3.5.

Impact Util-2 (CP3): Utility Infrastructure Relocation or Modification Project implementation would require relocation or modification of utility infrastructure, which could result in localized impacts on vegetation, land use, transportation, wildlife, noise, water quality, and utility service. This impact would be potentially significant.

This impact would be similar to Impact Util-2 (CP1). An increase in the height of the dam could result in a larger area of inundation, which would result in additional relocation or modification of utility infrastructure compared to Impact Util-1 (CP1). Construction activities for CP3 would take longer than for CP1 and would extend the duration of impacts resulting from CP3. CP3 would require the relocation of approximately 7,500 more feet of power lines and associated transmission facilities and about 5,000 more feet of telecommunications lines and associated facilities; CP3 would take approximately 24 more months than CP1 to implement. Additional vegetation clearing would also be required to accommodate infrastructure relocation.

Project implementation could result in localized impacts on vegetation, land use, transportation, wildlife, noise, water quality, and utility service. Therefore, this impact would be potentially significant. Mitigation for this impact is proposed in Section 21.3.5.

Impact Util-3 (CP3): Short-Term Increase in Solid Waste Generation Project implementation would result in a short-term increase of solid waste generation

during construction activities. The project would not generate construction waste materials that would exceed the capacity of local landfills. This impact would be less than significant.

This impact would be similar to Impact Util-3 (CP1). An increase in the height of the dam would result in a larger area of inundation, which could result in a greater potential for generation of construction waste materials compared to Impact Util-1 (CP1). CP3 would generate roughly 194,195 cubic yards of solid waste (see Table 21-1). Similar to CP1, the anticipated increase in the amount of solid waste generated during construction of this alternative would still be sufficiently handled by the three local landfills and permitted hazardous waste landfills. Therefore, this impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact Util-4 (CP3): Increases in Solid Waste Generation from Increased Recreational Opportunities Project implementation could result in more recreationists in and around Shasta Lake, on streams near Shasta Lake, and along the upper Sacramento River, creating incremental increases in the amount of solid waste generated. However, multiple landfills are located throughout the region with adequate capacity for disposal of solid waste generated from implementation of the project. Therefore, this impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

This impact would be similar to Impact Util-4 (CP1). An increase in the height of the dam could result in a larger area of inundation, which could result in more recreationists and greater potential for generation of solid waste materials compared to Impact Util-1 (CP1). The anticipated increase in the amount of solid waste generated during long-term operation of this alternative would be handled by the three local landfills and permitted hazardous waste landfills. Therefore, this impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact Util-5 (CP3): Increased Demand for Water Treatment and Distribution Facilities Resulting from Increases in Water Supply Similar to CP1, it is reasonable to assume that the increased water supply expected under CP3 would increase demand for construction and operation of water treatment and distribution facilities. However, evaluation of the environmental effects of building and operating such facilities would be remote and speculative and, therefore, is not provided in this document. Mitigation for this impact is not needed, and thus not proposed.

Lower Sacramento River and Delta/CVP/SWP Service Areas

Impact Util-6 (CP3): Damage or Disruption of Public Utility and Service Systems Infrastructure Construction would not occur outside of the primary study area; therefore, there would be no impact related to temporary disruption of utilities service during construction in the extended study area. Mitigation for this impact is not needed, and thus not proposed.

Impact Util-7 (CP3): Utility Infrastructure Relocation or Modification Construction would not occur outside of the primary study area; therefore, there would be no impact related to relocation or modification of utilities infrastructure in the extended study area. Mitigation for this impact is not needed, and thus not proposed.

Impact Util-8 (CP3): Short-Term Increase in Solid Waste Generation Construction would not occur outside of the primary study area; therefore, there would be no impact related to increases in solid waste generation from construction activities in the extended study area. Mitigation for this impact is not needed, and thus not proposed.

Impact Util-9 (CP3): Increases in Solid Waste Generation from Increased Recreational Opportunities Increased recreational opportunities resulting from project implementation would occur only in the primary study area; therefore, no impacts related to increases in solid waste generation from increased recreational opportunities would occur in the extended study area. Mitigation for this impact is not needed, and thus not proposed.

Impact Util-10 (CP3): Increased Demand for Water Treatment and Distribution Facilities Resulting from Increases in Water Supply Similar to CP1, it is reasonable to assume that the increased water supply expected under CP3 would increase demand for construction and operation of water treatment and distribution facilities within the extended study area. However, evaluation of the environmental effects of building and operating such facilities would be remote and speculative and, therefore, is not provided in this document. Mitigation for this impact is not needed, and thus not proposed.

CP4 – 18.5-Foot Dam Raise, Anadromous Fish Focus with Water Supply Reliability

Shasta Lake and Vicinity and Upper Sacramento River (Shasta Dam to Red Bluff) The impact discussion for CP2 addresses the Shasta Lake and Vicinity and Upper Sacramento River study areas together, because impacts from construction activities would affect both study areas.

Impact Util-1 (CP4): Damage or Disruption of Public Utility and Service Systems Infrastructure Project implementation could damage public utilities and service systems infrastructure, which could result in short-term disruptions of service. The potential exists for construction activities to damage or interfere with utilities and service systems infrastructure and, thus, service during construction operations. Construction activities would occur in areas proposed for utilities or service systems abandonment and relocation. Project implementation could require disruption of public utilities or services to accommodate construction activity. This impact would be potentially significant.

This impact would be similar to Impact Util-1 (CP1) and identical to Impact Util-1 (CP3). Therefore, this impact would be potentially significant. Mitigation for this impact is proposed in Section 21.3.5.

Impact Util-2 (CP4): Utility Infrastructure Relocation or Modification Project implementation would require relocation or modification of utilities infrastructure, which could result in localized impacts on vegetation, land use, transportation, wildlife, noise, water quality, and utility service. This impact would be potentially significant.

This impact would be similar to Impact Util-2 (CP1) and identical to Impact Util-2 (CP3). Therefore, this impact would be potentially significant. Mitigation for this impact is proposed in Section 21.3.5.

Impact Util-3 (CP4): Short-Term Increase in Solid Waste Generation Project implementation would result in a short-term increase of solid waste generation during construction activities. The project would not generate construction waste materials that would exceed the capacity of local landfills. This impact would be less than significant.

This impact would be similar to Impact Util-3 (CP3), with a very slight increase in solid waste generation related to downstream restoration construction activities. Therefore, this impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact Util-4 (CP4): Increases in Solid Waste Generation from Increased Recreational Opportunities Project implementation could result in more recreationists in and around Shasta Lake, on streams near Shasta Lake, and along the upper Sacramento River, which could cause incremental increases in the amount of solid waste generated. However, multiple landfills are located throughout the region with adequate capacity for disposal of solid waste generated from project implementation. Therefore, this impact would be less than significant.

This impact would be similar to Impact Util-4 (CP1) and identical to Impact Util-4 (CP3). Therefore, this impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact Util-5 (CP4): Increased Demand for Water Treatment and Distribution Facilities Resulting from Increases in Water Supply Similar to CP1, it is reasonable to assume that the increased water supply expected under CP4 would increase demand for construction and operation of water treatment and distribution facilities. However, evaluation of the environmental effects of building and operating such facilities would be remote and speculative and, therefore, is not provided in this document. Mitigation for this impact is not needed, and thus not proposed.

Lower Sacramento River and Delta and CVP/SWP Service Areas
Impact Util-6 (CP4): Damage or Disruption of Public Utility and Service Systems Infrastructure Construction would not occur outside of the primary study area. Gravel augmentation and the Reading Island habitat restoration along the upper Sacramento River would slightly, but not substantially, increase the potential for temporary disruption of utilities service. This impact is considered less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact Util-7 (CP4): Utility Infrastructure Relocation or Modification No utility infrastructure relocation or modification would occur outside of the primary study area; therefore, there would be no impact related to relocation or modification of utilities infrastructure in the extended study area. Mitigation for this impact is not needed, and thus not proposed.

Impact Util-8 (CP4): Short-Term Increase in Solid Waste Generation Construction would not occur outside of the primary study area. Gravel augmentation and the Reading Island habitat restoration along the upper Sacramento River would generate a nominal amount of solid waste. However, substantial landfill capacity is available to accommodate solid waste generated by these activities. This impact is considered less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact Util-9 (CP4): Increases in Solid Waste Generation from Increased Recreational Opportunities Increased recreational opportunities resulting from project implementation would occur only in the primary study area; therefore, no impacts related to increases in solid waste generation from increased recreational opportunities would occur in the extended study area. Mitigation for this impact is not needed, and thus not proposed.

Impact Util-10 (CP4): Increased Demand for Water Treatment and Distribution Facilities Resulting from Increases in Water Supply Similar to CP1, it is reasonable to assume that the increased water supply expected under CP4 would increase demand for construction and operation of water treatment and distribution facilities within the extended study area. However, evaluation of the environmental effects of building and operating such facilities would be remote and speculative and is, therefore, not provided in this document. Mitigation for this impact is not needed, and thus not proposed.

CP5 – 18.5-Foot Dam Raise, Combination Plan
Shasta Lake and Vicinity and Upper Sacramento River (Shasta Dam to Red Bluff) The impact discussion for CP2 addresses the Shasta Lake and Vicinity and Upper Sacramento River study areas together, because impacts from construction activities would affect both study areas.

Impact Util-1 (CP5): Damage or Disruption of Public Utility and Service Systems Infrastructure Project implementation could damage public utilities

and service systems infrastructure, which could result in short-term disruptions of service. The potential exists for construction activities to damage or interfere with utilities and service systems infrastructure and, thus, service during construction operations. Construction activities would occur in areas proposed for abandonment and relocation of utilities or service systems. Project implementation could require disruption of public utilities or services to accommodate construction activity. This impact would be potentially significant.

This impact would be similar to Impact Util-1 (CP1) and identical to Impact Util-1 (CP3). Therefore, this impact would be potentially significant. Mitigation for this impact is proposed in Section 21.3.5.

Impact Util-2 (CP5): Utility Infrastructure Relocation or Modification Project implementation would require relocation or modification of utilities infrastructure, which could result in localized impacts on vegetation, land use, transportation, wildlife, noise, water quality, and utility service. This impact would be potentially significant.

This impact would be similar to Impact Util-2 (CP1) and identical to Impact Util-2 (CP3). Therefore, this impact would be potentially significant. Mitigation for this impact is proposed in Section 21.3.5.

Impact Util-3 (CP5): Short-Term Increase in Solid Waste Generation Project implementation would result in a short-term increase of solid waste generation during construction activities. The project would not generate construction waste materials that would exceed the capacity of local landfills. This impact would be less than significant.

This impact would be similar to Impact Util-3 (CP4) , with a very slight increase in solid waste generation related to enhancement of tributary and warm-water habitat and recreational trails. Therefore, this impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact Util-4 (CP5): Increases in Solid Waste Generation from Increased Recreational Opportunities Project implementation could result in more recreationists in and around Shasta Lake, on streams near Shasta Lake, and along the upper Sacramento River, which could cause incremental increases in the amount of solid waste generated. However, multiple landfills are located throughout the region with adequate capacity for disposal of solid waste generated from implementation of the project. Therefore, this impact would be less than significant.

This impact would be similar to Impact Util-4 (CP1) and identical to Impact Util-4 (CP3). Therefore, this impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact Util-5 (CP5): Increased Demand for Water Treatment and Distribution Facilities Resulting from Increases in Water Supply Similar to CP1, it is reasonable to assume that the increased water supply expected under CP5 would increase demand for construction and operation of water treatment and distribution facilities. However, evaluation of the environmental effects of building and operating such facilities would be remote and speculative and, therefore, is not provided in this document. Mitigation for this impact is not needed, and thus not proposed.

Lower Sacramento River and Delta and CVP/SWP Service Areas

Impact Util-6 (CP5): Damage or Disruption of Public Utility and Service Systems Infrastructure Construction would not occur outside of the primary study area. Gravel augmentation and the Reading Island habitat restoration along the upper Sacramento River would slightly, but not substantially, increase the potential for temporary disruption of utilities service. This impact is considered less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact Util-7 (CP5): Utility Infrastructure Relocation or Modification No utility infrastructure relocation or modification would occur outside of the primary study area; therefore, there would be no impact related to relocation or modification of utilities infrastructure in the extended study area. Mitigation for this impact is not needed, and thus not proposed.

Impact Util-8 (CP5): Short-Term Increase in Solid Waste Generation Construction would not occur outside of the primary study area. Gravel augmentation and the Reading Island habitat restoration along the upper Sacramento River would generate a nominal amount of solid waste. However, substantial landfill capacity is available to accommodate solid waste generated by these activities. This impact is considered less than significant. Mitigation for this impact is not needed, and thus not proposed.

*Impact Util-9 (CP5): Increases in Solid Waste Generation from Increased Recreational Opportunitie*s Increased recreational opportunities caused by project implementation would occur only in the primary study area; therefore, no impacts related to increases in solid waste generation from increased recreational opportunities would occur in the extended study area. Mitigation for this impact is not needed, and thus not proposed.

Impact Util-10 (CP5): Increased Demand for Water Treatment and Distribution Facilities Resulting from Increases in Water Supply Similar to CP1, it is reasonable to assume that the increased water supply expected under CP5 would increase demand for construction and operation of water treatment and distribution facilities within the extended study area. However, evaluation of the environmental effects of building and operating such facilities would be remote and speculative and, therefore, is not provided in this document. Mitigation for this impact is not needed, and thus not proposed.

21.3.5 Mitigation Measures

Table 21-2 presents a summary of mitigation measures for utilities and service systems.

Table 21-2. Summary of Mitigation Measures for Utilities and Service Systems

Impact		No-Action Alternative	CP1	CP2	CP3	CP4	CP5
Impact Util-1: Damage or Disruption of Public Utility and Service Systems Infrastructure (Shasta Lake and Vicinity and Upper Sacramento River)	LOS before Mitigation	NI	PS	PS	PS	PS	PS
	Mitigation Measure	None required.	Util-1: Implement Procedures to Avoid Damage to or Temporary Disruption of Service.				
	LOS after Mitigation	NI	LTS	LTS	LTS	LTS	LTS
Impact Util-2: Utility Infrastructure Relocation or Modification (Shasta Lake and Vicinity and Upper Sacramento River)	LOS before Mitigation	NI	PS	PS	PS	PS	PS
	Mitigation Measure	None required.	Util-2: Adopt Measures to Minimize Infrastructure Relocation Impacts.				
	LOS after Mitigation	NI	LTS	LTS	LTS	LTS	LTS
Impact Util-3: Short-Term Increase in Solid Waste Generation (Shasta Lake and Vicinity and Upper Sacramento River)	LOS before Mitigation	NI	LTS	LTS	LTS	LTS	LTS
	Mitigation Measure	None required.	None needed; thus none proposed.				
	LOS after Mitigation	NI	LTS	LTS	LTS	LTS	LTS
Impact Util-4: Increases in Solid Waste Generation from Increased Recreational Opportunities (Shasta Lake and Vicinity and Upper Sacramento River)	LOS before Mitigation	NI	LTS	LTS	LTS	LTS	LTS
	Mitigation Measure	None required.	None needed; thus none proposed.				
	LOS after Mitigation	NI	LTS	LTS	LTS	LTS	LTS
Impact Util-5: Increased Demand for Water Treatment and Distribution Facilities Resulting from Increases in Water Supply (Shasta Lake and Vicinity and Upper Sacramento River)	LOS before Mitigation	NI	N/A (RS)	N/A (RS)	N/A (RS)	N/A (RS)	N/A (RS)
	Mitigation Measure	None required.	None needed; thus none proposed.				
	LOS after Mitigation	NI	N/A (RS)	N/A (RS)	N/A (RS)	N/A (RS)	N/A (RS)

Table 21-2. Summary of Mitigation Measures for Utilities and Service Systems (contd.)

Impact		No-Action Alternative	CP1	CP2	CP3	CP4	CP5
Impact Util-6: Damage or Disruption of Public Utility and Service Systems Infrastructure (Lower Sacramento River, Delta, CVP/SWP Service Areas)	LOS before Mitigation	N/A	NI	NI	NI	LTS	LTS
	Mitigation Measure	None required.	None needed; thus none proposed.				
	LOS after Mitigation	N/A	NI	NI	NI	LTS	LTS
Impact Util-7: Utility Infrastructure Relocation or Modification (Lower Sacramento River, Delta, CVP/SWP Service Areas)	LOS before Mitigation	N/A	NI	NI	NI	NI	NI
	Mitigation Measure	None required.	None needed; thus none proposed.				
	LOS after Mitigation	N/A	NI	NI	NI	NI	NI
Impact Util-8: Short-Term Increase in Solid Waste Generation (Lower Sacramento River, Delta, CVP/SWP Service Areas)	LOS before Mitigation	N/A	NI	NI	NI	LTS	LTS
	Mitigation Measure	None required.	None needed; thus none proposed.				
	LOS after Mitigation	N/A	NI	NI	NI	LTS	LTS
Impact Util-9: Increases in Solid Waste Generation from Increased Recreational Opportunities (Lower Sacramento River, Delta, CVP/SWP Service Areas)	LOS before Mitigation	N/A	NI	NI	NI	NI	NI
	Mitigation Measure	None required.	None needed; thus none proposed.				
	LOS after Mitigation	N/A	NI	NI	NI	NI	NI
Impact Util-10: Increased Demand for Water Treatment and Distribution Facilities Resulting from Increases in Water Supply (Lower Sacramento River, Delta, CVP/SWP Service Areas)	LOS before Mitigation	N/A	N/A (RS)	N/A (RS)	N/A (RS)	N/A (RS)	N/A (RS)
	Mitigation Measure	None required.	None needed; thus none proposed.				
	LOS after Mitigation	N/A	N/A (RS)	N/A (RS)	N/A (RS)	N/A (RS)	N/A (RS)

Key:
B = beneficial
LOS = level of significance
LTS = less than significant
N/A = not applicable
RS = remote and speculative
NI = no impact
PS = potentially significant
S = significant

No-Action Alternative

No mitigation is required for the No-Action Alternative.

CP1 – 6.5-Foot Dam Raise, Anadromous Fish Survival and Water Supply Reliability

No mitigation is required for Impact Util-3 and Impact Util-4. Mitigation is provided below for other impacts of CP1 on utilities and service systems.

Mitigation Measure Util-1 (CP1): Implement Procedures to Avoid Damage to or Temporary Disruption of Service To avoid temporary disruption of service, the following measures will be implemented during project construction to ensure that existing utilities infrastructure is not damaged:

- **Permits** – Reclamation will obtain utilities excavation or encroachment permits as necessary before initiating any work with potential to affect utility lines and will include all necessary permit terms in construction contract specifications.

- **Locating Line** – Utility locations will be identified through field surveys and the use of the Underground Service Alert services. Any buried utility lines will be clearly marked before initiation of any ground-disturbing construction activity.

- **Clearing Right-of-Way and Road Access** – If necessary, infrastructure will be removed or reinforced in coordination with all potential service providers known to have, or potentially having, utilities infrastructure in the project area.

- **Response Plan** – The construction contractor will prepare a response plan to address potential accidental damage to utility lines prior to the start of construction. The plan will identify chain of command rules for notification of authorities and appropriate actions and responsibilities to ensure the safety of the public and workers. The response plan will be circulated to the potentially affected service system providers for review and approval prior to the start of construction activities. Worker education training in response to such situations will be conducted by the contractor.

Implementation of this mitigation measure would reduce Impact Util-1 (CP1) to a less than significant level.

Mitigation Measure Util-2 (CP1): Adopt Measures to Minimize Infrastructure Relocation Impacts For each segment of a utility line that would need to be relocated or modified as a result of project construction and operations, the following measures will be implemented:

- **Permits** – Reclamation will obtain utilities excavation or encroachment permits as necessary before initiating any work associated with modification or relocation of an existing utility line and will include all necessary permit terms in construction contract specifications.

- **Locating and Staking Line** – Locations for relocated utility lines will be identified in coordination with affected service providers. As part of this effort, field surveys will be conducted and the Underground Service Alert services will be used to ensure that there are no conflicts with other existing utility lines. After the alignment of the line has been finalized, a survey will be made to map the route of the line. The results of the survey will be plan and profile drawings, which will be used to spot the poles. After exact positions have been fixed, a stake will be driven to indicate the center of the structure or pole.

- **Clearing Right-of-Way and Road Access** – The right-of-way must be cleared of all obstructions that will interfere with the operation of the power line. A strip of land must be cleared on each side of the centerline of the transmission line by cutting or trimming the trees and brush. All trees and brush should be cut 3 inches or less from the ground line so that the passage of trucks and tractors will not be hindered. The cut trees and brush must be disposed of by chipping or spreading, burning, or hauling away. Disposal of the debris by burning, or otherwise, must be accomplished in accordance with State and local laws and regulations without creating a hazard or nuisance. The right-of-way should be treated with chemical spray to retard the growth of brush or trees that could endanger the operation of the transmission line.

- **Installing Pole Footings and Foundations** – Pole sites must be properly graded in accordance with the specifications. Usually the slope of the grade must not be more than 3:1. All topsoil should be removed prior to grading the pole location.

- **Utilities Modification Plan** – The construction contractor will prepare a utilities modification and relocation plan prior to the start of construction. The plan will identify chain of command rules for notification of authorities and appropriate actions and responsibilities to ensure the safety of the public and workers and include a description of how utilities infrastructure will be modified or relocated and identification of precise alignment where utility lines will be relocated. The plan will be circulated to the potentially affected service system providers for review and approval prior to the start of construction activities. Worker education training in response to such situations will be conducted by the contractor.

- The contractor will stage utility line modifications and relocations in a manner that minimizes interruption of service.

- In accordance with the STNF LRMP, relocated power lines less than 35 kV and telephone lines on Forest Service land within the STNF will be buried unless the STNF VQO can be met without burying, geologic conditions make burying infeasible, or burying will produce greater long-term site disturbance.

- **Traffic Control and Safety Assurance Plan** – Reclamation will implement Mitigation Measure Trans-1 as described in PDEIS Chapter 20, "Transportation and Traffic" to reduce adverse effects of road closures and detours or partial road closures on access to local streets and adjacent uses.

Implementation of this mitigation measure would reduce Impact Util-2 (CP1) to a less than significant level.

CP2 - 12.5-Foot Dam Raise, Anadromous Fish Survival and Water Supply Reliability

No mitigation is required for Impact Util-3 and Impact Util-4. Mitigation is provided below for other impacts of CP2 on utilities and service systems.

Mitigation Measure Util-1 (CP2): Implement Procedures to Avoid Damage to or Temporary Disruption of Service This mitigation measure is identical to Mitigation Measure Util-1 (CP1). Implementation of this mitigation measure would reduce Impact Util-1 (CP2) to a less than significant level.

Mitigation Measure Util-2 (CP2): Adopt Measures to Minimize Infrastructure Relocation Impacts This mitigation measure is identical to Mitigation Measure Util-2 (CP1). Implementation of this mitigation measure would reduce Impact Util-2 (CP2) to a less than significant level.

CP3 – 18.5-Foot Dam Raise, Anadromous Fish Survival and Water Supply

No mitigation is required for Impact Util-3 and Impact Util-4. Mitigation is provided below for other impacts of CP3 on utilities and service systems.

Mitigation Measure Util-1 (CP3): Implement Procedures to Avoid Damage to or Temporary Disruption of Service This mitigation measure is identical to Mitigation Measure Util-1 (CP1). Implementation of this mitigation measure would reduce Impact Util-1 (CP3) to a less than significant level.

Mitigation Measure Util-2 (CP3): Adopt Measures to Minimize Infrastructure Relocation Impacts This mitigation measure is identical to Mitigation Measure Util-2 (CP1). Implementation of this mitigation measure would reduce Impact Util-2 (CP3) to a less than significant level.

CP4 – 18.5-Foot Dam Raise, Anadromous Fish Focus with Water Supply Reliability

No mitigation is required for Impact Util-3 and Impact Util-4. Mitigation is provided below for other impacts of CP4 on utilities and service systems.

Mitigation Measure Util-1 (CP4): Implement Procedures to Avoid Damage to or Temporary Disruption of Service This mitigation measure is identical to Mitigation Measure Util-1 (CP1). Implementation of this mitigation measure would reduce Impact Util-1 (CP4) to a less than significant level.

Mitigation Measure Util-2 (CP4): Adopt Measures to Minimize Infrastructure Relocation Impacts This mitigation measure is identical to Mitigation Measure Util-2 (CP1). Implementation of this mitigation measure would reduce Impact Util-2 (CP4) to a less than significant level.

CP5 – 18.5-Foot Dam Raise, Combination Plan

No mitigation is required for Impact Util-3 and Impact Util-4. Mitigation is provided below for other impacts of CP5 on utilities and service systems.

Mitigation Measure Util-1 (CP5): Implement Procedures to Avoid Damage to or Temporary Disruption of Service This mitigation measure is identical to Mitigation Measure Util-1 (CP1). Implementation of this mitigation measure would reduce Impact Util-1 (CP5) to a less than significant level.

Mitigation Measure Util-2 (CP5): Adopt Measures to Minimize Infrastructure Relocation Impacts This mitigation measure is identical to Mitigation Measure Util-2 (CP1). Implementation of this mitigation measure would reduce Impact Util-2 (CP5) to a less than significant level.

21.3.6 Cumulative Effects

Cumulative Effects

Past, present, and reasonably foreseeable future projects would generate construction-related solid waste. As discussed in Impacts Util-3, affected landfills have sufficient capacity to accommodate project-generated solid waste, and are also expected to have sufficient capacity to accommodate reasonably foreseeable development in addition to project waste. Therefore, none of the action alternatives would contribute to cumulative effects related to solid waste disposal.

Implementing the proposed SLWRI alternatives would have a significant cumulative effect on utilities and service systems in the primary study area. As discussed above, construction activities associated with CP1 through CP5 could inadvertently damage utilities and public service systems infrastructure. In addition, utilities and service systems could be temporarily disrupted to accommodate construction activities. These effects would be of greater and longer in duration with the larger dam raises. Thus, effects of CP2 would be similar to but greater than those of CP1, and similar to but less than those of

CP3 through CP5. Although Mitigation Measure Util-1 would reduce these effects, the effects would not be eliminated. Given the reasonably foreseeable development actions described previously, utilities and service systems provided by local, State, and Federal agencies within the primary study area could be subject to cumulatively considerable incremental effects resulting from CP1 through CP5. However, these effects would diminish with distance from the project construction sites, and CP1 through CP5 would not have cumulatively considerable effects on utilities and public service systems downstream from Red Bluff (i.e., in the extended study area).

Chapter 22
Public Services

22.1 Affected Environment

This chapter describes the affected environment related to public services for the dam and reservoir modifications proposed under the SLWRI. The public services addressed are fire protection, emergency services, law enforcement, and schools. Utilities, sewer services, and water supply are analyzed in Chapter 21, "Utilities and Service Systems," of this PDEIS.

Because of the potential influence of the proposed modification of Shasta Dam and water deliveries over a large geographic area, the SLWRI includes both a primary study area and an extended study area. The primary study area has been further divided into Shasta Lake and vicinity and upper Sacramento River (Shasta Dam to Red Bluff). The extended study area has been further divided into the lower Sacramento River and Delta and the CVP/SWP service areas.

The public services setting for Shasta Lake and vicinity consists of the portion of Shasta County above Shasta Dam. Public services needs in this region are influenced by rugged, mountainous terrain, rural lakeside communities, and Shasta Lake. The public services setting for the upper Sacramento River study area consists of Shasta County below Shasta Dam and Tehama County. Public services needs in this area are influenced by topography and population densities. Four incorporated cities, City of Shasta Lake, Redding, Anderson, and Red Bluff, create an urban setting in the otherwise rural upper Sacramento Valley, which is characterized by rolling hills with mountains to the north, east, and west.

The public services setting for the extended study area consists of 24 counties downstream from Red Bluff and encompasses all areas served by the CVP and the SWP.

Table 22-1 lists the public service providers considered in this PDEIS.

Table 22-1. Key Public Service Providers

Fire Protection Services
U.S. Forest Service
California Department of Forestry and Fire Protection
Shasta County Fire Department
Tehama County Fire Department
Redding Fire Department
Shasta Lake Fire Protection District
Anderson Fire Protection District
Red Bluff Fire Department
Corning Volunteer Fire Department
Emergency Services
California Highway Patrol
California Office of Emergency Services
Shasta County Sheriff's Office
Tehama County Sheriff's Department
Shasta Area Safety Communications Agency
Law Enforcement
U.S. Forest Service
California Highway Patrol
California Department of Fish and Game
Shasta County Sheriff's Office
Tehama County Sheriff's Department
Red Bluff Police Department
Corning Police Department
Schools
Gateway Unified School District

22.1.1 Fire Protection Services

Fire protection services consist of fire suppression, emergency dispatching, specialized training, fire prevention, fire safety education, and emergency medical response.

Shasta Lake and Vicinity

The Shasta County Fire Department (SCFD) and the California Department of Forestry and Fire Protection (CDF) respond to nonwildland fires in the Shasta Lake and vicinity portion of the primary study area. Nonwildland fires consist of structural, chemical, petroleum, electrical, vehicle, and other fires that involve human-made materials. CDF and the USFS are responsible primarily for wildland fires, which consist of fires in vegetated areas such as forests, chaparral, and grassland.

CDF and USFS generally respond according to established jurisdictional boundaries. However, a fire protection agreement between CDF and USFS provides for the sharing of fire protection resources to augment the capabilities of each agency (USFS 1995). In practice, SCFD, CDF, and USFS provide mutual assistance when needed.

The National Interagency Fire Center, located in Boise, Idaho, assists with wildland fire suppression nationwide. The center is a collaboration among seven Federal agencies: the Bureau of Indian Affairs, the Bureau of Land Management, USFS, USFWS, the National Park Service, the National Weather Service, and the Office of Aircraft Services. These agencies work together to coordinate and support wildland fire and disaster operations. CDF and the California Office of Emergency Services (OES) work closely with these agencies to manage wildland fire operations.

Upper Sacramento River (Shasta Dam to Red Bluff)

Fire protection services in the upper Sacramento River study area are similar to those in the Shasta Lake and vicinity portion of the primary study area. SCFD and the Tehama County Fire Department (TCFD) are responsible primarily for nonwildland fires, and CDF and USFS respond primarily to wildland fires.

In Shasta County, the Redding Fire Department, SCFD, and CDF have mutual automatic aid agreements to ensure adequate fire protection services and to share resources. Under these agreements, the agencies respond automatically to emergencies in Shasta County that are in adjacent jurisdictions.

Fire departments serving the unincorporated areas of Shasta County include one SCFD station that is housed in Redding, 12 community fire districts, and 19 volunteer fire companies. CDF operates several fire stations during the off-season winter months through an agreement with local fire departments. The community fire districts operate autonomously; the remaining fire departments, fire stations, and the Shasta County Fire District fall under the jurisdiction of SCFD.

The City of Shasta Lake, Redding, and Anderson are incorporated cities in Shasta County. Fire protection in Redding is provided by the Redding Fire Department, which has eight fully equipped stations and 72 full-time employees. The City of Shasta Lake provides fire protection supported by three fire stations with 27 employees. The Anderson Fire Protection District provides service to Anderson and operates two fire stations with 15 employees.

Shasta and Tehama counties share fire protection resources along their shared county line through a mutual automatic aid agreement. Like

SCFD, TCFD has mutual automatic aid agreements with local fire protection agencies that operate in the county. One difference between Shasta and Tehama counties is the level of integration with CDF: TCFD is fully integrated with CDF, which administers fire protection services in all unincorporated areas of the county except for the areas covered by the Gerber and Capay Fire Protection Districts.

TCFD provides fire protection services for the citizens of Tehama County through a network of 16 fire stations and 15 volunteer fire companies. Five of the stations, Los Molinos, Corning, Bowman, El Camino, and Antelope, are staffed 24 hours a day year around. The distribution of stations places most residents of Tehama County within 5 road miles of a responding fire station.

Red Bluff and Corning are incorporated cities in Tehama County; both cities provide fire protection services for their residents. Fire protection in Red Bluff is provided by the Red Bluff Fire Department. The Corning Volunteer Fire Department, which employs full-time staff assisted by volunteers, provides fire protection for the incorporated area of Corning.

Other fire protection services in Tehama County include the Gerber Fire Protection District, Lassen Volcanic National Park, Capay Fire Protection District, and Cottonwood Fire Protection District.

Lower Sacramento River and Delta and CVP/SWP Service Areas

Fire protection services in the extended study area are similar to those discussed for the primary study area. However, urban population densities are higher in parts of the extended study area, which influences the types and extent of fire protection services provided. Cities and counties in the extended study area provide fire protection services primarily for nonwildland fires, and CDF and USFS provide fire protection services primarily for wildland fires.

22.1.2 Emergency Services

Emergency services consist of emergency preparation, response, and recovery efforts. Emergencies range from calls for medical assistance to individuals to large-scale disasters, such as evacuations resulting from wildland fires and floods.

Shasta Lake and Vicinity

The Shasta County Sheriff's Office (SCSO) is responsible for coordinating emergency services on Shasta Lake and in the unincorporated areas of Shasta County upstream from Shasta Dam. Large scale emergency services are handled by SCSO in cooperation with the State emergency response network run by OES. As of 1996, OES has designated emergency service "Operational Areas" for all California counties, cities, and special districts (e.g., school, water, and

waste reclamation districts). Shasta Lake and vicinity is located in the Region 3 Operational Area, which consists of 12 Northern California counties. Emergency services providers could be called on to assist with emergencies that occur in their designated region and to assist the Central and South emergency services regions. CDF, USFS, the Federal Emergency Management Agency, and the American Red Cross also provide assistance in large-scale emergencies.

SCSO provides emergency services, including patrol boats and deputies, at Shasta Lake from a substation at Bridge Bay Marina. Medical aid is provided by Shasta County fire departments and private ambulance companies, including land and air ambulance services, based in the Redding area.

Upper Sacramento River (Shasta Dam to Red Bluff)

Emergency services in the upper Sacramento River area are similar to those described in the previous section. SCSO is responsible for coordinating emergency services in the Shasta County portion of the upper Sacramento River study area, and Tehama County Sheriff's Department is responsible for coordinating emergency services in the Tehama County portion. Both county agencies coordinate emergency services with OES and serve as the emergency services headquarters during declared public emergencies.

A number of emergency services agencies in Shasta County have formed a joint-powers agency, called the Shasta Area Safety Communications Agency, to consolidate emergency services related to fire, medical services, and law enforcement. Current participants include the Redding Fire Department, the Redding Police Department, and SCSO. American Medical Response, Redding Medical Center, and Mercy Medical Center in Redding participate in the Shasta Area Safety Communications Agency under a contractual agreement for ambulance services. Emergency medical response is also provided by St. Elizabeth Community Hospital in Red Bluff.

The Tehama County Sheriff's Department is responsible for emergency services coordination in Tehama County. In addition, TCFD responds to some medical emergencies in Tehama County.

The California Highway Patrol (CHP), Northern Division, provides ground and air support for emergencies along the Interstate 5 (I-5) corridor and State highways throughout the primary study area. CHP maintains two A-star helicopters and two Cessna airplanes that are used to assist other agencies with search and rescue and fire response. In addition, CHP assists with traffic control during emergencies.

Emergency services in the upper Sacramento River area are also supplemented by CDF, USFS, the Federal Emergency Management Agency, and the American Red Cross.

Lower Sacramento River and Delta and CVP/SWP Service Areas

Emergency services in the extended study area are similar to those discussed for the primary study area. Cities and counties in the extended study area are primarily responsible for providing emergency services, and receive assistance from regional, State, and Federal agencies for emergencies that require resources beyond the capability of the local jurisdiction.

22.1.3 Law Enforcement

Law enforcement services consist of crime prevention, investigation, and apprehension of lawbreakers and include duties to keep the peace and protect life and property. Law enforcement agencies often enter into cooperative aid agreements with neighboring or overlapping law enforcement jurisdictions to consolidate resources and facilitate communication.

Shasta Lake and Vicinity

Law enforcement services in the Shasta Lake and vicinity portion of the primary study area are provided by SCSO, CHP, DFG, and USFS. In general, the nature of an offense or law enforcement duty establishes jurisdiction. SCSO has primary responsibility for conflicts between people and most violations of State law, CHP handles most traffic violations, DFG enforces State fish and game laws, and USFS handles violations of Federal law.

Agencies responsible for law enforcement on Shasta Lake and the surrounding area carry out their duties from several locations. SCSO operates a substation in the City of Shasta Lake with nine assigned deputies and another substation in Lakehead with two resident deputies. Because of the nature and volume of human activity around Shasta Lake, SCSO also maintains a substation at Bridge Bay Marina, located on the main dock above the store. SCSO boat dock is located on the main dock near the substation. Services provided by SCSO include search and rescue, safety patrol boats, boating safety education, emergency services, and animal control.

USFS uses Federal law enforcement officers with jurisdiction on Federal lands. USFS does not assume the Sheriff's responsibilities; instead, it enforces the Federal codes that govern public behavior on lands managed by USFS. The DFG Northern District enforcement unit is based in Redding and provides law enforcement related to State fish and game laws in Shasta, Trinity, and Tehama counties.

Traffic law enforcement along I-5, State routes, and State highways is provided primarily by the Northern Division of the CHP. The CHP operates several offices in the primary study area, including offices in Redding and Red Bluff.

Upper Sacramento River (Shasta Dam to Red Bluff)

SCSO provides law enforcement services for the unincorporated areas of Shasta County. County law enforcement operations are based in Redding. Sheriff substations are located in Burney, the City of Shasta Lake, and Shingletown. The incorporated cities of Redding and Anderson provide law enforcement services for their residents.

The Tehama County Sheriff's Department office is located in Red Bluff. The sheriff is the chief law enforcement officer of Tehama County, with jurisdiction throughout the unincorporated county, the incorporated cities, and State-owned property. The incorporated cities of Red Bluff and Corning provide law enforcement services for their residents.

Lower Sacramento River and Delta and CVP/SWP Service Areas

Law enforcement services in the extended study area are similar to those discussed for the primary study area. Counties maintain sheriff's departments that have jurisdiction within the county boundaries, and incorporated cities maintain police departments that have jurisdiction within the city limits. However, urban population densities are higher in parts of the extended study area, which influences the types and extent of law enforcement services provided.

22.1.4 Schools

School districts are autonomous entities responsible for providing educational services for elementary, middle school, and high school students. Districts elect their own governing boards and appoint their own superintendents. County offices of education assist the school districts with administrative and curricular support.

Shasta Lake and Vicinity

There are no schools located in the Shasta Lake and vicinity portion of the primary study area. The Gateway Unified School District serves residents in this area and previously operated Canyon Elementary in Lakehead. This school, however, is currently closed.

Upper Sacramento River (Shasta Dam to Red Bluff)

School districts in the upper Sacramento River area serve students in levels kindergarten through grade 12. Shasta County is served by 25 school districts, and Tehama County is served by 21 school districts. The California Community College system provides continuing education services at locations in Shasta County and Tehama County.

Simpson University, located in Redding, also provides college-level educational services.

The Gateway Unified School District operates several schools in Shasta Lake and Redding. Mountain Lakes High School (grades 10 through 12) and Shasta Lake Alternative School (kindergarten through grade 12) are located at the northeast corner of the intersection of Lake Boulevard and Shasta Dam Boulevard.

Lower Sacramento River and Delta and CVP/SWP Service Areas

Educational services in the extended study area are similar to those discussed for the primary study area. Cities and counties form school districts to provide educational services for children between 6 and 18 years of age. Numerous community colleges and 4-year colleges and universities are also located in the extended study area. Urban population densities are higher in parts of the extended study area, which may influence the variety of educational services provided.

22.2 Regulatory Framework

22.2.1 Federal

Shasta-Trinity National Forest Land and Resource Management Plan

USFS personnel conduct their responsibilities for regulating the use of and protecting National Forest lands under Title 36 and sections of Title 16, 18, and 21 of the Code of Federal Regulations. Public services directives from the code are integrated into the Shasta-Trinity National Forest Land and Resource Management Plan (LRMP), which includes the following topics: fire and fuels management, facilities management, law enforcement, and land management.

The LRMP identifies goals, standards, and guidelines related to public services in Shasta-Trinity National Forest. The following goals, standards, and guidelines related to public services in Shasta-Trinity National Forest were excerpted from the LRMP (USFS 1995).

Fire and Fuels Goals (LRMP, p. 4-4):

- Achieve a balance of fire suppression capability and fuels management investments that are cost effective and able to meet ecosystem objectives and protection responsibilities.

Fire and Fuels Standards and Guidelines (LRMP, p 4-17):

- Wildland fires will receive an appropriate suppression response that may range from confinement to control. Unless a different suppression response is authorized in this plan, or subsequent

approved plans, all suppression responses will have an objective of "control."

- All wildland fires, on or threatening private land protected by agreement with the State of California, will receive a "control" suppression response.

- Fire prevention efforts will be designed to minimize human-caused wildfires commensurate with the resource values at risk.

Facilities Goals (LRMP, p. 4-4):

- Provide and maintain those administrative facilities that effectively and safely serve the public and USFS workforce.

Facilities Standards and Guidelines (LRMP, p 4-17):

- Manage, construct, and maintain buildings and administrative sites to meet applicable codes and to provide the necessary facilities to support resource management.

- Closure of roads and/or selected areas to assist in management of Forest resources may be made by regulatory and/or physical devices on the road for the following purpose[s]: safety, fire, and general administrative purposes.

Law Enforcement Goals (LRMP, p. 4-5):

- Establish priority in law enforcement activities as follows: (a) provide for employee and public safety, (b) protect resources and property, (c) provide for the accomplishment of management objectives, and (d) prevent violation of laws and associated loss and damage.

Law Enforcement Standards and Guidelines (LRMP, p 4-21):

- Protect the public interest by a thorough and aggressive program of violation prevention, violation detection, investigation and apprehension of violators, and prosecution.

22.2.2 State

Standardized Emergency Management Systems

The Standardized Emergency Management Systems law (Govt. Code 8607) directs OES to establish, implement, and maintain a coordinated emergency response system. The California Mutual Aid Agreement defines responsibilities and resource sharing between agencies to ensure that adequate resources, facilities, and other support are provided to jurisdictions when their own resources are insufficient to cope with the needs of a given emergency.

California Education Code

The California Education Code provides educational goals and requirements for the educational providers in the State (California Code of Regulations Title 5). It governs school district formation and operation, county board of education authorities and responsibilities, and educational criteria for children between 6 and 18 years of age.

California Fire Plan

The California Fire Plan provides guidance for reducing the risk of wildfire. The basic principles of the fire plan are:

- Community involvement
- Community risk assessment
- Development of solutions and implementation of projects

22.2.3 Regional and Local

Shasta County

The Shasta County General Plan (Shasta County 2004) identifies goals, objectives, and policies related to public services in Shasta County. Fire protection and law enforcement services are discussed in the section titled "Fire Safety and Sheriff Protection." Schools are discussed in the section titled "Public Facilities."

Tehama County

The Tehama County General Plan Update (Tehama County 2009) identifies goals, objectives, and policies for public services in Tehama County. The public services element of the general plan addresses concerns associated with growth and development as they relate to public services including schools. The safety element addresses potential dangers and damages associated with fire, floods, earthquakes, landslides, and other hazards.

22.3 Environmental Consequences and Mitigation Measures

22.3.1 Methods and Assumptions

This chapter addresses potential impacts associated with implementation of the project on the following public services: law enforcement, fire protection, emergency services, and schools. The analysis is based on a review of planning documents applicable to the project area, consultation with various agencies, and field reconnaissance.

22.3.2 Criteria for Determining Significance of Effects

An environmental document prepared to comply with the NEPA must consider the context and intensity of the environmental effects that

would be caused by, or result from, the proposed action. Under NEPA, the significance of an effect is used solely to determine whether an Environmental Impact Statement must be prepared. An environmental document prepared to comply with the CEQA must identify the potentially significant environmental effects of a proposed project. A "[s]ignificant effect on the environment" means a substantial, or potentially substantial, adverse change in any of the physical conditions within the area affected by the project" (CEQA Guidelines, Section 15382). CEQA also requires that the environmental document propose feasible measures to avoid or substantially reduce significant environmental effects (CEQA Guidelines, Section 15126.4(a)).

The following significance criteria were developed based on guidance provided by the State CEQA Guidelines and consider the context and intensity of the environmental effects as required under NEPA. An alternative was determined to result in a significant impact related to public services if it would do any of the following:

- Interfere with emergency services
- Degrade the level of service of a public service
- Require relocating public service facilities
- Require substantial improvements to the facilities or level of staffing of a public service to maintain its existing level of service

22.3.3 Topics Eliminated from Further Consideration

No topics were eliminated from consideration.

22.3.4 Direct and Indirect Effects

No-Action Alternative

The impact discussion for the No-Action Alternative addresses all of the study areas together because this alternative would not affect land use in any of the study areas. It also addresses the Lower Sacramento River and Delta study area and the CVP/SWP Service Areas together because their distance from the project area results in similar impacts.

Shasta Lake and Vicinity, Upper Sacramento River (Shasta Dam to Red Bluff), Lower Sacramento River and Delta, and CVP/SWP Service Areas

Impact PS-1 (No-Action): Disruption of Public Services Under the No-Action Alternative, no new facilities would be constructed in the primary or extended study areas, and no changes in Reclamation's existing facilities or operations would occur that would directly or

indirectly result in the disruption of public services in the project area. Therefore, there would be no impact related to the disruption of public services associated with the No-Action Alternative. Mitigation is not required for the No-Action Alternative..

Impact PS-2 (No-Action): Degraded Level of Public Services Under the No-Action Alternative, no new facilities or infrastructure would be constructed in the primary or extended study areas and no changes in Reclamation's existing facilities or operations would occur that would directly or indirectly result in degraded levels of public services in the project area. Therefore, there would be no impact related to degraded levels of public services associated with the No-Action Alternative. Mitigation is not required for the No-Action Alternative.

Impact PS-3 (No-Action): Relocation of Public Service Facilities
Under the No-Action Alternative, no new facilities would be constructed in the primary or extended study areas and no changes in Reclamation's existing facilities or operations would occur that would directly or indirectly result in the relocation of public service facilities in the project area. Therefore, there would be no impact on public services related to the relocation of infrastructure for public service facilities associated with the No-Action Alternative. Mitigation is not required for the No-Action Alternative.

CP1 – 6.5-Foot Dam Raise, Anadromous Fish Survival and Water Supply Reliability

The impact discussion for CP1 addresses the Shasta Lake and Vicinity and Upper Sacramento River study areas together because impacts from construction activities would affect both study areas. It also addresses the Lower Sacramento River and Delta study area and the CVP/SWP Service Areas together because their distance from the project area results in similar impacts.

Shasta Lake and Vicinity and Upper Sacramento River (Shasta Dam to Red Bluff)

Impact PS-1 (CP1): Short-Term Disruption of Public Services
Construction activities associated with enlarging Shasta Dam and related infrastructure (e.g., road relocations, bridge replacements) near the dam and near relocation sites for utilities, roads, and structures could temporarily disrupt transportation and circulation patterns in the vicinity, which could affect emergency services response and school bus service. Emergency preparedness, emergency communications, and emergency supplies, including food and shelter for emergency crews and public services staff, could also be affected by project implementation because of temporary increases in the work force.

Direct impacts could include disruption of traffic flows and street operations through temporary lane closures, detours, blockages, and restrictions on curbside parking; these impacts could result in delays for emergency services vehicles and school buses traveling through or around construction zones. In addition, project construction could cause short-term interruptions in power and telecommunications services, which could affect emergency response capabilities in the primary study area.

Construction activities that could disrupt emergency services and school bus service in the primary study area include road and bridge replacement, telecommunications facility replacement, power facility replacement, vegetation clearing for utility relocation, structure removal, and emergency services facility relocation. Reclamation estimates that construction activities for CP1 would take 36 months.

Routes proposed for transporting construction materials to the dam consist of I-5 and local roads, particularly Shasta Dam Boulevard and Lake Boulevard. These routes are used primarily by Reclamation personnel to access the Shasta Dam facilities, by visitors and tourists, and by residents of the City of Shasta Lake. At this time, there are no detours or lane closures proposed for the portions of Shasta Dam Boulevard and Lake Boulevard that serve the City of Shasta Lake. Road closures would likely be required adjacent to the facilities in the immediate vicinity of Shasta Dam and Reclamation's Northern California Area Office.

The Gateway Unified School District covers Shasta Lake and vicinity and portions of the upper Sacramento River area. Project construction could result in traffic delays and the need to reroute local traffic to ensure public health and safety. School bus routes could be temporarily affected by road closures and detours during project construction in communities around Shasta Lake.

Several roads around Shasta Lake would be affected by infrastructure and utility relocation activities. These activities could require road closures, detours, or traffic restrictions on Lakeshore Drive.

Emergency supplies and resources that could be affected by project implementation include food, shelter for emergency crews and local residents, and public services staff and equipment. Project construction activities are located within commuting distance of Redding, where ample food and shelter are available in emergencies. The OES network could supplement local emergency services staffing and equipment levels. However, OES may not be able to provide assistance when wildfires in the state require OES resources.

Construction activities at Shasta Dam and various locations surrounding Shasta Lake could affect emergency response capabilities throughout Shasta County (i.e., in a portion of the upper Sacramento River area) because the areas share emergency services resources and responsibilities.

In summary, project construction could result in short-term disruptions of school bus services throughout the Gateway Unified School District. Short-term traffic delays and access restrictions would require traffic controls and coordination with public services agencies. Therefore, this impact would be potentially significant. Mitigation for this impact is proposed in Section 22.3.5.

Impact PS-2 (CP1): Degraded Level of Public Services Project implementation could result in short-term degradation of levels of public services, including law enforcement, fire protection, and emergency services. This conclusion is based on the size of the project and proposed locations for construction activity associated with infrastructure alterations. The relocation of infrastructure combined with possible consolidation of recreational facilities (e.g., campgrounds, boat ramps, marinas) could result in changing demands for public services. Project construction activities proposed around Shasta Lake could require local, State, and Federal agencies to change the locations of some public services, which could affect the areas where the public services are currently located.

Project implementation could also result in degraded levels of public services in the upper Sacramento River study area because the Shasta Lake area and portions of the upper Sacramento River area share public services. Project construction activities at Shasta Lake could require the use of public services resources that could be needed simultaneously for public services assistance in the upper Sacramento River area.

Reclamation estimates that CP1 would take 36 months to complete. Public services levels that are increased as a result of the project would return to pre-project levels once construction activities have been completed. However, project implementation could temporarily degrade local public resources. This impact would be potentially significant. Mitigation for this impact is proposed in Section 22.3.5.

Impact PS-3 (CP1): Relocation of Public Services The project would require relocation of some public service facilities in the Shasta Lake and vicinity portion of the study area. No public services facilities in the upper Sacramento River portion of the primary study area would need to be relocated.

The NRA is managed by USFS, which has several facilities throughout the reservoir area. Two USFS facilities would be inundated and thus require relocation or replacement. The station located in the Lakeshore area would be inundated by raising Shasta Dam and would have to be relocated to an area above the new full pool. The new facility would contain all of the features that exist at the current facility. The inundated facility would be demolished and hauled to waste. At Turntable Bay, another USFS facility would be inundated by the raising of Shasta Dam. Additional space at Turntable Bay would allow for the facility to be relocated on fill in the current location. Also, the SCSO substation and dock at the Bridge Bay Marina could need to be relocated within the marina complex. Reclamation would construct the replacement facilities before abandonment and demolition of the existing facilities, thereby ensuring that levels of public services provided by these facilities would not be adversely affected by the relocation process. This impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Lower Sacramento River and Delta and CVP/SWP Service Areas

Impact PS-4 (CP1): Short-Term Disruption of Public Services Project implementation would not disrupt public services in the extended study area because of the distance of the extended study area from project elements that could affect public services.

The northern end of the extended study area is more than 30 miles from the nearest project construction activities. Emergency services providers with mutual aid agreements that could be called on to assist with emergencies resulting from project activities are located in the primary study area. Project construction activities in the primary study area that could disrupt public services are too far removed from the extended study area to disrupt emergency services or law enforcement serving areas south of Red Bluff. Project implementation would not disrupt school bus service in the extended study area because school districts located in the extended study area do not operate school bus routes in or near project construction activities. Therefore, there would be no impact related to disruption of public services in the extended study area. Mitigation for this impact is not needed, and thus not proposed.

Impact PS-5 (CP1): Degraded Levels of Public Services Construction activities are not expected to affect public service levels in the extended study area. Existing facilities, personnel, and equipment in the extended study area could provide short-term assistance for project-related public services needs without degrading public services levels in the extended study area.

The northern end of the extended study area is more than 30 miles from the nearest project construction activities. Public services providers with

mutual aid agreements that could be called on to assist with law enforcement, fire suppression, or other emergencies resulting from project activities are located in the primary study area. Project construction activities around Shasta Lake are too far removed from the extended study area to disrupt public services below Red Bluff. Public services providers located in the extended study area could be called on by OES to assist with large-scale emergencies in the primary study area that result from project implementation. However, existing facilities, personnel, and equipment in the extended study area are adequate to maintain current levels of service while providing assistance to the primary study area.

Indirect impacts to public services in the extended study area could result from traffic accidents associated with the transport of project materials and workers. Some project materials and workers could originate in the extended study area, requiring northbound travel to the primary study area. At this time, Reclamation estimates that the project would employ 350 workers. Project-related travel that would likely occur on I-5, the railway, or via air transport is not anticipated to result in accidents in the extended study area that would require significant response from law enforcement, fire protection, or emergency services providers; however, the fact that traffic accidents resulting from project-related travel could occur in the extended study area means that the possibility of travel-related accidents exists. It is expected that existing facilities, personnel, and equipment in the extended study area would be adequate to maintain current levels of service while providing assistance for any such accidents.

Existing facilities, staff, and equipment in the extended study area would be capable of providing short-term assistance for project-related public services needs without degrading levels of public services in the extended study area. Therefore, this impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact PS-6 (CP1): Relocation of Public Services Facilities Project implementation would not result in the relocation of public services facilities in the extended study area. Therefore, public services in the extended study area would not be affected by relocation of public services facilities. There would be no impact. Mitigation for this impact is not needed, and thus not proposed.

CP2 – 12.5-Foot Dam Raise, Anadromous Fish Survival and Water Supply Reliability

The impact discussion for CP2 addresses the Shasta Lake and Vicinity and Upper Sacramento River study areas together because impacts from construction activities would affect both study areas. It also addresses

the Lower Sacramento River and Delta study area and the CVP/SWP Service Areas together because their distance from the project area results in similar impacts.

Shasta Lake and Vicinity and Upper Sacramento River (Shasta Dam to Red Bluff)

Impact PS-1 (CP2): Short-Term Disruption of Public Services
Construction activities associated with enlarging Shasta Dam and related infrastructure (e.g., road relocations, bridge replacements) near the dam and near the relocation sites for utilities, roads, and structures could temporarily disrupt transportation and circulation patterns in the vicinity of Shasta Lake, which could affect emergency services response and school bus service. Emergency preparedness, emergency communications, and emergency supplies (e.g., food, shelter for emergency crews, public services staff) could also be affected by project implementation.

Impacts related to short-term disruption of emergency services that would result from implementing the 12.5-foot dam raise (CP2) are similar to those identified for the 6.5-foot dam raise (Impact PS-1 (CP1)). However, the duration of the impacts would be longer for CP2 because construction activities associated with the 12.5-foot dam raise would take more time than under the 6.5-foot dam raise. The 12.5-foot dam raise would require significantly more concrete and is anticipated to take 12 more months to construct than the 6.5-foot dam raise (CP1).

The increased amount of infrastructure demolition and relocation activity associated with CP2 would also require more time than under CP1. More structures would need to be demolished and relocated, and additional power and telecommunication lines would need to be relocated. Additional septic systems and wells would also require demolition and relocation, and 20 additional road segments would need to be realigned for CP2. The increased construction activity in the Shasta Lake and vicinity portion of the primary study area under CP2 would extend the duration of potential disruptions to emergency services and school bus service in the Shasta Lake and vicinity portion of the study area. This impact would be potentially significant. Mitigation for this impact is proposed in Section 22.3.5.

Impact PS-2 (CP2): Degraded Levels of Public Services Project implementation could result in short-term degradation of levels of public services, including law enforcement, fire protection, and emergency services. This conclusion is based on the size of the project and proposed locations for construction activity associated with infrastructure alterations. The relocation of infrastructure combined with possible consolidation of recreational facilities (e.g., campgrounds, boat ramps, marinas) could result in changing demands for public services.

Project construction activities proposed around Shasta Lake could require local, State, and Federal agencies to change the locations of some public services, which could affect the areas where the resources are currently located.

This impact would be similar to Impact PS-2 (CP1). However, the impacts would last longer for CP2 than CP1 because more time would be needed to complete project construction under the 12.5-foot dam raise. Reclamation estimates that CP2 would take 48 months to complete. Project implementation could temporarily degrade local public services. This impact would be potentially significant. Mitigation for this impact is proposed in Section 22.3.5.

Impact PS-3 (CP2): Relocation of Public Services Facilities This impact would be similar to Impact PS-3 (CP1). Facility relocation would not degrade levels of public services while the public service agencies are relocating to their new facilities. This impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Lower Sacramento River and Delta and CVP/SWP Service Areas
Impact PS-4 (CP2): Short-Term Disruption of Public Services This impact would be similar to Impact PS-4 (CP1) for the extended study area. Project implementation would not disrupt public services in the extended study area because of the distance of the extended study area from project elements that could affect public services. There would be no impact. Mitigation for this impact is not needed, and thus not proposed.

Impact PS-5 (CP2): Degraded Levels of Public Services This impact would be similar to Impact PS-5 (CP1) for the extended study area. Project construction activities are not expected to affect public services levels in the extended study area. Existing facilities, staff, and equipment in the extended study area would be capable of providing short-term assistance for project-related public services needs without degrading levels of public services in the extended study area. This impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact PS-6 (CP2): Relocation of Public Services Facilities This impact would be identical to Impact PS-6 (CP1) for the extended study area. Project implementation would not result in the relocation of public service facilities in the extended study area. There would be no impact. Mitigation for this impact is not needed, and thus not proposed.

CP3 – 18.5-Foot Dam Raise, Anadromous Fish Survival and Water Supply Reliability

The impact discussion for CP3 addresses the Shasta Lake and Vicinity and Upper Sacramento River study areas together because impacts from construction activities would affect both study areas. It also addresses the Lower Sacramento River and Delta study area and the CVP/SWP Service Areas together because their distance from the project area results in similar impacts.

Shasta Lake and Vicinity and Upper Sacramento River (Shasta Dam to Red Bluff)

Impact PS-1 (CP3): Short-Term Disruption of Public Services
Construction activities associated with enlarging Shasta Dam and the related infrastructure (e.g., road relocations, bridge replacements) near the dam and near the relocation sites for utilities, roads, and structures could temporarily disrupt transportation and circulation patterns in the vicinity, which could affect emergency services response and school bus service. Emergency preparedness, emergency communications, and emergency supplies (food, shelter for emergency crews, public services staff) could also be affected by project implementation.

This impact would be similar to Impact PS-1 (CP1). However, the impact would last longer for CP3 because construction activities associated with the 18.5-foot dam raise would take more time than for the 6.5-foot dam raise. Reclamation estimates that the 18.5-foot dam raise would take 60 months. The 18.5-foot dam raise would require significantly more concrete and is anticipated to take 24 more months to construct than the 6.5-foot dam raise (CP1). The increased amount of infrastructure demolition and relocation activity associated with CP3 would also require more time than for CP1. Almost twice as many structures would need to be demolished and relocated, and additional power and telecommunication lines would require removal and relocation. Additional septic systems and wells would be abandoned and relocated, and 25 more road segments would be realigned. The increased construction activity at Shasta Dam and in the surrounding area would extend the time of potential disruptions to emergency services. This impact would be potentially significant. Mitigation for this impact is proposed in Section 22.3.5.

Impact PS-2 (CP3): Degraded Levels of Public Services Project implementation could result in short-term degradation of levels of public services, including law enforcement, fire protection, and emergency services. This conclusion is based on the size of the project and proposed locations for construction activity associated with infrastructure alterations. The relocation of infrastructure, combined with possible consolidation of recreational facilities (e.g., campgrounds, boat ramps, marinas), could result in changing demands for public

services. Project construction activities proposed around Shasta Lake could require local, State, and Federal agencies to change the locations of some public services, which could affect the areas where the public services are currently located.

This impact would be similar to Impact PS-2 (CP1). However, the impact would last longer for CP3 than for CP1 because more time would be needed to complete project construction for the 18.5-foot dam raise. This impact would be potentially significant. Mitigation for this impact is proposed in Section 22.3.5.

Impact PS-3 (CP3): Relocation of Public Services Facilities This impact would be similar to Impact PS-3 (CP1). Facilities relocation would not degrade levels of public services while the public services agencies are relocating to new facilities. This impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Lower Sacramento River and Delta and CVP/SWP Service Areas

Impact PS-4 (CP3): Short-Term Disruption of Public Services This impact would be similar to Impact PS-4 (CP1) for the extended study area. Project implementation would not disrupt public services in the extended study area because of the distance of the extended study area from project elements that could affect public services. There would be no impact. Mitigation for this impact is not needed, and thus not proposed.

Impact PS-5 (CP3): Degraded Levels of Public Services This impact would be similar to Impact PS-5 (CP1) for the extended study area. Project construction activities are not expected to affect public services levels in the extended study area. Existing facilities, staff, and equipment in the extended study area would be capable of providing short-term assistance for project-related public services needs without degrading levels of public services in the extended study area. This impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact PS-6 (CP3): Relocation of Public Services Facilities This impact would be identical to Impact PS-6 (CP1) for the extended study area. Project implementation would not result in the relocation of public services facilities in extended study area. There would be no impact. Mitigation for this impact is not needed, and thus not proposed.

CP4 – 18.5-Foot Dam Raise, Anadromous Fish Focus with Water Supply Reliability

The impact discussion for CP4 addresses the Shasta Lake and Vicinity and Upper Sacramento River study areas together because impacts from

construction activities would affect both study areas. It also addresses the Lower Sacramento River and Delta study area and the CVP/SWP Service Areas together because their distance from the project area results in similar impacts.

Shasta Lake and Vicinity and Upper Sacramento River (Shasta Dam to Red Bluff)

Impact PS-1 (CP4): Short-Term Disruption of Public Services This impact would be similar to Impact PS-1 (CP3). Construction activities associated with enlarging Shasta Dam and related infrastructure (e.g., road relocations, bridge replacements) near the dam and near the relocation sites for utilities, roads, and structures could temporarily disrupt transportation and circulation patterns in the vicinity of Shasta Lake, which could affect emergency services response and school bus service. Emergency preparedness, emergency communications, and emergency supplies (e.g., food, shelter for emergency crews, public services staff) could also be affected by project implementation. This impact would be potentially significant. Mitigation for this impact is proposed in Section 22.3.5.

Impact PS-2 (CP4): Degraded Levels of Public Services This impact would be similar to Impact PS-2 (CP3). Project implementation could result in short-term degradation of levels of public services, including law enforcement, fire protection, and emergency services. This conclusion is based on the size of the project and proposed locations for construction activity associated with infrastructure alterations. The relocation of infrastructure, combined with possible consolidation of recreational facilities (e.g., campgrounds, boat ramps, marinas), could result in changing demands for public services. Project construction proposed around Shasta Lake could require local, State, and Federal agencies to change the location of some public services, which could affect the areas where the public services are currently located. This impact would be potentially significant. Mitigation for this impact is proposed in Section 22.3.5.

Impact PS-3 (CP4): Relocation of Public Services Facilities This impact would be similar to Impact PS-3 (CP1). Facilities relocation would not degrade levels of public services while the public services agencies are relocating to new facilities. This impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Lower Sacramento River and Delta and CVP/SWP Service Areas

Impact PS-4 (CP4): Short-Term Disruption of Public Services This impact would be similar to Impact PS-4 (CP1), except that gravel augmentation and Reading Island habitat restoration along the upper Sacramento River would slightly, but not substantially, increase the

potential for short-term disruption of public services in the extended study area. This impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact PS-5 (CP4): Degraded Levels of Public Services This impact would be similar to Impact PS-5 (CP1), except that gravel augmentation and Reading Island habitat restoration along the upper Sacramento River would slightly, but not substantially, increase the potential for degradation of public services.

Existing facilities, personnel, and equipment in the extended study area could provide short-term assistance for project-related public services needs without degrading levels of public services in the extended study area. This impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact PS-6 (CP4): Relocation of Public Services Facilities This impact would be identical to Impact PS-6 (CP1) for the extended study area. Project implementation would not result in the relocation of public services facilities in the extended study area. There would be no impact. Mitigation for this impact is not needed, and thus not proposed.

CP5 – 18.5-Foot Dam Raise, Combination Plan

The impact discussion for CP5 addresses the Shasta Lake and Vicinity and Upper Sacramento River study areas together because impacts from construction activities would affect both study areas. It also addresses the Lower Sacramento River and Delta study area and the CVP/SWP Service Areas together because their distance from the project area results in similar impacts.

Shasta Lake and Vicinity and Upper Sacramento River (Shasta Dam to Red Bluff)

Impact PS-1 (CP5): Short-Term Disruption of Public Services This impact would be similar to Impact PS-1 (CP3). Construction activities associated with enlarging Shasta Dam and related infrastructure (e.g., road relocations, bridge replacement) near the dam and near relocation sites for utilities, roads, and structures could temporarily disrupt transportation and circulation patterns in the vicinity, which could affect emergency services response and school bus service. Emergency preparedness, emergency communications, and emergency supplies (e.g., food, shelter for emergency crews, public service staff) could also be affected by project implementation. This impact would be potentially significant. Mitigation for this impact is proposed in Section 22.3.5.

Impact PS-2 (CP5): Degraded Levels of Public Services This impact would be similar to Impact PS-2 (CP3). Project implementation could

result in short-term degradation of levels of public services, including impacts on law enforcement, fire protection, and emergency services. This conclusion is based on the size of the project and proposed locations for construction activity associated with infrastructure alterations. Project construction activities proposed around Shasta Lake could require local, State, and Federal agencies to change the location of some public services, which could affect the areas where the public services are currently located. This impact would be potentially significant. Mitigation for this impact is proposed in Section 22.3.5.

Impact PS-3 (CP5): Relocation of Public Services Facilities This impact is similar to Impact PS-3 (CP1). Facilities relocation would not degrade levels of public service while the public service agencies are relocating to new facilities. This impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Lower Sacramento River and Delta and CVP/SWP Service Areas
Impact PS-4 (CP5): Short-Term Disruption of Public Services This impact would be similar to Impact PS-4 (CP1), except that gravel augmentation and Reading Island habitat restoration along the upper Sacramento River would slightly, but not substantially, increase the potential for short-term disruption of public services in the extended study area. This impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact PS-5 (CP5): Degraded Levels of Public Services This impact would be similar to Impact PS-5 (CP1), except that gravel augmentation and Reading Island habitat restoration along the upper Sacramento River would slightly, but not substantially, increase the potential for degradation of public services.

Existing facilities, personnel, and equipment in the extended study area could provide short-term assistance for project-related public services needs without degrading levels of public services in the extended study area. This impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

Impact PS-6 (CP5): Relocation of Public Services Facilities This impact would be identical to Impact PS-6 (CP1) for the extended study area. Project implementation would not result in the relocation of public services facilities in the extended study area. There would be no impact. Mitigation for this impact is not needed, and thus not proposed.

22.3.5 Mitigation Measures

Table 22-2 presents a summary of mitigation measures for public services.

Table 22-2. Summary of Mitigation Measures for Public Services

Impact		No-Action Alternative	CP1	CP2	CP3	CP4	CP5
Impact PS-1: Disruption of Public Services (Shasta Lake and Vicinity and Upper Sacramento River)	LOS before Mitigation	NI	PS	PS	PS	PS	PS
	Mitigation Measure	None required.	PS-1: Coordinate and Assist Public Services Agencies.				
	LOS after Mitigation	NI	LTS	LTS	LTS	LTS	LTS
Impact PS-2: Degraded Level of Public Services (Shasta Lake and Vicinity and Upper Sacramento River)	LOS before Mitigation	NI	PS	PS	PS	PS	PS
	Mitigation Measure	None required.	PS-2: Provide Support to Public Services Agencies.				
	LOS after Mitigation	NI	LTS	LTS	LTS	LTS	LTS
Impact PS-3: Relocation of Public Service Facilities (Shasta Lake and Vicinity and Upper Sacramento River)	LOS before Mitigation	NI	LTS	LTS	LTS	LTS	LTS
	Mitigation Measure	None required.	None needed; thus, none proposed.				
	LOS after Mitigation	NI	LTS	LTS	LTS	LTS	LTS
Impact PS-4: Short-Term Disruption of Public Services (Lower Sacramento River, Delta, CVP/SWP Service Areas)	LOS before Mitigation	NI	NI	NI	NI	LTS	LTS
	Mitigation Measure	None required.	None needed; thus, none proposed.				
	LOS after Mitigation	NI	NI	NI	NI	LTS	LTS
Impact PS-5: Degraded Levels of Public Services (Lower Sacramento River, Delta, CVP/SWP Service Areas)	LOS before Mitigation	NI	LTS	LTS	LTS	LTS	LTS
	Mitigation Measure	None required.	None needed; thus, none proposed.				
	LOS after Mitigation	NI	LTS	LTS	LTS	LTS	LTS
Impact PS-6: Relocation of Public Services Facilities (Lower Sacramento River, Delta, CVP/SWP Service Areas)	LOS before Mitigation	NI	NI	NI	NI	NI	NI
	Mitigation Measure	None required.	None needed; thus, none proposed.				
	LOS after Mitigation	NI	NI	NI	NI	NI	NI

Notes:
LOS = level of significance
LTS = less than significant
NI = no impact
PS = potentially significant

No-Action Alternative

No mitigation measures are required for the No-Action Alternative.

CP1 – 6.5-Foot Dam Raise, Anadromous Fish Survival and Water Supply Reliability

No mitigation is required for Impacts PS-3 through PS-6. Mitigation is provided below for impacts of CP1 related to short-term disruptions of public services (PS-1) and degraded levels of public services in the primary study area (PS-2).

Mitigation Measure PS-1 (CP1): Coordinate and Assist Public Services Agencies Reclamation will coordinate all proposed road closures, detours, and traffic control measures with the Shasta County Sheriff's Office and Tehama County Sheriff's Office, which are the designated OES headquarters for the primary study area.

Reclamation will appoint a public liaison to communicate construction schedules, road closures, and project activities to the public. The liaison will organize and conduct public meetings for the purpose of communicating project information. The liaison will meet with all affected public services agencies to coordinate public meetings and information exchanges.

Reclamation will obtain all necessary permits and/or authorizations from public services agencies for matters requiring agency approval and/or cooperation.

Reclamation will meet with public services agencies to determine traffic controls for infrastructure, utility, and structure relocation.

Reclamation will develop and implement a monitoring plan to track the effectiveness of this mitigation measure, and will make adjustments, if necessary.

Traffic Control and Safety Assurance Plan Reclamation will implement Mitigation Measure Trans-1 as described in Chapter 20, "Transportation and Traffic" to reduce adverse effects of road closures and detours or partial road closures on access to local streets and adjacent uses.

Implementation of this mitigation measure would reduce Impact PS-1 (CP1) to a less than significant level.

Mitigation Measure PS-2 (CP1): Provide Support to Public Services Agencies Reclamation will provide affected public services providers (e.g., law enforcement, fire protection, emergency services) with sufficient funding and support to ensure that levels of public services are not substantially degraded by construction activities. Reclamation will coordinate with affected providers to develop a mutual understanding of the amount and schedule of financial and administrative support required to reduce this impact to a less than significant level.

Reclamation will develop and implement a monitoring plan to track the effectiveness of this mitigation measure, and will make adjustments, if necessary.

Implementation of this mitigation measure would reduce Impact PS-2 (CP1) to a less than significant level.

CP2 – 12.5-Foot Dam Raise, Anadromous Fish Survival and Water Supply Reliability

No mitigation is required for Impacts PS-3 through PS-6. Mitigation is provided below for the impacts of CP1 related to short-term disruptions of public services (PS-1) and CP2 related to degraded levels of public services (PS-2) in the primary study area.

Mitigation Measure PS-1 (CP2): Coordinate and Assist Public Services Agencies This mitigation measure is identical to Mitigation Measure PS-1 (CP1). Implementation of this mitigation measure would reduce Impact PS-1 (CP2) to a less than significant level.

Mitigation Measure PS-2 (CP2): Provide Support to Public Services Agencies This mitigation measure is identical to Mitigation Measure PS-2 (CP1). Implementation of this mitigation measure would reduce Impact PS-2 (CP2) to a less than significant level.

CP3 – 18.5-Foot Dam Raise, Anadromous Fish Survival and Water Supply Reliability

No mitigation is required for Impacts PS-3 through PS-6. Mitigation is provided below for the impacts of CP1 related to short-term disruptions of public services (PS-1) and degraded levels of public services (PS-2) in the primary study area.

Mitigation Measure PS-1 (CP3): Coordinate and Assist Public Services Agencies This mitigation measure is identical to Mitigation Measure PS-1 (CP1). Implementation of this mitigation measure would reduce Impact PS-1 (CP3) to a less than significant level.

Mitigation Measure PS-2 (CP3): Provide Support to Public Services Agencies This mitigation measure is identical to Mitigation Measure PS-2 (CP1). Implementation of this mitigation measure would reduce Impact PS-2 (CP3) to a less than significant level.

CP4-18.5 Foot Dam Raise, Anadromous Fish Focus with Water Supply Reliability

No mitigation is required for Impacts PS-3 through PS-6. Mitigation is provided below for the impacts of CP1 related to short-term disruptions of public services (PS-1) and degraded levels of public services (PS-2) in the primary study area.

Mitigation Measure PS-1 (CP4): Coordinate and Assist Public Services Agencies This mitigation measure identical to Mitigation Measure PS-1 (CP1). Implementation of this mitigation measure would reduce Impact PS-1 (CP4) to a less than significant level.

Mitigation Measure PS-2 (CP4): Provide Support to Public Services Agencies This mitigation measure is identical to Mitigation Measure

PS-2 (CP1). Implementation of this mitigation measure would reduce Impact PS-2 (CP4) to a less than significant level.

CP5 – 18.5-Foot Dam Raise, Combination Plan

No mitigation is required for Impacts PS-3 through PS-6. Mitigation is provided below for the impacts of CP5 related to short-term disruptions of public services (PS-1) and degraded levels of public services (PS-2) in the primary study area.

Mitigation Measure PS-1(CP5): Coordinate and Assist Public Services Agencies This mitigation measure is identical to Mitigation Measure PS-1 (CP1). Implementation of this mitigation measure would reduce Impact PS-1 (CP5) to a less than significant level.

Mitigation Measure PS-2 (CP5): Provide Support to Public Services Agencies This mitigation measure is identical to Mitigation Measure PS-2 (CP1). Implementation of this mitigation measure would reduce Impact PS-2 (CP5) to a less than significant level.

22.3.6 Cumulative Effects

As described above, CP1 through CP5 would result in short-term disruption of public services, degrade the levels of public services provided, and require the relocation of public services facilities in the primary study area. These effects would be of greater magnitude and duration with the larger dam raises. Thus, effects of CP2 would be similar to but greater than those of CP1, and similar to but less than those of CP3 through CP5. Although Mitigation Measures PS-1 and PS-2 would enhance the coordination of public services during project implementation, the adverse effects of CP1 through CP5 would not be eliminated, particularly regarding short-term disruption of public services. Given the reasonably foreseeable development actions, public services provided by Federal, State, and local agencies within the primary study area could be subject to cumulatively incremental effects resulting from CP1 through CP5. These effects would diminish with distance from the project construction sites. CP1 through CP5 would not have cumulative effects on public services downstream from Red Bluff (i.e., in the extended study area).

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Chapter 23
Power and Energy

23.1 Affected Environment

This chapter describes the affected environment related to hydropower generation and consumption for the dam and reservoir modifications proposed under the SLWRI. The affected environment includes the existing CVP and SWP generating and pumping plants. For a more in-depth description of the affected environment, see the *Power and Energy Technical Report.*

The CVP is a multipurpose project with 20 dams and reservoirs, 11 powerplants, and 500 miles of major canals, as well as conduits, tunnels, and related facilities. The power generated from these plants helps to meet California's energy needs. The Western Area Power Administration (Western), created in 1977 under the Department of Energy Organization Act, markets and transmits electric power throughout 15 western states. Western's Sierra Nevada Customer Service Region (Sierra Nevada Region) markets and transmits power generated from the CVP and the Washoe Project in excess of CVP use. Western follows a formal procedure for allocating CVP energy to "preference" customers. These customers have 20-year contracts for their share of CVP energy in excess of Reclamation's water pumping needs.

Major SWP facilities include 17 pumping plants, 8 hydroelectric powerplants, 32 storage facilities, and 660-plus miles of aqueducts and pipelines. The SWP is also a multipurpose project. The primary purpose of SWP power generation facilities is to meet energy requirements of the SWP pumping plants. To the extent possible, SWP pumping is scheduled during off-peak periods, and energy generation is scheduled during peak periods. Although the SWP uses more energy than it generates from its hydroelectric facilities, DWR has exchange agreements with other utility companies, and has developed other power resources. DWR sells surplus power, when it is available, to minimize the net cost of pumping energy.

23.1.1 Shasta Lake and Vicinity

The Shasta Division of the CVP contains Shasta Dam, Lake, and Powerplant, and Keswick Dam, Reservoir, and Powerplant; it captures water from the Sacramento River basin. Shasta Powerplant is located just below Shasta Dam as part of the Shasta Division. Water from the dam is released through five 15-foot penstocks leading to the five main generating units and two station service units with a maximum generation capacity of 715 megawatts (MW). Shasta Powerplant is a peaking plant and generally runs when demand for electricity is

high. Its power is dedicated first to meeting the requirements of CVP facilities. The remaining energy is marketed to various preference customers in Northern California. The 2007 net annual generation of Shasta Powerplant was 1,914,175 megawatt-hours (MWh).

23.1.2 Upper Sacramento River (Shasta Dam to Red Bluff)

CVP powerplants located downstream from Shasta Reservoir, but upstream from the Red Bluff Diversion Dam are the Trinity, Lewiston, Judge Francis Carr, and Spring Creek powerplants of the Trinity River Division and the Keswick Powerplant of the Shasta Division. The Trinity River Division captures headwaters from the Trinity River basin and diverts surplus water to the Sacramento River.

Trinity Dam stores water from the Trinity River in Trinity Reservoir and makes releases to the Trinity River through the Trinity Powerplant. Downstream, Lewiston Dam diverts water from the Trinity River through the Lewiston Powerplant into the Clear Creek Tunnel and through Judge Francis Carr Powerplant to Whiskeytown Reservoir. Some Whiskeytown Reservoir releases are made through the Spring Creek Power Conduit and Powerplant into Keswick Reservoir in the Shasta Division. The remainder of the releases from Whiskeytown Reservoir are made to Clear Creek. Releases from Keswick Reservoir are made through the Keswick Powerplant to the Sacramento River.

Keswick Powerplant belongs to the Shasta Diversion, is located at Keswick Dam, and has three generating units with a total capacity of 105 MW. Keswick Powerplant is a run-of-the-river plant, creating Shasta Powerplant's afterbay, and providing uniform flows to the Sacramento River.

23.1.3 Lower Sacramento River and Delta

Two CVP powerplants located between the Red Bluff Diversion Dam and Sacramento–San Joaquin River Delta (Delta) are the Folsom and Nimbus powerplants. Both powerplants belong to the Folsom Unit on the American River.

Folsom Powerplant is a peaking powerplant located at the foot of Folsom Dam on the north side of the American River. Water from the dam is released through three 15-foot-diameter penstocks to three generating units with a maximum capacity of 199 MW. Folsom Dam was constructed by the USACE and, on completion, was transferred to Reclamation for coordinated operation as an integral part of the CVP.

Nimbus Dam forms Lake Natoma to act as an afterbay for Folsom Powerplant. It allows dam operators to coordinate power generation and flows in the lower American River channel during normal reservoir operations. Nimbus Powerplant, with two units and a maximum capacity of 13.5 MW, is a run-of-the-river plant and provides station service backup for Folsom Powerplant.

23.1.4 CVP/SWP Service Areas

There are a number of generation facilities and pumping facilities in the greater CVP/SWP service areas, beyond the specific geographies discussed above. These facilities are discussed below.

Generation Facilities

The CVP powerplants located in the CVP south-of-Delta service area include New Melones Powerplant in the New Melones Unit of the CVP East Side Division, and the William R. Gianelli and O'Neill Pumping-Generating Plants in the San Luis Unit of the CVP West San Joaquin Division. The latter two, with dual functions of generating electricity and pumping water, are jointly owned by Reclamation and DWR.

New Melones Dam was completed in 1979, and inundated the original Melones Dam and created New Melones Reservoir on the Stanislaus River. New Melones Powerplant, located on the north bank immediately downstream from the dam, is a peaking plant. The powerplant contains two units and a maximum capacity of 300 MW.

The San Luis Unit, part of both the CVP and SWP, was authorized in 1960. Reclamation and the State of California constructed and operate this unit jointly; 45 percent of the total cost was contributed by the Federal Government and the remaining 55 percent by the State of California. The joint-use facilities are O'Neill Dam and Forebay, B.F. Sisk San Luis Dam, San Luis Reservoir, William R. Gianelli Pumping-Generating Plant, Dos Amigos Pumping Plant, Los Banos and Little Panoche Reservoirs, and San Luis Canal from O'Neill Forebay to Kettleman City, together with the necessary switchyard facilities. The Federal-only portion of the San Luis Unit includes the O'Neill Pumping-Generating Plant and Intake Canal, Coalinga Canal, Pleasant Valley Pumping Plant, and San Luis Drain.

San Luis Reservoir serves as the major storage reservoir, and O'Neill Forebay acts as an equalizing basin, for the upper stage dual-purpose pumping-generating plant. O'Neill Pumping-Generating Plant takes water from the Delta-Mendota Canal and discharges it into the O'Neill Forebay, where the California Aqueduct (SWP feature) flows directly. The William R. Gianelli Pumping-Generating Plant lifts water from O'Neill Forebay and discharges it into San Luis Reservoir. During releases from the reservoir, these plants generate electric power by reversing flow through the turbines. Water for irrigation is released into the San Luis Canal and flows by gravity to Dos Amigos Pumping Plant, where the water is lifted more than 100 feet to permit gravity flow to the canal terminus at Kettleman City. The SWP canal system continues to southern coastal areas.

The O'Neill Pumping-Generating Plant consists of an intake channel, leading off the Delta-Mendota Canal, and six pumping-generating units. Normally, these units operate as pumps to lift water from 45 to 53 feet into O'Neill

Forebay; each unit can discharge 700 cubic feet per second (cfs) and has a rating of 6,000 horsepower (hp). Water is occasionally released from the forebay to the Delta-Mendota Canal, and these units then operate as generators; each unit has a generating capacity of about 4.2 MW.

William R. Gianelli Pumping-Generating Plant, the joint Federal-State facility located at San Luis Dam, lifts water by pump-turbines from O'Neill Forebay into San Luis Reservoir. During the irrigation season, water is released from San Luis Reservoir back through the pump-turbines to the forebay and energy is reclaimed. Each of the eight pumping-generating units has a capacity of 63,000 hp as a motor and 53 MW as a generator. As a pumping plant to fill San Luis Reservoir, each unit lifts 1,375 cfs at a design dynamic head of 290 feet. As a generating plant, each unit passes 2,120 cfs at a design dynamic head of 197 feet.

Among the eight SWP hydroelectric powerplants, three powerplants are located in the Lake Oroville vicinity and the remaining in the south-of-Delta area.

Lake Oroville, the SWP's largest reservoir, stores winter and spring runoff from the Feather River watershed, and releases water for SWP needs. These releases generate power at three powerplants: the Edward Hyatt Pumping-Generating Plant, Thermalito Diversion Dam Powerplant, and Thermalito Pumping-Generating Plants (Oroville Facilities). DWR schedules hourly releases through the Oroville Facilities to maximize the amount of energy produced when power values are highest. Because the downstream water supply does not depend on hourly releases, water released for power in excess of local and downstream requirements is conserved by pumpback operation during off-peak times into Lake Oroville. Energy prices primarily dictate hourly operations for the power generation facilities.

The remaining five SWP powerplants are the jointly owned William R. Gianelli Pumping-Generating Plant, Alamo Powerplant, Mojave Siphon Powerplant, Devil Canyon Powerplant, and Warne Powerplant. They generate about one sixth of the total energy used by the SWP. The Alamo Powerplant uses the 133 foot head between Tehachapi Afterbay and Pool 43 of the California Aqueduct to generate electricity. The Mojave Siphon Powerplant generates electricity from water flowing downhill after its 540-foot lift by the Pearblossom Pumping Plant. The Devil Canyon Powerplant generates electricity with water from Silverwood Lake with more than 1,300 feet of head, the highest water head[1] in a powerplant in the SWP system. The Warne Powerplant uses the 725-foot drop

[1] [1] Potential hydropower generation is a function of the hydraulic net head and rate of fluid flow. The net head is the actual head available for power generation and is used for computing the energy generated. The net head is the gross head minus the head losses due to intake structures, penstocks, and outlet works. The gross or static head is the vertical distance between the tailwater elevation and the forebay water surface elevation (i.e., the height of water in the reservoir relative to its height after discharge). The head losses are generally assumed 2 to 10 percent of the gross head, depending on the configuration of the powerhouse structure.

from the Peace Valley Pipeline to generate electricity with its Pelton wheel turbines.

Pumping Facilities

CVP pumping plants to move water from the Delta to CVP service areas in the Central Valley include C.W. "Bill" Jones Pumping Plant, O'Neill and William R. Gianelli Pumping-Generating Plants, Dos Amigo Pumping Plant, and SWP Banks Pumping Plant. Reclamation constructed and operates the C.W. "Bill" Jones Pumping Plant. Harvey O. Banks Pumping Plant is an SWP facility; however, Reclamation has access to its pumping capacity through use of the Joint Point of Diversion, described in State Water Resource Control Board Water Right Decision 1641. The remaining plants, described previously, are joint-use facilities between the two agencies under the San Luis Unit.

C.W. "Bill" Jones Pumping Plant, formerly Tracy Pumping Plant, is a component of the CVP Delta Division. Construction of the plant started in 1947 and was completed in 1951, with an inlet channel, pumping plant, and discharge pipes. Delta water is lifted 197 feet up and carried about 1 mile into the Delta-Mendota Canal. Each of the six pumps at C.W. "Bill" Jones Pumping Plant is powered by a 22,500 hp motor and is capable of pumping 767 cfs. The intake canal includes the C.W. "Bill" Jones Fish Screen, which was built to intercept downstream migrant fish to be returned to the main channel to resume their journey to the ocean.

Dos Amigo Pumping Plant is a joint CVP/SWP facility, located 17 miles south of O'Neill Forebay on the San Luis Canal. It lifts water 113 feet to permit gravity flow to the terminus of San Luis Canal at Kettleman City. The plant contains six pumping units, each capable of delivering 2,200 cfs at 125 feet of head.

Among the SWP pumping plants, plants that historically consumed most of the energy are William R. Gianelli Pumping-Generating Plant (SWP share), Harvey O. Banks Pumping Plant, Dos Amigos Pumping Plant (SWP share), Ira J. Chrisman Pumping Plant, and A.D. Edmonston Pumping Plant.

The Harvey O. Banks Pumping Plant is located 2.5 miles (4 kilometers) southwest of the Clifton Court Forebay on the California Aqueduct. The plant is the first pumping plant for the California Aqueduct and the South Bay Aqueduct. It provides the necessary head[2] for water in the California Aqueduct to flow for approximately 80 miles south past O'Neill Forebay and San Luis Reservoir to the Dos Amigos Pumping Plant (another jointly owned facility, as previously described). The Harvey O. Banks Pumping Plant initially flows into Bethany Reservoir, where the South Bay Aqueduct truly begins. The design head is 236 to 252 feet and installed capacity is 10,670 cfs with 333,000 hp.

[2] In pumping plants, the design head is the gross head plus the head losses due to intake structures.

Along the California Aqueduct, the Pearblossom, Chrisman, and Edmonston Pumping Plants historically consumed the highest amount of energy. The Pearblossom Pumping Plant lifts water about 540 feet and discharges the water 3,479 feet above mean sea level (msl), the highest point along the entire California Aqueduct. The Chrisman and Edmonston Pumping Plants provide 524 and 1,970 feet of lift, respectively, to convey California Aqueduct water across the Tehachapi Mountains.

23.2 Regulatory Framework

There are two categories of regulatory framework for hydropower: Federal regulations for CVP hydroelectric operations and State regulations for the SWP.

23.2.1 Federal

Reclamation operates the CVP hydroelectric generation facilities to manage and release water in accordance with various acts authorizing specific projects, and with other laws, permits, and enabling legislation (see the *Hydrology, Hydraulics, and Water Management Technical Report* in the Physical Resources Appendix for details). Western's capacity and energy sales must conform with the laws that govern its sale of electrical power. Hydropower operations at each facility comply with water flows and other constraints set by Reclamation, the USWFS, or other regulatory agencies, acting in accordance with laws, regulations, and policies.

Western announced its 2004 Power Marketing Plan (Marketing Plan) for the Sierra Nevada Region because all of the Sierra Nevada Region’s long-term firm CVP power sales contracts expired on December 31, 2004. The Marketing Plan specifies the terms and conditions under which Western markets power from the CVP and the Washoe Project, beginning January 1, 2005. This Marketing Plan supersedes all previous marketing plans for these projects.

23.2.2 State

DWR is currently seeking a new 50-year hydroelectric license from the Federal Energy Regulatory Commission to operate the existing Oroville Facilities. The DEIS is available for public review and comment. The initial Federal Energy Regulatory Commission license for the Oroville Facilities, issued on February 11, 1957, expired on January 31, 2007. The Oroville Facilities are currently operating under an annual license issued by Federal Energy Regulatory Commission effective February 1, 2007.

23.2.3 Regional and Local

There are no known regional or local regulations that would govern power and energy resources.

23.3 Environmental Consequences and Mitigation Measures

The purpose of this section is to provide information about hydropower generation, energy use, and impacts on existing hydropower facilities from the SLWRI study alternatives described in the PDEIS. Hydropower modeling for the PDEIS was conducted to identify potential impacts from the SLWRI on hydropower generation and consumption at CVP and SWP facilities, which are operated by Reclamation, and DWR, respectively. This section describes the analytical methodology used to calculate, for all alternatives, the hydropower generation and pumping energy required in CVP and SWP existing hydropower facilities. This chapter also describes criteria for determining significant impacts and mitigation measures associated with the SLWRI alternatives, and then lists the impacts and mitigation measures.

23.3.1 Methods and Assumptions

Several modeling tools were used for the SLWRI hydropower analysis. CalSim-II was used to determine project operations, and the Common Assumptions power tools were used to quantify the hydropower generation and pumping energy associated with each alternative. A spreadsheet postprocessor was used to evaluate impacts to the Pit 7 Powerplant.

Common Assumptions Power Tools

Energy estimates were made using the Common Assumptions power tools, LongTermGen (LTG) and SWP Power CA (SWP Power), for CVP and SWP facilities, respectively. LTG and SWP Power use operations data from CalSim-II simulations to predict energy generation and consumption throughout the CVP and SWP.

Methods applied to evaluate power generation are discussed below.

For each SLWRI alternative, outputs from CalSim-II simulation were inputs to LTG and SWP Power to simulate power generation and consumption throughout the CVP and SWP systems, respectively. These CalSim-II outputs include reservoir releases, conveyance flow rates, and end-of-month reservoir storages. Both LTG and SWP Power are monthly models. Their simulation periods are from October 31, 1921, to September 30, 2003.

In LTG and SWP Power, energy generation is a function of turbine configuration, reservoir release, net head, and duration of generation. Net head is the actual head available for power generation; it is reservoir water surface elevation (a function of storage) minus tailrace elevation (a function of release).

Similarly, the calculation of energy required for pumping in both models is a function of pump configuration, pumping rate, pumping head (i.e., net head with hydraulic losses), and duration of pumping. Detailed descriptions of LTG and SWP Power are included in Chapter 9 of the Modeling Appendix.

CalSim-II

CalSim-II is the application of the Water Resources Integrated Modeling System software to the CVP/SWP. This application was jointly developed by Reclamation and DWR for planning studies relating to CVP/SWP operations. The primary purpose of CalSim-II is to evaluate the water supply reliability of the CVP and SWP at current and/or future levels of development (e.g., 2005, 2030), with and without various assumed future facilities, and with different modes of facility operations. Geographically, the model covers the drainage basin of the Delta, and CVP/SWP exports to the San Francisco Bay Area, San Joaquin Valley, Central Coast, and Southern California.

CalSim-II typically simulates system operations for an 83-year period using a monthly time step. The model assumes that facilities, land use, water supply contracts, and regulatory requirements are constant over this period, representing a fixed level of development (e.g., 2005 or 2030). The historical flow record of October 1921 to September 2003, adjusted for the influences of land use changes and upstream flow regulation, is used to represent the possible range of water supply conditions. Major Central Valley rivers, reservoirs, and CVP/SWP facilities are represented by a network of arcs and nodes. CalSim-II uses a mass balance approach to route water through this network. Simulated flows are mean flows for the month; reservoir storage volumes correspond to end-of-month storage.

Monthly CalSim-II model results are intended to be used for comparative purposes. It is important to differentiate between "absolute" or "predictive" modeling applications and "comparative" applications. In "absolute" applications, the model is run once to predict a future outcome; errors or assumptions in formulation, system representation, data, operational criteria, etc., all contribute to total error or uncertainty in model results. In "comparative" applications, the model is run twice, once to represent a base condition (no project) and a second time with a specific change (project) to assess the change in the outcome due to the input change. In this comparative mode (the mode used for this PDEIS), the difference between the two simulations is of principal importance. Potential errors or uncertainties that exist in the "no project" simulation are also present in the "project" simulation such that their impacts are reduced when assessing the change in outcomes.

Spreadsheet Postprocessors For analysis of impacts from each alternative on generation from the Pit 7 Powerplant, a spreadsheet postprocessor was used in lieu of a model. Since no model was available for Pit 7 Powerplant operations, an evaluation of potential impacts of the SLWRI alternatives, as simulated using CalSim-II, on recent historical data was used instead.

The spreadsheet post-processor interpolated CalSim-II output for Shasta Reservoir storage to determine the reservoir water surface elevation. The Shasta Reservoir water surface elevations for each alternative were compared to historical Pit 7 Powerplant tailwater elevations to calculate the change in net

head at the Pit 7 Powerplant. Changes in net head at the Pit 7 Powerplant were assumed to be small enough that turbine/generator efficiencies would be unaffected. For each alternative, the monthly generation was determined by multiplying historical average monthly generation by the ratio of the alternative-reduced net head compared to the historical net head (assumed to be 200 feet based on historical average) raised to the 1.5 power.

23.3.2 Criteria for Determining Significance of Effects

An environmental document prepared to comply with NEPA must consider the context and intensity of the environmental effects that would be caused by, or result from, the proposed action. Under the NEPA, the significance of an effect is used solely to determine whether an Environmental Impact Statement must be prepared. An environmental document prepared to comply with CEQA must identify the potentially significant environmental effects of a proposed project. A "[s]ignificant effect on the environment" means a substantial, or potentially substantial, adverse change in any of the physical conditions within the area affected by the project (State CEQA Guidelines, Section 15382). CEQA also requires that the environment document propose feasible measures to avoid or substantially reduce significant environmental effects (State and CEQA Guidelines, Section 15126.4(a).

The significance criteria presented in Table 23-1 were developed based on guidance provided by the State CEQA Guidelines and consider the context and intensity of the environmental effects as required under NEPA. Impacts of an alternative on power and energy would be significant if project implementation would have any of the results listed in the second column of the table.

Table 23-1. Impact Indicators and Significance Criteria for Energy Generation and Usage

Impact Indicator	Significance Criterion
Shasta Powerplant Energy Generation	Decrease in long-term average monthly hydropower generation of more than 5 percent, due to reduction in net head available for energy generation at Shasta Dam.
CVP and SWP Powerplants Energy Generation	Decrease in long-term average monthly hydropower generation of more than 5 percent, due to decrease in net head available for energy generation at various CVP and SWP powerplants.
CVP and SWP Pumping Plants Energy Consumption	Increase in long-term average monthly power requirement of more than 5 percent, due to increased pumping at various CVP and SWP pumping plants.
CVP and SWP Net Energy Generation	Decrease in long-term average monthly net energy generation, which is the difference between energy generation and energy consumption, of more than 5 percent at various CVP and SWP powerplants.
Pit 7 Powerplant Energy Generation	Decrease in long-term average annual hydropower generation of more than 5 percent, due to increase in Pit 7 tailwater elevation, resulting in reduced net head available for energy generation at Pit 7 Powerplant.

Key:
CVP = Central Valley Project
SWP = State Water Project

An alternative would be considered to have a potentially significant impact on hydropower production if the change in the average monthly energy generation or consumption over the 82-year period of simulation is greater than 5 percent.

A threshold of 5 percent was selected as the threshold of significance for hydroelectric generation for several reasons, including seasonal and annual hydrologic variability, short-term operations decisions that might affect water level in storage, and regional power market demands and prices that might dictate hydropower facilities operations. All these factors could contribute to potentially substantial variations in hydropower generation on a monthly or annual basis. As a result, generation variations of less than 5 percent are not considered significant.

Significance statements are relative to both existing conditions (2005) and future conditions (2030), unless stated, otherwise.

Shasta Powerplant Energy Generation

Shasta Powerplant energy generation would be directly affected by any potential enlargement. While long-term net releases are not likely to change under any enlargement scenario, the monthly pattern of releases could potentially be affected. Assuming there would be no corresponding reduction in power demand, a significant reduction in power production would require an increase in generation from another powerplant to meet any unmet demand.

An alternative would be considered to have a significant impact on Shasta Powerplant energy generation if its monthly average generation was reduced by more than 5 percent at a level of recurrence substantially affecting the power market.

CVP and SWP Powerplants Energy Generation

Changes in CVP operations due to any of the SLWRI alternatives could result in some reoperation of other CVP and SWP facilities, and could result in a decrease in generation at the various CVP and SWP powerplants. A decrease in generation from CVP and SWP powerplants could require an increase in generation in other parts of the generation market, even if the annual amount of generation did not change.

An alternative would be considered to have a significant impact on CVP/SWP powerplant energy generation if its monthly average generation was reduced by more than 5 percent at a level of recurrence substantially affecting the power market.

CVP and SWP Pumping Plants Energy Consumption

Changes in CVP operations due to any of the SLWRI alternatives could result in changes in operations of the CVP and SWP pumping plants. Changes in timing or volume of pumping could cause changes in energy consumption.

An alternative would be considered to have a significant impact on hydropower production if its monthly average pumping plant energy consumption would increase by more than 5 percent at a level of recurrence substantially affecting the power market.

CVP and SWP Net Energy Generation

While changes in CVP operations due to the SLWRI alternatives may increase generation at CVP and SWP powerplants, a similar increase in pumping could result in a net decrease in generation.

A decrease greater than 5 percent in net energy generation at hydropower facilities at a level of recurrence substantially affecting the power market would indicate a significant impact on hydropower production.

Pit 7 Powerplant Energy Generation

The Pit 7 Powerplant is owned and operated by the Pacific Gas and Electric Company. Increases in Shasta Lake water surface elevations could increase the tailwater elevation below the Pit 7 Powerplant, reducing the net head and decreasing generation. An alternative would be considered to have a significant impact on Pit 7 Powerplant energy generation if its monthly average generation was reduced by more than 5 percent at a level of recurrence substantially affecting the power market.

23.3.3 Direct and Indirect Effects

This section describes the environmental consequences of the SLWRI Comprehensive Plans, and proposed mitigation measures for any impacts determined to be significant or potentially significant. All Comprehensive Plans are compared to a basis of comparison; for the existing condition (2005 level of development), a CalSim-II simulation for the existing condition is used. Similarly, the future condition (2030 level of development) uses a CalSim-II simulation of the No-Action Alternative as a basis of comparison. Each of the Comprehensive Plans are simulated using the same level of development so that any changes from the basis of comparison hydropower generation or consumption can be attributed the alternative. Detailed tables of the monthly energy generation and energy consumption associated with each comprehensive plan are included in Attachment 1 of the *Power and Energy Technical Report*.

Modeling results for CP1, CP2, CP3, and CP4 are included below. The operation modeling results for CP5 are not included because they are identical to those of CP3.

The No-Action Alternative and five SLWRI Comprehensive Plans are described in the following subsections. Potential effects of the existing condition, No-Action Alternative, and various SLWRI Comprehensive Plans on energy generation and usage are also described.

No-Action Alternative

Under the No-Action Alternative, the Federal Government would take reasonably foreseeable actions, as defined above, but would take no additional action toward implementing a specific plan to help increase anadromous fish survival in the upper Sacramento River, nor help address the growing water reliability issues in California. Shasta Dam would not be modified, and the CVP would continue operating similar to the existing condition. Changes in regulatory conditions and water supply demands would result in differences in flows on the Sacramento River and at the Delta. Possible changes include the following:

- Firm Level 2 Federal refuge needs
- Implementation of the Sacramento Area Water Forum Agreement on the American River
- Increased Contra Costa Water District contract supply and water rights
- SWP deliveries based on full Table A[3] amounts
- Use of the Delta-Mendota Canal–California Aqueduct Intertie
- Implementation of the San Joaquin River Salinity Management Program
- CVP use of Banks Pumping Plant to move 50,000 acre-feet/year of Level 2 refuge water

This alternative is used as a basis of comparison for future condition comparisons.

In the impact analysis below, hydropower generation and consumption, and net energy generation at CVP and SWP facilities under the No-Action Alternative are compared with the existing condition.

Shasta Lake and Vicinity

Impact Hydro-1 (No-Action): Decrease in Shasta Powerplant Energy Generation Increasing the hydropower capabilities of Shasta Powerplant is a secondary planning objective of the SLWRI. An increase in Shasta Powerplant energy generation is one indicator of the project's beneficial impacts. Simulated monthly average Shasta Powerplant energy generation for the No-Action Alternative is shown in Table 23-2. The greatest decrease in long-term monthly average hydropower generation is more than 5 percent compared to the existing condition. In addition, monthly decreases in hydropower generation of greater

[3] The Monterey Agreement (DWR 2003) signed by 27 of the 29 SWP water contractors in 1995, restructured the SWP contracts to allocate water based on contractual Table A amounts instead of the amount of water requested for a given year.

than 5 percent were observed at a level of recurrence that would substantially affect the power market.

Consequently, this impact would be potentially significant. Mitigation is not required for the No-Action Alternative.

Table 23-2. Simulated Monthly Average Shasta Powerplant Energy Generation for No-Action Alternative

Month	Existing Condition (GWh)	No-Action Alternative Change (GWh (%))	
October	132	-9	-7%
November	120	-6	-5%
December	156	-4	-3%
January	160	2	1%
February	187	-4	-2%
March	180	-1	-1%
April	160	0	0%
May	200	2	1%
June	259	-2	-1%
July	275	5	2%
August	201	8	4%
September	116	8	7%
Total	2,146	-1	0%

Source: Common Assumptions Common Modeling Package Version 9 LongTermGen

Note:
Simulation period: 1922 – 2003
Key:
GWh = gigawatt-hour

Upper Sacramento River Negligible effects on Power and Energy are expected to occur in the Upper Sacramento River geographic region; therefore, potential effects in that geographic region are not discussed further in this PDEIS.

Lower Sacramento River and Delta Negligible effects on Power and Energy are expected to occur in the Lower Sacramento River and Delta geographic region; therefore, potential effects in that geographic region are not discussed further in this PDEIS.

CVP/SWP Service Areas

Impact Hydro-2 (No-Action): Decrease in CVP and SWP Powerplant Energy Generation Simulated monthly average CVP and SWP energy generation for the No-Action Alternative shown in Table 23-3 and Table 23-4, respectively. Hydropower generation at CVP powerplants under the No-Action Alternative is similar to that in the existing condition. However, the No-Action Alternative shows an overall beneficial impact from increases on hydropower generation at SWP powerplants compared to the existing condition. Monthly decreases

greater than 5 percent were observed at both CVP and SWP powerplants at a level of recurrence that would substantially affect the power market.

Therefore, this impact would be potentially significant. Mitigation is not required for the No-Action Alternative.

Table 23-3. Simulated Monthly Average CVP Energy Generation for No-Action Alternative

Month	Existing Condition (GWh)	No-Action Alternative Change (GWh (%))	
October	304	-12	-4%
November	245	-11	-4%
December	294	-10	-3%
January	336	-4	-1%
February	353	-7	-2%
March	358	-1	0%
April	364	-2	-1%
May	511	-2	0%
June	587	-8	-1%
July	678	-7	-1%
August	533	13	2%
September	370	11	3%
Total	4,934	-41	-1%

Source: Common Assumptions Common Modeling Package Version 9, LongTermGen
Note:
Simulation period: 1922 – 2003
Key:
CVP = Central Valley Project
GWh = gigawatt-hour

Table 23-4. Simulated Monthly Average SWP Energy Generation for No-Action Alternative

Month	Existing Condition (GWh)	No-Action Alternative Change (GWh (%))	
October	325	19	6%
November	269	26	10%
December	322	11	3%
January	348	-1	0%
February	408	14	3%
March	460	5	1%
April	392	37	9%
May	475	39	8%
June	523	28	5%
July	508	55	11%
August	426	36	8%
September	341	32	9%
Total	4,798	299	6%

Source: Common Assumptions Common Modeling Package Version 9, SWP Power CA
Note:
Simulation period: 1922 – 2003
Key:
GWh = gigawatt-hour
SWP = State Water Project

Impact Hydro-3 (No-Action): Increase in CVP and SWP Pumping Plant Energy Consumption Simulated monthly average CVP and SWP energy consumption for the No-Action Alternative is shown in Table 23-5 and Table 23-6, respectively. The greatest increase in long-term monthly average energy consumption at CVP and SWP pumping plants for the No-Action Alternative is more than 5 percent compared to the existing condition, and would cause a potentially significant effect. In addition, monthly increases greater than 5 percent were observed at a level of recurrence that would substantially affect the power market.

Therefore, this impact would be potentially significant. Mitigation is not required for the No-Action Alternative.

Table 23-5. Simulated Monthly Average CVP Energy Consumption for No-Action Alternative

Month	Existing Condition (GWh)	No-Action Alternative Change (GWh (%))	
October	100	1	1%
November	116	7	6%
December	135	9	7%
January	145	6	4%
February	118	-9	-8%
March	104	-19	-18%
April	53	0	0%
May	57	2	4%
June	89	1	1%
July	116	9	8%
August	119	7	6%
September	90	8	9%
Total	1,243	21	2%

Source: Common Assumptions Common Modeling Package Version 9, LongTermGen

Note:
Simulation period: 1922 – 2003

Key:
CVP = Central Valley Project
GWh = gigawatt-hour

Table 23-6. Simulated Monthly Average SWP Energy Consumption for No-Action Alternative

Month	Existing Condition (GWh)	No-Action Alternative Change (GWh (%))	
October	685	94	14%
November	625	112	18%
December	673	93	14%
January	753	5	1%
February	750	41	5%
March	815	69	8%
April	700	123	18%
May	763	117	15%
June	801	79	10%
July	783	114	15%
August	803	102	13%
September	774	107	14%
Total	8,925	1056	12%

Source: Common Assumptions Common Modeling Package Version 9, SWP Power CA

Note:
Simulation period: 1922 – 2003
Key:
GWh = gigawatt-hour
SWP = State Water Project

Impact Hydro-4 (No-Action): Decrease in CVP and SWP Net Energy Generation Net energy generation is the difference between long-term monthly average energy generation and monthly average energy consumption. Simulated monthly average CVP and SWP net energy generation for the No-Action Alternative is depicted in Table 23-7 and Table 23-8, respectively. The greatest decrease in long-term monthly average net energy generation is more than 5 percent and would cause a potentially significant impact. In addition, monthly decreases greater than 5 percent were observed at a level of recurrence that would substantially affect the power market.

Therefore, this impact would be potentially significant. Mitigation is not required for the No-Action Alternative.

Impact Hydro-5 (No-Action): Decrease in Pit 7 Powerplant Net Energy Generation Simulated monthly average Pit 7 Powerplant energy generation for the No-Action Alternative is depicted in Table 23-9. Total Pit 7 Powerplant energy production for the No-Action Alternative would be similar to that of the existing condition.

Therefore, there would be no impacts. Mitigation is not required for the No-Action Alternative.

Table 23-7. Simulated Monthly Average CVP Net Energy Generation for No-Action Alternative

Month	Existing Condition (GWh)	No-Action Alternative Change (GWh (%))	
October	204	-13	-6%
November	129	-18	-14%
December	159	-18	-11%
January	191	-10	-5%
February	235	2	1%
March	254	18	7%
April	311	-1	0%
May	454	-5	-1%
June	497	-9	-2%
July	562	-17	-3%
August	414	6	1%
September	280	3	1%
Total	3,691	-62	-2%

Source: Common Assumptions Common Modeling Package Version 9, LongTermGen.

Note:
Simulation period: 1922 – 2003
Key:
CVP = Central Valley Project
GWh = gigawatt-hour

Table 23-8. Simulated Monthly Average SWP Net Energy Generation for No-Action Alternative

Month	Existing Condition (GWh)	No-Action Alternative Change (GWh (%))	
October	-360	-75	21%
November	-356	-85	24%
December	-351	-82	23%
January	-405	-6	1%
February	-342	-27	8%
March	-355	-64	18%
April	-308	-86	28%
May	-288	-78	27%
June	-278	-51	18%
July	-275	-60	22%
August	-378	-65	17%
September	-433	-75	17%
Total	-4,128	-756	18%

Source: Common Assumptions Common Modeling Package Version 9, SWP Power CA

Note:
Simulation period: 1922 – 2003
Key:
GWh = gigawatt-hour
SWP = State Water Project

Table 23-9. Simulated Monthly Average Pit 7 Powerplant Energy Generation for No-Action Alternative

Month	Existing Condition (GWh)	No-Action Alternative Change (GWh (%))	
October	52.6	0	0%
November	52.6	0	0%
December	64.6	0	0%
January	57.8	0	0%
February	52.1	0	0%
March	38.5	0	0%
April	33.2	0	0%
May	31.2	0	0%
June	30.9	0	0%
July	33.6	0	0%
August	36.7	0	0%
September	45.1	0	0%
Total	528.9	0	0%

Source: Spreadsheet model, Pit 7 Dam MONTHLY AVG.xls,2007
Note:
Simulation period: 1922 – 2003
Key:
GWh = gigawatt-hour

CP1 – 6.5-Foot Dam Raise, Anadromous Fish Survival and Water Supply Reliability

CP1 focuses on increasing water supply reliability while contributing to increased anadromous fish survival, actions that are consistent with the 2000 CALFED Bay-Delta Program (CALFED) Record of Decision (ROD). In addition to the common features above, CP1 primarily consists of raising Shasta Dam 6.5 feet, an elevation change that increases the reservoir's full pool by 8.5 feet, and enlarges the total storage space in the reservoir by 256,000 acre-feet. Under this plan, Shasta Dam normal operational guidelines would continue essentially unchanged, with the additional storage retained for water supply reliability. This scenario helps to reduce future water shortages through increasing drought and average-year water supply reliability. This plan would also include the potential to revise the operational rules for flood control for Shasta Dam and Reservoir, which could benefit flood damage reduction and recreation. Reservoir reoperation would likely include increasing the bottom of the flood control pool elevation based on increased dam height and reservoir capacity. The increased Shasta Reservoir pool depth and volume would also contribute to maintaining lower seasonal water temperatures for anadromous fish on the upper Sacramento River.

This section describes the environmental consequences of CP1. Impacts discussed include the following:

- Decrease in Shasta Powerplant energy generation
- Decrease in CVP and SWP powerplant energy generation
- Increase in CVP and SWP pumping plant energy consumption
- Decrease in CVP and SWP net energy generation
- Decrease in Pit 7 Powerplant energy generation

Shasta Lake and Vicinity

Impact Hydro-1 (CP1): Decrease in Shasta Powerplant Energy Generation

Increasing the hydropower capabilities of Shasta Powerplant is one of the secondary objectives of the study. An increase in Shasta Powerplant energy generation is one indicator of the project's beneficial impacts. This impact would be potentially significant.

Table 23-10 shows an overall increase in monthly generation of 1 to 4 percent at Shasta Powerplant for CP1 compared to the existing condition. Similarly, CP1 shows an overall beneficial impact on hydropower generation from increases of 1 to 5 percent compared to the future condition. Although CP1 indicates an overall beneficial impact, monthly decreases in hydropower generation greater than 5 percent were observed 63 times in the existing condition level of

development and 95 times in the future condition level of development out of 984 occurrences.

Consequently, this impact would be potentially significant. Mitigation for this impact is not proposed because reductions in power generation from Shasta Powerplant would be offset by increased generation from other sources.

Table 23-10. Simulated Monthly Average Shasta Powerplant Energy Generation for CP1

Month	Existing Condition (2005)			Future Condition (2030)		
	Existing Condition (GWh)	CP1 Change (GWh (%))		No-Action Alternative (GWh)	CP1 Change (GWh (%))	
October	132	1	(1%)	123	1	(1%)
November	120	0	(0%)	114	1	(1%)
December	156	-1	(0%)	152	-1	(0%)
January	160	2	(1%)	162	0	(0%)
February	187	3	(2%)	183	9	(5%)
March	180	4	(2%)	179	1	(0%)
April	160	5	(3%)	160	5	(3%)
May	200	2	(1%)	202	1	(1%)
June	259	4	(2%)	257	3	(1%)
July	275	7	(2%)	280	7	(2%)
August	201	7	(4%)	209	6	(3%)
September	116	4	(3%)	124	3	(3%)
Total	2,146	39	(2%)	2,145	37	(2%)

Source: Common Assumptions Common Modeling Package Version 9 LongTermGen
Note:
Simulation period: 1922 – 2003
Key:
CP = Comprehensive Plan
GWh = gigawatt-hour

Upper Sacramento River Negligible effects on Power and Energy are expected to occur in the Upper Sacramento River geographic region; therefore, potential effects in that geographic region are not discussed further in this PDEIS.

Lower Sacramento River and Delta Negligible effects on Power and Energy are expected to occur in the Lower Sacramento River and Delta geographic region; therefore, potential effects in that geographic region are not discussed further in this PDEIS.

CVP/SWP Service Areas

Impact Hydro-2 (CP1): Decrease in CVP and SWP Powerplant Energy Generation Table 23-11 shows a beneficial impact from an overall increase in monthly generation at CVP powerplants of 1 to 2 percent for CP1 compared to the existing condition. A decrease in long-term monthly generation of 1 percent, observed for January and September, would be a less than significant impact. Similarly, CP1 shows an overall beneficial impact on hydropower generation from increases of 1 to 2 percent compared to the future condition. A decrease in long-term monthly average generation of 1 percent, in January, April, and September, would be a less than significant impact. However, when considering the maximum monthly for CP1 on hydropower generation, decreases greater than 5 percent were observed 75 times in the existing condition level of development and 93 times in the future condition level of development out of 984 occurrences. Consequently, there would be a potentially significant impact on CVP energy generation.

Table 23-11. Simulated Monthly Average CVP Energy Generation for CP1

Month	Existing Condition (2005)			Future Condition (2030)		
	Existing Condition (GWh)	CP1 Change (GWh (%))		No-Action Alternative (GWh)	CP1 Change (GWh (%))	
October	304	2	(1%)	292	3	(1%)
November	245	5	(2%)	234	4	(2%)
December	294	2	(1%)	284	4	(1%)
January	336	-3	(-1%)	332	-4	(-1%)
February	353	2	(0%)	346	7	(2%)
March	358	7	(2%)	357	2	(1%)
April	364	-2	(0%)	362	-2	(-1%)
May	511	2	(0%)	509	1	(0%)
June	587	7	(1%)	579	9	(1%)
July	678	11	(2%)	671	14	(2%)
August	533	5	(1%)	546	0	(0%)
September	370	-3	(-1%)	381	-4	(-1%)
Total	4,934	35	(1%)	4,893	34	(1%)

Source: Common Assumptions Common Modeling Package Version 9 LongTermGen

Note:
Simulation period: 1922 – 2003
Key:
CP = Comprehensive Plan
CVP = Central Valley Project
GWh = gigawatt-hour

Table 23-12 shows a beneficial impact from an overall increase in monthly generation at SWP powerplants of 1 percent for CP1 compared to the existing condition. A decrease in long-term monthly generation of 1 percent, observed for November, January and March, would be a less than significant impact. Similarly, CP1 shows an overall beneficial impact on hydropower generation from increases of 1 percent compared to the future condition. A decrease in long-term monthly average generation of 1 percent, in June, would be a less than significant impact. However, when considering the maximum monthly impact for CP1 on hydropower generation, decreases greater than 5 percent were observed 60 times in the existing condition level of development and 88 times in the future condition level of development out of 984 occurrences. Consequently, there would be a potentially significant impact on SWP energy generation.

Table 23-12. Simulated Monthly Average SWP Energy Generation for CP1

Month	Existing Condition (2005)			Future Condition (2030)		
	Existing Condition (GWh)	CP1 Change (GWh (%))		No-Action Alternative (GWh)	CP1 Change (GWh (%))	
October	325	2	(1%)	344	2	(1%)
November	269	-2	(-1%)	295	0	(0%)
December	322	0	(0%)	333	4	(1%)
January	348	-3	(-1%)	347	4	(1%)
February	408	-2	(0%)	422	1	(0%)
March	460	-4	(-1%)	465	-2	(0%)
April	392	2	(1%)	429	1	(0%)
May	475	3	(1%)	514	1	(0%)
June	523	3	(1%)	551	-3	(-1%)
July	508	6	(1%)	563	-1	(0%)
August	426	6	(1%)	462	-1	(0%)
September	341	2	(0%)	373	2	(0%)
Total	4,798	12	(0%)	5,097	9	(0%)

Source: Common Assumptions Common Modeling Package Version 9, SWP Power CA

Note:

Simulation period: 1922 – 2003

Key:

CP = Comprehensive Plan

SWP = State Water Project

GWh = gigawatt-hour

Therefore, this impact would be potentially significant. Mitigation for this impact is not proposed because reductions in power generation would be offset by increased generation from other sources.

Impact Hydro-3 (CP1): Increase in CVP and SWP Pumping Plant Energy Consumption Table 23-13 shows the change in monthly energy consumption at CVP pumping plants for CP1, compared to the existing condition that would result from additional pumping to accommodate the primary planning objectives of the study, increasing water supply reliability and anadromous fish survival. The greatest increase in long-term monthly average energy consumption, 3 percent, observed for March and July, would be a less than significant impact. Similar operations criteria governing CP1, compared to the future condition, resulted in a maximum increase of 2 percent in long-term average March energy consumption, which would also be a less than significant impact. However, when considering the maximum monthly impact for CP1 on energy consumption, increases greater than 5 percent were observed 97 times in the existing condition level of development and 104 times in the future condition level of development out of 984 occurrences. Consequently, there would be a potentially significant impact on CVP energy consumption.

Table 23-13. Simulated Monthly Average CVP Energy Consumption for CP1

Month	Existing Condition (2005)			Future Condition (2030)		
	Existing Condition (GWh)	CP1 Change (GWh (%))		No-Action Alternative (GWh)	CP1 Change (GWh (%))	
October	100	0	(0%)	101	1	(1%)
November	116	0	(0%)	123	1	(1%)
December	135	0	(0%)	144	0	(0%)
January	145	1	(0%)	151	-2	(-1%)
February	118	2	(2%)	109	1	(1%)
March	104	3	(3%)	85	2	(2%)
April	53	0	(0%)	53	0	(1%)
May	57	1	(1%)	59	1	(1%)
June	89	1	(1%)	90	0	(0%)
July	116	3	(3%)	125	2	(1%)
August	119	1	(1%)	126	0	(0%)
September	90	0	(0%)	98	1	(1%)
Total	1,243	11	(1%)	1,264	7	(1%)

Source: Common Assumptions Common Modeling Package Version 9 LongTermGen
Note:
Simulation period: 1922 – 2003
Key:
CP = Comprehensive Plan
CVP = Central Valley Project
GWh = gigawatt-hour

Table 23-14 shows the change in monthly energy consumption at SWP pumping plants for CP1, compared to the existing condition, resulting from additional pumping. The greatest increase in long-term monthly average energy consumption, 2 percent, observed for February, would be a less than significant impact. Similar operations criteria governing CP1, compared to the future condition, resulted in a maximum increase of 3 percent in long-term average January energy consumption, which would also be a less than significant impact. However, when considering the maximum monthly impact for CP1 on energy consumption, increases greater than 5 percent were observed 125 times in the existing condition level of development and 102 times in the future condition level of development out of 984 occurrences. Consequently, there would be a potentially significant impact on SWP energy consumption.

Therefore, this impact would be potentially significant. Mitigation for this impact is not proposed because increases in energy consumption would be offset by increased generation from other sources.

Table 23-14. Simulated Monthly Average SWP Energy Consumption for CP1

Month	Existing Condition (2005)			Future Condition (2030)		
	Existing Condition (GWh)	CP1 Change (GWh (%))		No-Action Alternative (GWh)	CP1 Change (GWh (%))	
October	685	6	(1%)	779	4	(1%)
November	625	8	(1%)	737	4	(1%)
December	673	5	(1%)	766	7	(1%)
January	753	9	(1%)	758	25	(3%)
February	750	12	(2%)	791	7	(1%)
March	815	0	(0%)	884	1	(0%)
April	700	8	(1%)	823	8	(1%)
May	763	6	(1%)	880	3	(0%)
June	801	8	(1%)	880	-2	(0%)
July	783	9	(1%)	897	3	(0%)
August	803	9	(1%)	905	1	(0%)
September	774	6	(1%)	881	0	(0%)
Total	8,925	86	(1%)	9,981	60	(1%)

Source: Common Assumptions Common Modeling Package Version 9, SWP Power CA
Note:
Simulation period: 1922 – 2003
Key:
CP = Comprehensive Plan
GWh = gigawatt-hour
SWP = State Water Project

Impact Hydro-4 (CP1): Decrease in CVP and SWP Net Energy Generation
Table 23-15 shows the change in net energy generation, which is the difference between the long-term monthly average energy generation and monthly average energy consumption, at all CVP plants for CP1, compared to the existing condition. Overall, CP1 shows a beneficial impact in the form of increased long-term monthly net energy generation. The greatest decrease in long-term monthly average net energy generation, 2 percent, observed for January, would be a less than significant impact. Similarly, an overall beneficial impact from increase in net energy generation was observed for CP1, compared to the future condition. A maximum decrease in net energy generation of 2 percent, observed for September, would also be a less than significant impact. However, when considering the maximum monthly impact for CP1 on net energy generation, decreases greater than 5 percent were observed 128 times in the existing condition level of development and 158 times in the future condition level of development out of 984 occurrences. Consequently, there would be a potentially significant impact on CVP net energy generation.

Table 23-15. Simulated Monthly Average CVP Net Energy Generation for CP1

Month	Existing Condition (2005)			Future Condition (2030)		
	Existing Condition (GWh)	CP1 Change (GWh (%))		No-Action Alternative (GWh)	CP1 Change (GWh (%))	
October	204	2	(1%)	191	2	(1%)
November	129	5	(4%)	111	3	(3%)
December	159	1	(1%)	141	4	(3%)
January	191	-4	(-2%)	181	-2	(-1%)
February	235	0	(0%)	237	6	(3%)
March	254	4	(2%)	272	1	(0%)
April	311	-1	(0%)	310	-2	(-1%)
May	454	2	(0%)	449	1	(0%)
June	497	6	(1%)	488	8	(2%)
July	562	8	(1%)	545	13	(2%)
August	414	3	(1%)	420	0	(0%)
September	280	-3	(-1%)	283	-5	(-2%)
Total	3,691	24	(1%)	3,629	27	(1%)

Source: Common Assumptions Common Modeling Package Version 9 LongTermGen

Note:
Simulation period: 1922 – 2003
Key:
CP = Comprehensive Plan
CVP = Central Valley Project
GWh = gigawatt-hour

Table 23-16 shows the change in net energy generation, which is the difference between the long-term monthly average energy generation and monthly average energy consumption, at all SWP plants for CP1 compared to the existing condition. CP1 shows an overall decrease in long-term monthly net energy generation; the greatest decrease, 4 percent, occurring in February, would be a less than significant impact. Similarly, an overall decrease in net energy generation was observed for CP1 compared to the future condition; the greatest decrease, 5 percent, observed for January, would also be a less than significant impact. However, when considering the maximum monthly impact for CP1 on net energy generation, decreases greater than 5 percent were observed 54 times in the existing condition level of development and 84 times in the future condition level of development out of 984 occurrences. Consequently, there would be a potentially significant impact on SWP net energy generation.

Therefore, this impact would be potentially significant. Mitigation for this impact is not proposed because reductions in power generation would be offset by increased generation from other sources.

Table 23-16. Simulated Monthly Average SWP Net Energy Generation for CP1

Month	Existing Condition (2005)			Future Condition (2030)		
	Existing Condition (GWh)	CP1 Change (GWh (%))		No-Action Alternative (GWh)	CP1 Change (GWh (%))	
October	-360	-4	(1%)	-435	-2	(1%)
November	-356	-10	(3%)	-441	-4	(1%)
December	-351	-5	(1%)	-433	-3	(1%)
January	-405	-12	(3%)	-411	-21	(5%)
February	-342	-13	(4%)	-369	-5	(1%)
March	-355	-5	(1%)	-419	-2	(1%)
April	-308	-6	(2%)	-394	-7	(2%)
May	-288	-3	(1%)	-366	-2	(1%)
June	-278	-4	(2%)	-329	-1	(0%)
July	-275	-3	(1%)	-335	-4	(1%)
August	-378	-3	(1%)	-443	-1	(0%)
September	-433	-5	(1%)	-508	2	(0%)
Total	-4,128	-74	(2%)	-4,884	-51	(1%)

Source: Common Assumptions Common Modeling Package Version 9, SWP Power CA

Note:
Simulation period: 1922 – 2003
Key:
CP = Comprehensive Plan
GWh = megawatt-hour
SWP = State Water Project

Impact Hydro-5 (CP1): Decrease in Pit 7 Powerplant Net Energy Generation
Table 23-17 shows the estimate of decreased energy production on Pit 7 Details

are included in Attachment 1 of the Power and Energy Technical Report, on energy generation, consumption, and change for CP1 compared to the existing condition and No-Action Alternative for all CVP and SWP powerplants and pumping plants.

Powerplant under CP1. Pit 7 Powerplant energy production would generally decrease only when the raised Shasta pool is higher than the normal Pit 7 tailwater elevation of 1,067 feet above msl based on National Geodetic Vertical Datum of 1929 (NGVD29). Assuming that the historic annual pattern of Shasta pool levels would be maintained with the higher maximum pool, in an average year, Pit 7 Powerplant energy production would decrease from March through July. These 5 months typically provide roughly 47 percent of the total average annual energy production. Taking these factors into account, total Pit 7 Powerplant average annual energy production for CP1 could decrease by roughly 4 gigawatt-hours (GWh) (1 percent) from the existing condition and future condition. Looking at maximum monthly impact for CP1, the decrease in net energy generation is less than 5 percent, which is a less than significant impact.

Table 23-17. Simulated Monthly Average Pit 7 Powerplant Energy Generation for CP1

Month	Existing Condition (2005)			Future Condition (2030)		
	Existing Condition (GWh)	CP1 Change (GWh (%))		No-Action Alternative (GWh)	CP1 Change (GWh (%))	
January	52.6	0.0	(0%)	52.6	0.0	(0%)
February	52.6	0.0	(0%)	52.6	0.0	(0%)
March	64.6	-0.2	(0%)	64.6	-0.2	(0%)
April	57.8	-1.4	(-2%)	57.8	-1.4	(-2%)
May	52.1	-1.5	(-3%)	52.1	-1.5	(-3%)
June	38.5	-0.7	(-2%)	38.5	-0.7	(-2%)
July	33.2	-0.1	(0%)	33.2	-0.1	(0%)
August	31.2	0.0	(0%)	31.2	0.0	(0%)
September	30.9	0.0	(0%)	30.9	0.0	(0%)
October	33.6	0.0	(0%)	33.6	0.0	(0%)
November	36.7	0.0	(0%)	36.7	0.0	(0%)
December	45.1	0.0	(0%)	45.1	0.0	(0%)
Total	528.9	-4.0	(-1%)	528.9	-4.0	(-1%)

Source: Spreadsheet model, Pit 7 Dam MONTHLY AVG.xls,2007

Note:
Simulation period: 1922 – 2003
Key:
CP = Comprehensive Plan
GWh = gigawatt-hour

Under the existing condition, the turbines operate over a net head range of approximately 173 to 204 feet. Under the 6.5-foot Shasta Dam raise option, the operating range of net head would decrease to about 168 to 193 feet, an approximately 4 percent decrease in net head. Assuming peak turbine efficiency is approximately 204 feet net head, the potential future minimum net head of 168 feet would be about 82 percent of the peak efficiency net head, which would still be an acceptable range for continuous operation. A decrease in maximum net head from 204 feet to 193 feet would reduce each unit's generating capacity by approximately 5 percent, from the current 56 MWh to approximately 53 MWh.

For these reasons, this impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

CP2 – 12.5-Foot Dam Raise, Anadromous Fish Survival and Water Supply Reliability

As with CP1, this Comprehensive Plan focuses on enlargement of Shasta Dam and Reservoir consistent with the goals of the 2000 CALFED ROD, and was formulated for the primary purposes of increased water supply reliability and increased anadromous fish survival. In addition to the common features above, CP2 consists of raising Shasta Dam 12.5 feet, an elevation change that increases the full pool by 14.5 feet, and enlarges the total storage space in the reservoir by 443,000 acre-feet. This alternative would help reduce future shortages by increasing drought and average year water supply reliability. The increased cold-water pool also would contribute to improved seasonal water temperatures for anadromous fish on the upper Sacramento River.

Simulations of CP2 did not involve any changes to the modeling logic for deliveries or flow requirements; all benchmark rules were updated to include the new storage, but were not otherwise changed.

Shasta Lake and Vicinity

Impact Hydro-1 (CP2): Decrease in Shasta Powerplant Energy Generation A decrease in Shasta Dam energy generation is one indicator of project impacts because increasing the hydropower capabilities of Shasta Powerplant is one of the secondary planning objectives of the study. This impact would be potentially significant.

Table 23-18 shows an overall beneficial impact from increase in monthly generation at Shasta Powerplant for CP2 of 38 percent in December to 157 percent in April, compared to the existing condition. Similarly, CP2 shows an overall beneficial impact from increase in hydropower generation of 2 to 5 percent compared to the future condition. A decrease of 2 percent in long-term average energy generation, observed for December, would be a less than significant impact. The increase in power generation is due to raising Shasta Dam by 14.5 feet, which would increase the available head for power generation. However, when considering the maximum monthly impact for CP2

in hydropower generation, decreases greater than 5 percent were observed 9 times in the existing condition level of development and 88 times in the future condition level of development out of 984 occurrences.

Therefore, this impact would be potentially significant. Mitigation for this impact is not proposed because reductions in power generation would be offset by increased generation from other sources.

Upper Sacramento River Negligible effects on Power and Energy are expected to occur in the Upper Sacramento River geographic region; therefore, potential effects in that geographic region are not discussed further in this PDEIS.

Lower Sacramento River and Delta Negligible effects on Power and Energy are expected to occur in the Lower Sacramento River and Delta geographic region; therefore, potential effects in that geographic region are not discussed further in this PDEIS.

Table 23-18. Simulated Monthly Average Shasta Powerplant Energy Generation for CP2

Month	Existing Condition (2005)			Future Condition (2030)		
	Existing Condition (GWh)	CP2 Change (GWh (%))		No-Action Alternative (GWh)	CP2 Change (GWh (%))	
October	132	66	(50%)	123	4	(3%)
November	120	53	(44%)	114	3	(3%)
December	156	59	(38%)	152	-2	(-2%)
January	160	79	(50%)	162	3	(2%)
February	187	106	(57%)	183	9	(5%)
March	180	168	(94%)	179	3	(2%)
April	160	251	(157%)	160	7	(4%)
May	200	261	(131%)	202	4	(2%)
June	259	214	(83%)	257	9	(4%)
July	275	189	(69%)	280	12	(4%)
August	201	155	(77%)	209	9	(4%)
September	116	85	(73%)	124	4	(3%)
Total	2,146	1687	(79%)	2,145	64	(3%)

Source: Common Assumptions Common Modeling Package Version 9 LongTermGen
Note:
Simulation period: 1922 – 2003

Key:
CP = Comprehensive Plan
GWh = gigawatt-hour

CVP/SWP Service Areas

Impact Hydro-2 (CP2): Decrease in CVP and SWP Powerplant Energy Generation Table 23-19 shows an overall beneficial impact from an increase in monthly generation of 21 to 67 percent at CVP powerplants for CP2, compared to the existing condition. Similarly, CP2 shows an overall beneficial impact from increases on hydropower generation of 1 to 3 percent compared to the future condition. A decrease in long-term monthly average energy generation of 1 percent, observed for January, would be a less than significant impact. However, when considering the maximum monthly impact for CP2 on hydropower generation, decreases greater than 5 percent were observed 79 times in the existing condition level of development and 93 times in the future condition level of development out of 984 occurrences. Consequently, there would be a potentially significant impact on CVP energy generation.

Table 23-19. Simulated Monthly Average CVP Energy Generation for CP2

Month	Existing Condition (2005)			Future Condition (2030)		
	Existing Condition (GWh)	CP2 Change (GWh (%))		No-Action Alternative (GWh)	CP2 Change (GWh (%))	
October	304	65	(21%)	292	3	(1%)
November	245	56	(23%)	234	3	(1%)
December	294	62	(21%)	284	4	(1%)
January	336	72	(21%)	332	-3	(-1%)
February	353	105	(30%)	346	8	(2%)
March	358	171	(48%)	357	3	(1%)
April	364	244	(67%)	362	0	(0%)
May	511	261	(51%)	509	3	(1%)
June	587	218	(37%)	579	12	(2%)
July	678	192	(28%)	671	22	(3%)
August	533	154	(29%)	546	7	(1%)
September	370	82	(22%)	381	0	(0%)
Total	4,934	1681	(34%)	4,893	62	(1%)

Source: Common Assumptions Common Modeling Package Version 9 LongTermGen
Note:
Simulation period: 1922 – 2003
Key:
CP = Comprehensive Plan
CVP= Central Valley Project
GWh = gigawatt-hour

Table 23-20 shows an overall beneficial impact from an increase in monthly generation at SWP powerplants of 1 to 2 percent for CP2, compared to the existing condition. A decrease in long-term monthly generation of 1 percent, observed for November, January, February, and March, would be a less than significant impact. Similarly, CP2 shows an overall beneficial impact from increases of approximately 1 percent in hydropower generation compared to the future condition. A decrease of long-term monthly average energy generation of less than 1 percent, observed for June, would be a less than significant impact. However, when considering the maximum monthly impact for CP2 on hydropower generation, decreases greater than 5 percent were observed 61 times in the existing condition level of development and 100 times in the future condition level of development out of 984 occurrences. Consequently, there would be a potentially significant impact on SWP energy generation.

For these reasons, this impact would be potentially significant. Mitigation for this impact is not proposed because reductions in power generation would be offset by increased generation from other sources.

Table 23-20. Simulated Monthly Average SWP Energy Generation for CP2

Month	Existing Condition (2005)			Future Condition (2030)		
	Existing Condition (GWh)	CP2 Change (GWh (%))		No-Action Alternative (GWh)	CP2 Change (GWh (%))	
October	325	3	(1%)	344	2	(1%)
November	269	-2	(-1%)	295	0	(0%)
December	322	2	(1%)	333	3	(1%)
January	348	-4	(-1%)	347	4	(1%)
February	408	-2	(-1%)	422	0	(0%)
March	460	-5	(-1%)	465	0	(0%)
April	392	3	(1%)	429	2	(1%)
May	475	3	(1%)	514	0	(0%)
June	523	4	(1%)	551	-5	(-1%)
July	508	6	(1%)	563	-2	(0%)
August	426	7	(2%)	462	-1	(0%)
September	341	1	(0%)	373	3	(1%)
Total	4,798	16	(0%)	5,097	6	(0%)

Source: Common Assumptions Common Modeling Package Version 9, SWP Power CA
Note:
Simulation period: 1922 – 2003
Key:
CP = Comprehensive Plan
GWh = gigawatt-hour
SWP = State Water Project

Impact Hydro-3 (CP2): Increase in CVP and SWP Pumping Plant Energy Consumption Table 23-21 shows the change in monthly energy consumption at CVP pumping plants for CP2, compared to the existing condition, resulting from additional pumping to accommodate the primary planning objectives of the study, increasing water supply reliability and anadromous fish survival. The greatest increase in long-term monthly average energy consumption, 3 percent, observed for July, would be a less than significant impact. Similar operations criteria governing CP2 compared to the future condition resulted in a maximum increase of 3 percent in long-term February average energy consumption, which also would be a less than significant impact. However, when considering the maximum monthly impact for CP2 on energy consumption, increases greater than 5 percent were observed 99 times in the existing condition level of development and 124 times in the future condition level of development out of 984 occurrences. Consequently, there would be a potentially significant impact

Table 23-21. Simulated Monthly Average CVP Energy Consumption for CP2

Month	Existing Condition (2005)			Future Condition (2030)		
	Existing Condition (GWh)	CP2 Change (GWh (%))		No-Action Alternative (GWh)	CP2 Change (GWh (%))	
October	100	-1	(-1%)	101	2	(2%)
November	116	0	(0%)	123	2	(1%)
December	135	0	(0%)	144	1	(1%)
January	145	1	(1%)	151	-1	(-1%)
February	118	2	(1%)	109	3	(3%)
March	104	2	(2%)	85	0	(0%)
April	53	0	(0%)	53	0	(1%)
May	57	1	(1%)	59	1	(1%)
June	89	1	(1%)	90	1	(1%)
July	116	3	(3%)	125	3	(2%)
August	119	2	(2%)	126	2	(1%)
September	90	0	(0%)	98	2	(2%)
Total	1,243	11	(1%)	1,264	14	(1%)

Source: Common Assumptions Common Modeling Package Version 9 LongTermGen

Note:
Simulation period: 1922 – 2003
Key:
CP = Comprehensive Plan
CVP = Central Valley Project
GWh = gigawatt-hour

Table 23-22 shows the change in monthly energy consumption at SWP pumping plants for CP2, compared to the existing condition, resulting from additional pumping. The greatest increase in long-term monthly average energy consumption, 2 percent, observed for November, would be a less than significant impact. Similar operations criteria governing CP2 compared to the future condition resulted in a maximum increase of 3 percent in long-term January average energy consumption, which would also be a less than significant impact. However, when considering the maximum monthly impact for CP2 in energy consumption, increases greater than 5 percent were observed 134 times in the existing condition level of development and 95 times in the future condition level of development out of 984 occurrences. Consequently, there would be a potentially significant impact on SWP energy consumption.

For these reasons, this impact would be potentially significant. Mitigation for this impact is not proposed because increases in energy consumption would be offset by increased generation from other sources.

Table 23-22. Simulated Monthly Average SWP Energy Consumption for CP2

Month	Existing Condition (2005)			Future Condition (2030)		
	Existing Condition (GWh)	CP2 Change (GWh (%))		No-Action Alternative (GWh)	CP2 Change (GWh (%))	
October	685	8	(1%)	779	3	(0%)
November	625	10	(2%)	737	3	(0%)
December	673	8	(1%)	766	6	(1%)
January	753	7	(1%)	758	24	(3%)
February	750	11	(1%)	791	6	(1%)
March	815	-2	(0%)	884	3	(0%)
April	700	10	(1%)	823	9	(1%)
May	763	7	(1%)	880	1	(0%)
June	801	9	(1%)	880	-4	(0%)
July	783	10	(1%)	897	1	(0%)
August	803	10	(1%)	905	-1	(0%)
September	774	7	(1%)	881	-2	(0%)
Total	8,925	92	(1%)	9,981	49	(0%)

Source: Common Assumptions Common Modeling Package Version 9, SWP Power CA
Note:
Simulation period: 1922 – 2003

Key:
CP = Comprehensive Plan
GWh = gigawatt-hour
SWP = State Water Project

Impact Hydro-4 (CP2): Decrease in CVP and SWP Net Energy Generation
Table 23-23 shows the change in net energy generation, which is the difference between long-term monthly average energy generation and monthly average energy consumption, at all CVP plants for CP2 compared to the existing condition. Overall, CP2 shows a beneficial impact in the form of increased long-term monthly net energy generation, ranging from 29 percent in September to 78 percent in April. No decrease in long-term monthly average net energy generation was observed. Similarly, an overall beneficial impact from increase in net energy generation was observed for CP2 compared to the future condition. A maximum decrease in net energy generation of 1 percent, observed for January and September, would be a less than significant impact. However, when considering the maximum monthly impact for CP2 on net energy generation, decreases greater than 5 percent were observed 127 times in the existing condition level of development and 150 times in future condition out of 984 occurrences. Consequently, there would be a potentially significant impact on CVP net energy generation.

Table 23-23. Simulated Monthly Average CVP Net Energy Generation for CP2

Month	Existing Condition (2005)			Future Condition (2030)		
	Existing Condition (GWh)	CP2 Change (GWh (%))		No-Action Alternative (GWh)	CP2 Change (GWh (%))	
October	204	66	(32%)	191	1	(1%)
November	129	56	(43%)	111	2	(2%)
December	159	62	(39%)	141	2	(2%)
January	191	71	(37%)	181	-2	(-1%)
February	235	103	(44%)	237	6	(2%)
March	254	169	(67%)	272	3	(1%)
April	311	244	(78%)	310	-1	(0%)
May	454	260	(57%)	449	2	(0%)
June	497	217	(44%)	488	11	(2%)
July	562	189	(34%)	545	19	(3%)
August	414	152	(37%)	420	5	(1%)
September	280	82	(29%)	283	-2	(-1%)
Total	3,691	1670	(45%)	3,629	47	(1%)

Source: Common Assumptions Common Modeling Package Version 9 LongTermGen
Note:
Simulation period: 1922 – 2003

Key:
CP = Comprehensive Plan
CVP = Central Valley Project
GWh = gigawatt-hour

Table 23-24 shows the change in net energy generation, which is the difference between long-term monthly average energy generation and monthly average energy consumption, all SWP plants for CP2 compared to the existing condition. Table 23-16 also shows a decrease in net energy generation in all months. The decrease of 1 to 4 percent, with an annual decrease of 2 percent, would be a less than significant impact. Similarly, an overall decrease in net energy generation was observed for CP2 compared to the future condition. The decrease, ranging from 1 percent to 5 percent, would be a less than significant impact. The only beneficial impact from increase in net generation of 1 percent was observed for September. However, when considering the maximum monthly impact for CP2 on net energy generation, decreases greater than 5 percent were observed 58 times in the existing condition level of development and 99 times in the future condition level of development out of 984 occurrences. Consequently, there would be a potentially significant impact on SWP net energy generation.

For these reasons, this impact would be potentially significant. Mitigation for this impact is not proposed because reductions in power generation would be offset by increased generation from other sources.

Table 23-24. Simulated Monthly Average SWP Average Net Energy Generation for CP2

Month	Existing Condition (2005)			Future Condition (2030)		
	Existing Condition (GWh)	CP2 Change (GWh (%))		No-Action Alternative (GWh)	CP2 Change (GWh (%))	
October	-360	-5	(1%)	-435	-1	(0%)
November	-356	-11	(3%)	-441	-4	(1%)
December	-351	-6	(2%)	-433	-3	(1%)
January	-405	-10	(3%)	-411	-20	(5%)
February	-342	-13	(4%)	-369	-6	(2%)
March	-355	-4	(1%)	-419	-3	(1%)
April	-308	-7	(2%)	-394	-7	(2%)
May	-288	-3	(1%)	-366	-1	(0%)
June	-278	-5	(2%)	-329	-1	(0%)
July	-275	-4	(1%)	-335	-2	(1%)
August	-378	-3	(1%)	-443	0	(0%)
September	-433	-5	(1%)	-508	5	(-1%)
Total	-4,128	-76	(2%)	-4,884	-43	(1%)

Source: Common Assumptions Common Modeling Package Version 9, SWP Power CA
Note:
Simulation period: 1922 – 2003
Key:
CP = Comprehensive Plan
GWh = gigawatt-hour
SWP = State Water Project

Details are included in Attachment 1 of the Power and Energy Technical Report, for energy generation, consumption, and change for CP2 compared to the existing condition and No-Action Alternative for all CVP and SWP powerplants and pumping plants.

Impact Hydro-5 (CP2): Decrease in Pit 7 Powerplant Net Energy Generation
Table 23-25 shows an estimate of reduced energy production for the Pit 7 Powerplant under CP2. Energy production for the Pit 7 Powerplant would generally decrease only when the raised Shasta pool is higher than the normal Pit 7 tailwater elevation of 1,067 feet above msl (NGVD29). Assuming that the historic annual pattern of Shasta pool level is maintained with the higher maximum pool, in an average year, Pit 7 Powerplant energy production would decrease from February through July. These 6 months typically provide roughly 56 percent of the total average annual energy production. Therefore, total average annual energy production for the Pit 7 Powerplant for CP2 could decrease by roughly 8.3 GWh (2 percent) from the existing condition and 8.2 GWh (2 percent) from the future condition. Considering the maximum monthly impact for CP2, decreases in net energy generation greater than 5 percent were observed in several instances, particularly in March through June, which could be a potentially significant impact on Pit 7 Powerplant net energy generation.

Table 23-25. Simulated Monthly Average Pit 7 Powerplant Energy Generation for CP2

Month	Existing Condition (2005)			Future Condition (2030)		
	Existing Condition (GWh)	CP2 Change (GWh (%))		No-Action Alternative (GWh)	CP2 Change (GWh (%))	
January	52.6	0.0	(0%)	52.6	0.0	(0%)
February	52.6	-0.1	(0%)	52.6	-0.1	(0%)
March	64.6	-1.1	(-2%)	64.6	-1.1	(-2%)
April	57.8	-2.7	(-5%)	57.8	-2.7	(-5%)
May	52.1	-2.7	(-5%)	52.1	-2.7	(-5%)
June	38.5	-1.4	(-4%)	38.5	-1.4	(-4%)
July	33.2	-0.4	(-1%)	33.2	-0.3	(-1%)
August	31.2	0.0	(0%)	31.2	0.0	(0%)
September	30.9	0.0	(0%)	30.9	0.0	(0%)
October	33.6	0.0	(0%)	33.6	0.0	(0%)
November	36.7	0.0	(0%)	36.7	0.0	(0%)
December	45.1	0.0	(0%)	45.1	0.0	(0%)
Total	528.9	-8.3	(-2%)	528.9	-8.2	(-2%)

Source: Spreadsheet model, Pit 7 Dam MONTHLY AVG.xls,2007
Note:
Simulation period: 1922 – 2003
Key:
CP = Comprehensive Plan
GWh = gigawatt-hour

Under the existing condition, the turbines operate over a net head range of approximately 173 to 204 feet. Under the 12.5-foot Shasta Dam raise option, the operating range of net head would decrease to about 162 to 187 feet, an approximate 7 percent reduction in net head. Assuming peak turbine efficiency is approximately 204 feet of net head, the potential future minimum net head of 162 feet would be about 79 percent of the peak efficiency net head, which should be an acceptable range for continuous operation. A reduction in maximum net head from 204 feet to 187 feet would reduce each unit's generating capacity by approximately 8 percent, from the current 56 MW to approximately 51 MW.

For these reasons, this impact would be potentially significant. Mitigation for this impact is not proposed because reductions in power generation would be offset by increased generation from other sources.

CP3 – 18.5-Foot Dam Raise, Anadromous Fish Survival and Water Supply Reliability

CP3 is similar to CP1 and CP2. It focuses on the greatest practical enlargement of Shasta Dam and Reservoir consistent with the goals of the 2000 CALFED ROD, and was formulated for the primary purposes of increased water supply reliability and increased anadromous fish survival. In addition to the common features above, CP3 consists of raising Shasta Dam 18.5 feet, an elevation change that increases the full pool by 20.5 feet, and enlarges the total storage space in the reservoir by 634,000 acre-feet to 5.19 million acre-feet. This Comprehensive Plan would help reduce future shortages by increasing drought and average year water supply reliability. The increased pool depth and volume would also contribute to improving seasonal water temperatures for anadromous fish on the upper Sacramento River.

Simulations of CP3 did not involve any changes to the modeling logic for deliveries or flow requirements; all benchmark rules were updated to include the new storage, but were not otherwise changed.

Shasta Lake and Vicinity

Impact Hydro-1 (CP3): Decrease in Shasta Powerplant Energy Generation A decrease in Shasta Dam energy generation is one indicator of project impacts because increasing the hydropower capabilities of the Shasta Powerplant is a secondary planning objective of the study. This impact would be potentially significant.

Table 23-26 shows a large beneficial impact from increase in monthly generation at the Shasta Powerplant, ranging from 37 percent in December to 159 percent in April, for CP3 compared to the existing condition. No decrease in long-term monthly generation was observed. Similarly, CP3 shows an overall beneficial impact from increases on hydropower generation, ranging from 2 percent in January to 7 percent in August, compared to the future condition. A decrease in long-term average energy generation of 2 percent, observed for

December, would be a less than significant impact. However, when considering the maximum monthly impact for CP3 on hydropower generation, decreases greater than 5 percent were observed 11 times in the existing condition level of development and 84 times in the future condition level of development out of 984 occurrences.

For these reasons, this impact would be potentially significant. Mitigation for this impact is not proposed because reductions in power generation would be offset by increased generation from other sources.

Upper Sacramento River Negligible effects on Power and Energy are expected to occur in the Upper Sacramento River geographic region; therefore, potential effects in that geographic region are not discussed further in this PDEIS.

Lower Sacramento River and Delta Negligible effects on Power and Energy are expected to occur in the Lower Sacramento River and Delta geographic region; therefore, potential effects in that geographic region are not discussed further in this PDEIS.

Table 23-26. Simulated Monthly Average Shasta Powerplant Energy for Generation for CP3 and CP5

Month	Existing Condition (2005)			Future Condition (2030)		
	Existing Condition (GWh)	CP3 /CP5 Change (GWh (%))		No-Action Alternative (GWh)	CP3/CP5 Change (GWh (%))	
October	132	69	(52%)	123	7	(5%)
November	120	56	(47%)	114	6	(5%)
December	156	58	(37%)	152	-3	(-2%)
January	160	80	(50%)	162	4	(2%)
February	187	108	(57%)	183	10	(6%)
March	180	178	(99%)	179	7	(4%)
April	160	255	(159%)	160	9	(6%)
May	200	265	(132%)	202	7	(4%)
June	259	216	(84%)	257	12	(5%)
July	275	193	(70%)	280	14	(5%)
August	201	163	(81%)	209	14	(7%)
September	116	87	(75%)	124	6	(5%)
Total	2,146	1,726	(80%)	2,145	92	(4%)

Source: Common Assumptions Common Modeling Package Version 9 LongTermGen
Note:
Simulation period: 1922 – 2003
Key:
CP = Comprehensive Plan
GWh = gigawatt-hour

CVP/SWP Service Areas

Impact Hydro-2 (CP3): Decrease in CVP and SWP Powerplant Energy Generation Table 23-27 shows large increases in monthly generation of 21 to 68 percent at CVP powerplants for CP3 compared to the existing condition. No decrease in long-term monthly generation was observed. Similarly, CP3 shows an overall beneficial impact from increases on hydropower generation of 1 to 4 percent compared to the future condition. A decrease in long-term monthly average energy generation of 1 percent, observed for January, would be a less than significant impact. However, when considering the maximum monthly impact for CP3 on hydropower generation, decreases greater than 5 percent were observed 96 times in the existing condition level of development and 101 times in the future condition level of development out of 984 occurrences. Consequently, there would be a potentially significant impact on CVP energy generation.

Table 23-27. Simulated Monthly Average CVP Energy Generation for CP3 and CP5

Month	Existing Condition (2005)			Future Condition (2030)		
	Existing Condition (GWh)	CP3/CP5 Change (GWh (%))		No-Action Alternative (GWh)	CP3/CP5 Change (GWh (%))	
October	304	67	(22%)	292	3	(1%)
November	245	57	(23%)	234	2	(1%)
December	294	61	(21%)	284	3	(1%)
January	336	71	(21%)	332	-2	(-1%)
February	353	107	(30%)	346	10	(3%)
March	358	181	(51%)	357	6	(2%)
April	364	248	(68%)	362	3	(1%)
May	511	264	(52%)	509	7	(1%)
June	587	219	(37%)	579	17	(3%)
July	678	199	(29%)	671	29	(4%)
August	533	160	(30%)	546	11	(2%)
September	370	84	(23%)	381	0	(0%)
Total	4,934	1,718	(35%)	4,893	88	(2%)

Source: Common Assumptions Common Modeling Package Version 9 LongTermGen
Note:
Simulation period: 1922 – 2003
Key:
CP = Comprehensive Plan
CVP = Central Valley Project
GWh = gigawatt-hour

Table 23-28 shows an overall beneficial impact from increases on monthly generation of 1 to 2 percent at SWP powerplants for CP3 compared to the existing condition. A decrease in long-term monthly generation of 1 percent, observed for January, March, and November, would be a less than significant impact. Similarly, CP3 shows a less than significant impact from decreases in hydropower generation compared to the future condition. A decrease in long-term monthly generation of 1 percent was observed for June. However, when considering the maximum monthly impact for CP3 on hydropower generation, decreases greater than 5 percent were observed 56 times in the existing condition level of development and 98 times in the future condition level of development out of 984 occurrences. Consequently, there would be a potentially significant impact on SWP energy generation.

For these reasons, this impact would be potentially significant. Mitigation for this impact is not proposed because reductions in power generation would be offset by increased generation from other sources.

Table 23-28. Simulated Monthly Average SWP Energy Generation for CP3 and CP5

Month	Existing Condition (2005)			Future Condition (2030)		
	Existing Condition (GWh)	CP3 Change (GWh (%))		No-Action Alternative (GWh)	CP3 Change (GWh (%))	
October	325	3	(1%)	344	2	(1%)
November	269	-3	(-1%)	295	0	(0%)
December	322	2	(1%)	333	4	(1%)
January	348	-3	(-1%)	347	4	(1%)
February	408	-1	(0%)	422	0	(0%)
March	460	-4	(-1%)	465	-2	(0%)
April	392	3	(1%)	429	2	(1%)
May	475	2	(0%)	514	0	(0%)
June	523	3	(1%)	551	-7	(-1%)
July	508	5	(1%)	563	0	(0%)
August	426	7	(2%)	462	-1	(0%)
September	341	1	(0%)	373	5	(1%)
Total	4,798	14	(0%)	5,097	7	(0%)

Source: Common Assumptions Common Modeling Package Version 9, SWP Power CA
Note:
Simulation period: 1922 – 2003
Key:
CP = Comprehensive Plan
GWh = gigawatt-hour
SWP = State Water Project

Impact Hydro-3 (CP3): Increase in CVP and SWP Pumping Plant Energy Consumption Table 23-29 shows the change in monthly energy consumption at CVP pumping plants for CP3 compared to the existing condition, resulting from additional pumping to accommodate the primary planning objectives of the study, increasing water supply reliability and anadromous fish survival. An increase in long-term monthly average energy consumption of 3 percent, observed for July, would be a less than significant impact. Similar operations criteria governing CP3, compared to the future condition, resulted in an increase of 3 percent for long-term average February and July energy consumption, which would also be a less than significant impact. However, when considering the maximum monthly impact for CP3 on energy consumption, increases greater than 5 percent were observed 116 times in the existing condition level of development and 148 times in the future condition level of development out of 984 occurrences. Consequently, there would be a potentially significant impact on CVP energy consumption.

Table 23-29. Simulated Monthly Average CVP Energy Consumption for CP3 and CP5

Month	Existing Condition (2005)			Future Condition (2030)		
	Existing Condition (GWh)	CP3/CP5 Change (GWh (%))		No-Action Alternative (GWh)	CP3/CP5 Change (GWh (%))	
October	100	0	(0%)	101	2	(2%)
November	116	1	(1%)	123	2	(1%)
December	135	0	(0%)	144	2	(2%)
January	145	0	(0%)	151	-2	(-1%)
February	118	1	(1%)	109	4	(3%)
March	104	0	(0%)	85	1	(1%)
April	53	0	(0%)	53	0	(1%)
May	57	1	(1%)	59	1	(2%)
June	89	2	(2%)	90	2	(2%)
July	116	4	(3%)	125	4	(3%)
August	119	3	(2%)	126	3	(2%)
September	90	0	(1%)	98	2	(2%)
Total	1,243	12	(1%)	1,264	21	(2%)

Source: Common Assumptions Common Modeling Package Version 9 LongTermGen
Note:
Simulation period: 1922 – 2003
Key:
CP = Comprehensive Plan
CVP = Central Valley Project
GWh = gigawatt-hour

Table 23-30 shows the change in monthly energy consumption at SWP pumping plants resulting from additional pumping for CP3 compared to the existing condition. The greatest increase in long-term monthly average energy consumption, 2 percent, observed for February, would be a less than significant impact. Similar operations criteria governing CP3 compared to the future condition resulted in a maximum increase of 3 percent for long-term average energy consumption in January, which would also be a less than significant impact. However, when considering the maximum monthly impact for CP3 on energy consumption, increases greater than 5 percent were observed 129 times in the existing condition level of development and 108 times in the future condition level of development out of 984 occurrences. Consequently, there would be a potentially significant impact on SWP energy consumption.

For these reasons, this impact would be potentially significant. Mitigation for this impact is not proposed because increases in energy consumption would be offset by increased generation from other sources.

Table 23-30. Simulated Monthly Average SWP Energy Consumption for CP3 and CP5

Month	Existing Condition (2005)			Future Condition (2030)		
	Existing Condition (GWh)	CP3 Change (GWh (%))		No-Action Alternative (GWh)	CP3 Change (GWh (%))	
October	685	7	(1%)	779	5	(1%)
November	625	9	(1%)	737	4	(1%)
December	673	8	(1%)	766	7	(1%)
January	753	11	(1%)	758	25	(3%)
February	750	14	(2%)	791	7	(1%)
March	815	1	(0%)	884	0	(0%)
April	700	8	(1%)	823	10	(1%)
May	763	5	(1%)	880	0	(0%)
June	801	6	(1%)	880	-9	(-1%)
July	783	8	(1%)	897	3	(0%)
August	803	8	(1%)	905	-1	(0%)
September	774	6	(1%)	881	-1	(0%)
Total	8,925	90	(1%)	9,981	51	(1%)

Source: Common Assumptions Common Modeling Package Version 9, SWP Power CA
Note:
Simulation period: 1922 – 2003
Key:
CP = Comprehensive Plan
GWh = gigawatt-hour
SWP = State Water Project

Impact Hydro-4 (CP3): Decrease in CVP and SWP Net Energy Generation
Table 23-31 shows the change in net energy generation, which is the difference between the long-term monthly average energy generation and monthly average energy consumption, at all CVP plants for CP3 compared to the existing condition. Overall, CP3 shows a beneficial impact in the form of increased long-term monthly net energy generation. No decrease in long-term monthly average net generation was observed. Similarly, an overall beneficial impact from increases on net energy generations was observed for CP3 compared to the future condition. A maximum decrease in net energy generation of 1 percent, observed for September, would also be a less than significant impact. However, when considering the maximum monthly impact for CP3 on net energy generation, decreases greater than 5 percent were observed 143 times in the existing condition level of development and 163 times in the future condition level of development out of 984 occurrences. Consequently, there would be a potentially significant impact on CVP net energy generation.

Table 23-31. Simulated Monthly Average CVP Net Energy Generation for CP3 and CP5

Month	Existing Condition (2005)			Future Condition (2030)		
	Existing Condition (GWh)	CP3 Change (GWh (%))		No-Action Alternative (GWh)	CP3 Change (GWh (%))	
October	204	67	(33%)	191	2	(1%)
November	129	56	(44%)	111	1	(1%)
December	159	60	(38%)	141	0	(0%)
January	191	71	(37%)	181	-1	(0%)
February	235	105	(45%)	237	6	(3%)
March	254	181	(71%)	272	5	(2%)
April	311	248	(80%)	310	2	(1%)
May	454	264	(58%)	449	6	(1%)
June	497	217	(44%)	488	15	(3%)
July	562	195	(35%)	545	25	(5%)
August	414	157	(38%)	420	8	(2%)
September	280	83	(30%)	283	-2	(-1%)
Total	3,691	1,706	(46%)	3,629	67	(2%)

Source: Common Assumptions Common Modeling Package Version 9 LongTermGen
Note:
Simulation period: 1922 – 2003
Key:
CP = Comprehensive Plan
CVP = Central Valley Project
GWh = megawatt-hour

Table 23-32 shows the change in net energy generation, which is the difference between long-term monthly average energy generation and monthly average energy consumption, at all SWP plants for CP3 compared to the existing condition. CP3 shows an overall decrease in long-term monthly net energy generation; the greatest decrease, 4 percent, observed for February, would be a less than significant impact. Similarly, an overall decrease in net energy generation was observed for CP3 compared to the future condition; the greatest decrease in net generation, 5 percent, observed for January, would also be considered a less than significant impact. However, when considering the maximum monthly impact for CP3 on net energy generation, decreases greater than 5 percent were observed 48 times in the existing condition level of development and 99 times in the future condition level of development out of 984 occurrences. Consequently, there would be a potentially significant impact on SWP net energy generation.

For these reasons, this impact would be potentially significant. Mitigation for this impact is not proposed because reductions in power generation would be offset by increased generation from other sources.

Table 23-32. Simulated Monthly Average SWP Net Energy Generation for CP3 and CP5

Month	Existing Condition (2005)			Future Condition (2030)		
	Existing Condition (GWh)	CP3 Change (GWh (%))		No-Action Alternative (GWh)	CP3 Change (GWh (%))	
October	-360	-4	(1%)	-435	-2	(0%)
November	-356	-11	(3%)	-441	-5	(1%)
December	-351	-6	(2%)	-433	-4	(1%)
January	-405	-13	(3%)	-411	-21	(5%)
February	-342	-15	(4%)	-369	-7	(2%)
March	-355	-5	(1%)	-419	-3	(1%)
April	-308	-5	(2%)	-394	-8	(2%)
May	-288	-3	(1%)	-366	-1	(0%)
June	-278	-3	(1%)	-329	2	(-1%)
July	-275	-3	(1%)	-335	-2	(1%)
August	-378	-1	(0%)	-443	0	(0%)
September	-433	-5	(1%)	-508	6	(-1%)
Total	-4,128	-75	(2%)	-4,884	-44	(1%)

Source: Common Assumptions Common Modeling Package Version 9, SWP Power CA
Note:
Simulation period: 1922 – 2003
Key:
CP = Comprehensive Plan
GWh = gigawatt-hour
SWP = State Water Project

Details are included in Attachment 1 of the *Power and Energy Technical Report*, for energy generation, consumption, and change for CP3 compared to the existing condition and No-Action Alternative for all CVP and SWP powerplants and pumping plants.

Impact Hydro-5 (CP3): Decrease in Pit 7 Powerplant Net Energy Generation
Table 23-33 shows an estimate of decreased energy production for the Pit 7 Powerplant under CP3. Energy production for the Pit 7 Powerplant would generally decrease only when the raised Shasta pool is higher than the normal Pit 7 tailwater elevation of 1,067 feet above msl (NGVD29). Assuming that the historic annual pattern of Shasta pool levels is maintained with the higher maximum pool, in an average year, Pit 7 Powerplant energy production would decrease from February through July. These 6 months typically provide roughly 56 percent of the total average annual energy production. Therefore, total average annual energy production for the Pit 7 Powerplant for CP3 could decrease by roughly 14 GWh (3 percent) for the existing condition and 13.9 GWh (3 percent) for the future condition. Considering the maximum monthly impacts for CP3, decreases in net energy generation greater than 5 percent were observed in several instances, particularly in March through July, which could potentially be a significant impact on Pit 7 Powerplant net energy generation.

Table 23-33. Simulated Monthly Average Pit 7 Powerplant Energy Generation for CP3 and CP5

Month	Existing Condition (2005)			Future Condition (2030)		
	Existing Condition (GWh)	CP3 Change (GWh (%))		No-Action Alternative (GWh)	CP3 Change (GWh (%))	
January	52.6	0.0	(0%)	52.6	0.0	(0%)
February	52.6	-0.4	(-1%)	52.6	-0.4	(-1%)
March	64.6	-2.5	(-4%)	64.6	-2.5	(-4%)
April	57.8	-4.2	(-7%)	57.8	-4.2	(-7%)
May	52.1	-4.0	(-8%)	52.1	-4.0	(-8%)
June	38.5	-2.2	(-6%)	38.5	-2.2	(-6%)
July	33.2	-0.8	(-2%)	33.2	-0.7	(-2%)
August	31.2	0.0	(0%)	31.2	0.0	(0%)
September	30.9	0.0	(0%)	30.9	0.0	(0%)
October	33.6	0.0	(0%)	33.6	0.0	(0%)
November	36.7	0.0	(0%)	36.7	0.0	(0%)
December	45.1	0.0	(0%)	45.1	0.0	(0%)
Total	528.9	-14.0	(-3%)	528.9	-13.9	(-3%)

Source: Spreadsheet model, Pit 7 Dam MONTHLY AVG.xls,2007
Note:
Simulation period: 1922 – 2003
Key:
CP = Comprehensive Plan
GWh = gigawatt-hour

Under the existing condition, the turbines operate with a net head range of approximately 173 to 204 feet. Under the 18.5-foot Shasta Dam raise option, the operating range of net head would decrease to about 156 to 181 feet, an approximate 10 percent reduction in net head. Assuming peak turbine efficiency is approximately 204 feet net head, the potential future minimum net head of 156 feet would be about 75 percent of the peak efficiency net head, which should an acceptable range for continuous operation. A decrease in maximum net head from 204 feet to 181 feet would reduce each unit's generating capacity by approximately 17 percent, from the current 56 MW to approximately 47 MW.

For these reasons, this impact would be potentially significant. Mitigation for this impact is not proposed because reductions in power generation would be offset by increased generation from other sources.

CP4 – 18.5-Foot Dam Raise, Anadromous Fish Focus With Water Supply Reliability

The primary function of CP4 is to address anadromous fish survival, while still improving water supply reliability. It focuses on increasing the volume of cold water available to the temperature control device through reservoir reoperations, and on raising Shasta Dam by 18.5 feet. As with CP3, and in addition to the common features above, this raise would increase the full pool by 20.5 feet and enlarge total reservoir storage space by 634,000 acre-feet. This additional storage space would expand Shasta Reservoirs' cold-water supply available to the temperature control device by 378,000 acre-feet, a feature that would help improve cooler water temperatures in the upper Sacramento River.

CP4 differs from CP3 by focusing on increased storage to maintaining cold-water volume, resulting in a higher seasonal carryover storage. The operations of CP4 are identical to those of CP1. With that constraint, simulation of CP4 did not involve any changes to the modeling logic for deliveries or flow requirements; all of the benchmark rules were updated to include the new storage, but were not otherwise changed.

Shasta Lake and Vicinity

Impact Hydro-1 (CP4): Decrease in Shasta Powerplant Energy Generation A decrease in Shasta Dam energy generation is one indicator of project impacts because increasing the hydropower capabilities of Shasta Powerplant is a secondary planning objective of the study. This impact would be potentially significant.

Table 23-34 shows an overall beneficial impact from increases on monthly generation at Shasta Powerplant of 5 to 8 percent for CP4 compared to the existing condition. No decrease in long-term monthly generation was observed. Similarly, CP4 shows an overall beneficial impact from increases on hydropower generation of 5 to 11 percent compared to the future condition. No decrease in long-term average monthly generation was observed. Although CP4 indicates an overall beneficial impact, maximum monthly decreases in hydropower generation greater than 5 percent were observed 43 times in the existing condition and 58 times in the future condition out of 984 occurrences.

For this reason, this impact would be potentially significant. Mitigation for this impact is not proposed because reductions in power generation would be offset by increased generation from other sources.

Upper Sacramento River Negligible effects on Power and Energy are expected to occur in the Upper Sacramento River geographic region; therefore, potential effects in that geographic region are not discussed further in this PDEIS.

Table 23-34. Simulated Monthly Average Shasta Powerplant Energy Generation for CP4

Month	Existing Condition (2005)			Future Condition (2030)		
	Existing Condition (GWh)	CP4 Change (GWh (%))		No-Action Alternative (GWh)	CP4 Change (GWh (%))	
October	132	7	(6%)	123	7	(6%)
November	120	6	(5%)	114	6	(6%)
December	156	8	(5%)	152	7	(5%)
January	160	11	(7%)	162	9	(5%)
February	187	14	(8%)	183	20	(11%)
March	180	12	(7%)	179	10	(5%)
April	160	11	(7%)	160	11	(7%)
May	200	12	(6%)	202	11	(5%)
June	259	16	(6%)	257	15	(6%)
July	275	19	(7%)	280	19	(7%)
August	201	16	(8%)	209	16	(8%)
September	116	9	(8%)	124	9	(7%)
Total	2,146	142	(7%)	2,145	141	(7%)

Source: Common Assumptions Common Modeling Package Version 9 LongTermGen
Note:
Simulation period: 1922 – 2003
Key:
CP = Comprehensive Plan
GWh = gigawatt-hour

Lower Sacramento River and Delta Negligible effects on Power and Energy are expected to occur in the Lower Sacramento River and Delta geographic region; therefore, potential effects in that geographic region are not discussed further in this PDEIS.

CVP/SWP Service Areas

Impact Hydro-2 (CP4): Decrease in CVP and SWP Powerplant Energy Generation Table 23-35 shows an overall beneficial impact from increases on monthly generation at CVP powerplants of 1 percent in April and September to 5 percent in November for CP4 compared to the existing condition. No decrease in long-term monthly generation was observed. Similarly, CP4 shows an overall beneficial impact from increases on hydropower generation of 2 to 6 percent compared to the future condition. No decrease in long-term average monthly generation was observed. However, when considering the maximum monthly impact for CP4 on hydropower generation, decreases greater than 5 percent were observed 62 times in the existing condition level of development and 27 times in the future condition level of development out of 984 occurrences. Consequently, there would be a potentially significant impact on CVP energy generation.

Table 23-35. Simulated Monthly Average CVP Energy Generation for CP4

Month	Existing Condition (2005)			Future Condition (2030)		
	Existing Condition (GWh)	CP4 Change (GWh (%))		No-Action Alternative (GWh)	CP4 Change (GWh (%))	
October	304	8	(3%)	292	7	(2%)
November	245	11	(5%)	234	6	(3%)
December	294	10	(3%)	284	7	(3%)
January	336	6	(2%)	332	9	(3%)
February	353	12	(3%)	346	20	(6%)
March	358	16	(4%)	357	8	(2%)
April	364	5	(1%)	362	10	(3%)
May	511	12	(2%)	509	11	(2%)
June	587	19	(3%)	579	17	(3%)
July	678	23	(3%)	671	26	(4%)
August	533	14	(3%)	546	14	(3%)
September	370	2	(1%)	381	7	(2%)
Total	4,934	139	(3%)	4,893	142	(3%)

Source: Common Assumptions Common Modeling Package Version 9 LongTermGen

Note:

Simulation period: 1922 – 2003

Key:
CP = Comprehensive Plan
CVP=Central Valley Project
GWh = gigawatt-hour

Table 23-36 shows an overall increase of 1 percent in monthly generation at SWP powerplants for CP4 compared to the existing condition. A decrease in long-term monthly generation of 1 percent, observed for January, March, and November, would be a less than significant impact. CP4 shows no change in hydropower generation compared to the future condition. A decrease in long-term monthly average generation of 1 percent, observed for February, would be a less than significant impact. However, when considering the maximum monthly impact for CP4 on hydropower generation, decreases greater than 5 percent were observed 60 times in the existing condition level of development and 33 times in the future condition level of development out of 984 occurrences. Consequently, there would be a potentially significant impact on SWP energy generation.

For these reasons, this impact would be potentially significant. Mitigation for this impact is not proposed because reductions in power generation would be offset by increased generation from other sources.

Table 23-36. Simulated Monthly Average SWP Energy Generation for CP4

Month	Existing Condition (2005)			Future Condition (2030)		
	Existing Condition (GWh)	CP4 Change (GWh (%))		No-Action Alternative (GWh)	CP4 Change (GWh (%))	
October	325	2	(1%)	344	0	(0%)
November	269	-2	(-1%)	295	-1	(0%)
December	322	0	(0%)	333	0	(0%)
January	348	-3	(-1%)	347	0	(0%)
February	408	-2	(0%)	422	-3	(-1%)
March	460	-4	(-1%)	465	-1	(0%)
April	392	2	(1%)	429	0	(0%)
May	475	3	(1%)	514	0	(0%)
June	523	3	(1%)	551	-1	(0%)
July	508	6	(1%)	563	0	(0%)
August	426	6	(1%)	462	2	(0%)
September	341	2	(0%)	373	0	(0%)
Total	4,798	12	(0%)	5,097	-4	(0%)

Source: Common Assumptions Common Modeling Package Version 9, SWP Power CA
Note:
Simulation period: 1922 – 2003
Key:
CP = Comprehensive Plan
GWh = gigawatt-hour
SWP = State Water Project

Impact Hydro-3 (CP4): Increase in CVP and SWP Pumping Plant Energy Consumption Table 23-37 shows the change in monthly energy consumption at CVP pumping plants for CP4 compared to the existing condition resulting from additional pumping to accommodate the primary planning objectives of the study, increasing water supply reliability and anadromous fish survival. The greatest increase in long-term monthly average energy consumption, 3 percent, observed for March and July, would be a less than significant impact. Similar operations criteria governing CP4 compared to the future condition resulted in a maximum increase of 1 percent in long-term average energy consumption for February, October, and November, which would also be a less than significant impact. However, when considering the maximum monthly impact for CP4 on energy consumption, increases greater than 5 percent were observed 97 times in the existing condition level of development and 43 times in the future condition level of development out of 984 occurrences. Consequently, there would be a potentially significant impact on CVP energy consumption.

Table 23-37. Simulated Monthly Average CVP Energy Consumption for CP4

Month	Existing Condition (2005)			Future Condition (2030)		
	Existing Condition (GWh)	CP4 Change (GWh (%))		No-Action Alternative (GWh)	CP4 Change (GWh (%))	
October	100	0	(0%)	101	1	(1%)
November	116	0	(0%)	123	1	(1%)
December	135	0	(0%)	144	0	(0%)
January	145	1	(0%)	151	-1	(0%)
February	118	2	(2%)	109	1	(1%)
March	104	3	(3%)	85	0	(0%)
April	53	0	(0%)	53	0	(0%)
May	57	1	(1%)	59	0	(0%)
June	89	1	(1%)	90	0	(0%)
July	116	3	(3%)	125	0	(0%)
August	119	1	(1%)	126	0	(0%)
September	90	0	(0%)	98	0	(0%)
Total	1,243	11	(1%)	1,264	2	(0%)

Source: Common Assumptions Common Modeling Package Version 9 LongTermGen
Note:
Simulation period: 1922 – 2003
Key:
CP = Comprehensive Plan
CVP = Central Valley Project
GWh = gigawatt-hour

Table 23-38 shows the change in monthly energy consumption at SWP pumping plants resulting from additional pumping for CP4 compared to the existing condition. The greatest increase in long-term monthly average energy consumption, 2 percent, observed for February, would be a less than significant impact. Similar operations criteria governing CP4 compared to the future condition resulted in no change in long-term average monthly energy consumption. However, when considering the maximum monthly impact for CP1 on energy consumption, increases greater than 5 percent were observed 125 times in the existing condition level of development and 23 times in the future condition level of development out of 984 occurrences. Consequently, there would be a potentially significant impact on SWP energy consumption.

For these reasons, this impact would be potentially significant. Mitigation for this impact is not proposed because increases in energy consumption would be offset by increased generation from other sources.

Table 23-38. Simulated Monthly Average SWP Energy Consumption for CP4

Month	Existing Condition (2005)			Future Condition (2030)		
	Existing Condition (GWh)	CP4 Change (GWh (%))		No-Action Alternative (GWh)	CP4 Change (GWh (%))	
October	685	6	(1%)	779	0	(0%)
November	625	8	(1%)	737	0	(0%)
December	673	5	(1%)	766	0	(0%)
January	753	9	(1%)	758	4	(0%)
February	750	12	(2%)	791	3	(0%)
March	815	0	(0%)	884	-3	(0%)
April	700	8	(1%)	823	-1	(0%)
May	763	6	(1%)	880	0	(0%)
June	801	8	(1%)	880	1	(0%)
July	783	9	(1%)	897	0	(0%)
August	803	9	(1%)	905	-1	(0%)
September	774	6	(1%)	881	-1	(0%)
Total	8,925	86	(1%)	9,981	2	(0%)

Source: Common Assumptions Common Modeling Package Version 9, SWP Power CA
Note:
Simulation period: 1922 – 2003
Key:
CP = Comprehensive Plan
GWh = gigawatt-hour
SWP = State Water Project

Impact Hydro-4 (CP4): Decrease in CVP and SWP Net Energy Generation
Table 23-39 shows the change in net energy generation, which is the difference between long-term monthly average energy generation and monthly average energy consumption, at all CVP plants for CP4 compared to the existing condition. Overall, CP4 shows a beneficial impact in the form of increased long-term monthly net energy generation, ranging from 1 percent in September to 9 percent in November. No decrease in long-term monthly net energy generation was observed. Similarly, an overall beneficial impact from increases on net energy generation of 2 percent in May and September to 8 percent in February was observed for CP4 compared to the future condition. No decrease in long-term monthly net energy generation was observed. However, when considering the maximum monthly impact for CP4 on net energy generation, decreases greater than 5 percent were observed 112 times in the existing condition level of development and 68 times in the future condition level of development out of 984 occurrences. Consequently, there would be a potentially significant impact on CVP net energy generation.

Table 23-39. Simulated Monthly Average CVP Net Energy Generation for CP4

Month	Existing Condition (2005)			Future Condition (2030)		
	Existing Condition (GWh)	CP4 Change (GWh (%))		No-Action Alternative (GWh)	CP4 Change (GWh (%))	
October	204	8	(4%)	191	6	(3%)
November	129	11	(9%)	111	6	(5%)
December	159	10	(6%)	141	7	(5%)
January	191	5	(3%)	181	10	(5%)
February	235	10	(4%)	237	19	(8%)
March	254	13	(5%)	272	8	(3%)
April	311	5	(2%)	310	10	(3%)
May	454	11	(2%)	449	11	(2%)
June	497	18	(4%)	488	17	(3%)
July	562	20	(4%)	545	26	(5%)
August	414	13	(3%)	420	14	(3%)
September	280	3	(1%)	283	7	(2%)
Total	3,691	127	(3%)	3,629	140	(4%)

Source: Common Assumptions Common Modeling Package Version 9 LongTermGen
Note:
Simulation period: 1922 – 2003
Key:
CP = Comprehensive Plan
CVP = Central Valley Project
GWh = gigawatt-hour

Table 23-40 shows the change in net energy generation, which is the difference between long-term monthly average energy generation and monthly average energy consumption, at all SWP plants for CP4 compared to the existing condition. CP4 shows an overall decrease in long-term monthly net energy generation. The greatest decrease in net generation, 4 percent, observed for February, would be a less than significant impact. No significant change in net energy generations was observed for CP4 compared to the future condition. The greatest decrease in net generation, 1 percent, observed for January, February, and June, would also be a less than significant impact. However, when considering the maximum monthly impact for CP4 on net energy generation, decreases greater than 5 percent were observed 54 times in the existing condition level of development and 32 times in the future condition level of development out of 984 occurrences. Consequently, there would be a potentially significant impact on SWP net energy generation.

For these reasons, this impact would be potentially significant. Mitigation for this impact is not proposed because reductions in power generation would be offset by increased generation from other sources.

Table 23-40. Simulated Monthly Average SWP Net Energy Generation for CP4

Month	Existing Condition (2005)			Future Condition (2030)		
	Existing Condition (GWh)	CP4 Change (GWh (%))		No-Action Alternative (GWh)	CP4 Change (GWh (%))	
October	-360	-4	(1%)	-435	0	(0%)
November	-356	-10	(3%)	-441	-2	(0%)
December	-351	-5	(1%)	-433	0	(0%)
January	-405	-12	(3%)	-411	-4	(1%)
February	-342	-13	(4%)	-369	-5	(1%)
March	-355	-5	(1%)	-419	2	(-1%)
April	-308	-6	(2%)	-394	1	(0%)
May	-288	-3	(1%)	-366	0	(0%)
June	-278	-4	(2%)	-329	-2	(1%)
July	-275	-3	(1%)	-335	0	(0%)
August	-378	-3	(1%)	-443	3	(-1%)
September	-433	-5	(1%)	-508	1	(0%)
Total	-4,128	-74	(2%)	-4,884	-5	(0%)

Source: Common Assumptions Common Modeling Package Version 9, SWP Power CA
Note:
Simulation period: 1922 – 2003
Key:
CP = Comprehensive Plan
GWh = gigawatt-hour
SWP = State Water Project

Details are included in Attachment 1 of the *Power and Energy Technical Report*, for energy generation, consumption, and change for CP4 compared to the existing condition and No-Action Alternative for all CVP and SWP powerplants and pumping plants.

Impact Hydro-5 (CP4): Decrease in Pit 7 Powerplant Net Energy Generation
Table 23-41 shows an estimate of decreased energy production for the Pit 7 Powerplant under CP4. Energy production for the Pit 7 Powerplant would generally decrease only when the raised Shasta pool is higher than the normal Pit 7 tailwater elevation of 1,067 feet above msl (NGVD29). Assuming that the historic annual pattern of Shasta full pool levels is maintained with the higher maximum pool, in an average year, Pit 7 Powerplant energy production would decrease from February through July. These 6 months typically provide roughly 56 percent of the total average annual energy production. Therefore, total average annual energy production for the Pit 7 Powerplant could decrease by roughly 12.2 GWh (2 percent). Considering maximum monthly impact for CP4, decreases in net energy generation greater than 5 percent were observed in several instances, particularly in March through June, which could potentially be a significant impact on Pit 7 Powerplant net energy generation.

Table 23-41. Simulated Monthly Average Pit 7 Powerplant Energy Generation for CP4

Month	Existing Condition (2005)			Future Condition (2030)		
	Existing Condition (GWh)	CP4 Change (GWh (%))		No-Action Alternative (GWh)	CP4 Change (GWh (%))	
January	52.6	0.0	(0%)	52.6	0.0	(0%)
February	52.6	-0.1	(0%)	52.6	-0.2	(0%)
March	64.6	-2.0	(-3%)	64.6	-2.0	(-3%)
April	57.8	-4.1	(-7%)	57.8	-4.0	(-7%)
May	52.1	-3.6	(-7%)	52.1	-3.6	(-7%)
June	38.5	-1.7	(-5%)	38.5	-1.7	(-4%)
July	33.2	-0.4	(-1%)	33.2	-0.3	(-1%)
August	31.2	0.0	(0%)	31.2	0.0	(0%)
September	30.9	0.0	(0%)	30.9	0.0	(0%)
October	33.6	0.0	(0%)	33.6	0.0	(0%)
November	36.7	0.0	(0%)	36.7	0.0	(0%)
December	45.1	0.0	(0%)	45.1	0.0	(0%)
Total	528.9	-11.9	(-2%)	528.9	-11.9	(-2%)

Source: Spreadsheet model, Pit 7 Dam MONTHLY AVG.xls,2007
Note:
Simulation period: 1922 – 2003
Key:
CP = Comprehensive Plan
GWh = gigawatt-hour

Under the existing condition, the turbines operate with a net head range of approximately 173 to 204 feet. Under the 18.5-foot Shasta Dam raise option, the operating range of net head would decrease to about 156 to 181 feet, an approximate 10 percent reduction in net head. Assuming peak turbine efficiency is approximately 204 feet net head, the potential future minimum net head of 156 feet would be about 75 percent of the peak efficiency net head, which should an acceptable range for continuous operation. A decrease in maximum net head from 204 feet to 181 feet would reduce each unit's generating capacity by approximately 17 percent, from the current 56 MW to approximately 47 MW.

For these reasons, this impact would be potentially significant. Mitigation for this impact is not proposed because reductions in power generation would be offset by increased generation from other sources.

CP5 – 18.5-Foot Dam Raise, Combination Plan

CP5 would address both the primary and secondary planning objectives. CP5 includes enlarging Shasta Dam by 18.5 feet, which is consistent with the objectives of the 2000 CALFED ROD, and also includes the common features above. In addition, CP5 includes (1) implementing environmental restoration features along the lower reaches of major tributaries to Shasta Lake, (2) constructing shoreline fish habitat around Shasta Lake, and (3) constructing either additional or improved recreation features at various locations around Shasta Lake to increase the value of the recreational experience. Formulation of specific environmental restoration features and increased recreation components is not yet complete but will be included in the Draft Feasibility Report.

Operations under CP5 would be identical to CP3. The differences between the two alternatives would be limited to nonperational features.

Shasta Lake and Vicinity

Impact Hydro-1 (CP5): Decrease in Shasta Powerplant Energy Generation

This impact would be the same as Impact Hydro-1 (CP3) and would be potentially significant.

Upper Sacramento River Negligible effects on Power and Energy are expected to occur in the Upper Sacramento River geographic region; therefore, potential effects in that geographic region are not discussed further in this PDEIS.

Lower Sacramento River and Delta Negligible effects on Power and Energy are expected to occur in the Lower Sacramento River and Delta geographic region; therefore, potential effects in that geographic region are not discussed further in this PDEIS.

CVP/SWP Service Areas

Impact Hydro-2 (CP5): Decrease in CVP and SWP Powerplants Energy Generation This impact would be the same as Impact Hydro-2 (CP3) and would be potentially significant.

Impact Hydro-3 (CP5): Increase in CVP and SWP Pumping Plant Energy Consumption This impact would be the same as Impact Hydro-3 (CP3) and would be potentially significant.

Impact Hydro-4 (CP5): Decrease in CVP and SWP Net Energy Generation This impact would be the same as Impact Hydro-4 (CP3) and would be potentially significant.

Impact Hydro-5 (CP5): Decrease in Pit 7 Powerplant Net Energy Generation This impact would be the same as Impact Hydro-5 (CP3) and would be potentially significant.

23.3.4 Mitigation Measures

Table 23-42 presents a summary of mitigation measures for power and energy.

No-Action Alternative and CP1 – CP5

No specific mitigation measures are proposed for the decrease in hydropower generation, and the increase in consumption of electrical energy.

There are several potential significant unavoidable impact to energy generation and energy consumption associated with the implementation of No-Action Alternative and CP1 – CP5, as shown in Table 23-42.

Each of these potential significant unavoidable impacts is the result of decrease in energy production (decrease in hydropower generation) or increase in energy usage (increase in power consumption for pumping). These unavoidable impacts are potentially significant because they would likely require the generation of electrical energy from another source (to replace lost hydroelectric generation or to provide additional power for pumping). Replacement of additional generation would likely come from a thermal generation source, such as combined cycle natural gas fired turbine, or a coal fired powerplant. Generation from a source that meets the California Public Utilities Commission's Emissions Performance Standards would contribute up to 1,200 pounds/MWh of greenhouse, plus other pollutants such as particulates and oxides of nitrogen. Thus, additional pumping electoral load of 5,000 MWh per year would likely contribute 3,000 tons of more greenhouse gasses to the atmosphere.

Table 23-42. Summary of Mitigation Measures for Power and Energy

Impact		No-Action Alternative	CP1	CP2	CP3	CP4	CP5
Impact Hydro-1: Decrease in Shasta Powerplant Energy Generation	LOS before Mitigation	PS	PS	PS	PS	PS	PS
	Mitigation Measure	None required.	No mitigation needed; thus, none proposed.				
	LOS after Mitigation	PS	PS	PS	PS	PS	PS
Impact Hydro-2: Decrease in CVP and SWP Powerplant Energy Generation	LOS before Mitigation	PS	PS	PS	PS	PS	PS
	Mitigation Measure	None required.	No mitigation needed; thus, none proposed.				
	LOS after Mitigation	PS	PS	PS	PS	PS	PS
Impact Hydro-3: Increase in CVP and SWP Pumping Plant Energy	LOS before Mitigation	PS	PS	PS	PS	PS	PS
	Mitigation Measure	None required.	No mitigation needed; thus, none proposed.				
	LOS after Mitigation	PS	PS	PS	PS	PS	PS
Impact Hydro-4: Decrease in CVP and SWP Net Energy Generation	LOS before Mitigation	PS	PS	PS	PS	PS	PS
	Mitigation Measure	None required.	No mitigation needed; thus, none proposed.				
	LOS after Mitigation	PS	PS	PS	PS	PS	PS
Impact Hydro-5: Decrease in Pit 7 Powerplant Net Energy Generation	LOS before Mitigation	NI	LTS	PS	PS	PS	PS
	Mitigation Measure	None required.	No mitigation needed; thus, none proposed.				
	LOS after Mitigation	NI	LTS	PS	PS	PS	PS

Key:
LOS = level of significance
LTS = less than significant
NI = No Impact
PS = potentially significant

23.3.5 Cumulative Effects

Chapter 3, "Considerations for Describing the Affected Environment and Environmental Consequences" discusses the overall cumulative impacts of the project alternatives, including the relationship to CALFED Programmatic Cumulative Impacts Analysis, qualitative and quantitative assessment, past and future actions in the study area, and significance criteria.

This section provides an analysis of overall cumulative impacts of the project alternatives with other past, present, and reasonably foreseeable future projects producing related impacts.

The projects listed in the quantitative analysis section of Chapter 3, "Considerations for Describing the Affected Environment and Environmental Consequences" are included in the 2030 level-of-development alternatives. Accordingly, quantitative effects of the projects combined with the SLWRI alternatives are described in the Section 23.2. Project alternatives would cause

potentially significant impacts on CVP and SWP facility hydropower generation and consumption. The discussion below focuses on the qualitative effect of the SLWRI alternatives and other past, present, and reasonably foreseeable future projects.

The effects of climate change on operations at Shasta Lake could potentially result in changes to power and energy. As described in the Climate Change Projection Appendix, climate change could result in higher reservoir releases in the winter and early spring due to an increase in runoff during these times. Similarly, climate change could result in lower reservoir inflows and Sacramento tributary flows during the late spring and summer due to a decreased snow pack. This reduction in inflow and tributary flow could result in Shasta Lake storage being reduced due to both a reduced ability to capture flows, and an increased need to make releases to meet downstream requirements.

CP1 – 6.5-Foot Dam Raise, Anadromous Fish Survival and Water Supply Reliability

When combined with other past, present, and reasonably foreseeable future projects, it is likely there would be a change in river flows and reservoir elevations. Since Shasta Reservoir is operated to meet flow and water quality requirements in the Sacramento River and Delta, any new project or program along the Sacramento River and in the Delta could potentially impact the CVP and SWP facility hydropower generation and consumption of CP1. With the implementation of many of the projects, Shasta Reservoir could be reoperated, which would result in changes to the Sacramento River flow regime and reservoir elevations, and could cause a potentially significant impact on CVP/SWP facility hydropower generation and consumption.

As stated previously, effects of climate change on operations of Shasta Lake could include increased inflows and releases at certain times of the year, and decreased inflows and storage at other times. The additional storage associated with CP1 would potentially diminish these effects and allow Shasta Lake to capture some of the increased runoff in the winter and early spring for release in late spring and summer. Additionally, the increased storage volume would allow Shasta Lake to maintain greater storage and potentially greater hydropower generation. Therefore, the addition of anticipated effects of climate change, would not result in CP1 having a significant cumulative effect.

CP2 – 12.5-Foot Dam Raise, Anadromous Fish Survival and Water Supply Reliability

When combined with other past, present, and reasonably foreseeable future projects, it is likely there would be a change in river flows and reservoir elevations. Since Shasta Reservoir is operated to meet flow and water quality requirements in the Sacramento River and Delta, any new project or program along the Sacramento River and in the Delta could potentially impact the CVP and SWP facility hydropower generation and consumption of CP2. With the

implementation of many of the projects, Shasta Reservoir could be reoperated, which would result in changes to the Sacramento River flow regime and reservoir elevations, and could cause a potentially significant impact on CVP/SWP facility hydropower generation and consumption.

As stated previously, effects of climate change on operations of Shasta Lake could include increased inflows and releases at certain times of the year, and decreased inflows and storage at other times. The additional storage associated with CP2 would potentially diminish these effects and allow Shasta Lake to capture some of the increased runoff in the winter and early spring for release in late spring and summer. Additionally, the increased storage volume would allow Shasta Lake to maintain greater storage and potentially greater hydropower generation. Therefore, the addition of anticipated effects of climate change, would not result in CP2 having a significant cumulative effect.

CP3 – 18.5-Foot Dam Raise, Anadromous Fish Survival and Water Supply Reliability

When combined with other past, present, and reasonably foreseeable future projects, it is likely there would be a change in river flows and reservoir elevations. Since Shasta Reservoir is operated to meet flow and water quality requirements in the Sacramento River and Delta, any new project or program along the Sacramento River and in the Delta could potentially impact the CVP and SWP facility hydropower generation and consumption of CP3. With the implementation of many of the projects, Shasta Reservoir could be reoperated, which would result in changes to the Sacramento River flow regime and reservoir elevations, and could cause a potentially significant impact on CVP/SWP facility hydropower generation and consumption.

As stated previously, effects of climate change on operations of Shasta Lake could include increased inflows and releases at certain times of the year, and decreased inflows and storage at other times. The additional storage associated with CP3 would potentially diminish these effects and allow Shasta Lake to capture some of the increased runoff in the winter and early spring for release in late spring and summer. Additionally, the increased storage volume would allow Shasta Lake to maintain greater storage and potentially greater hydropower generation. Therefore, the addition of anticipated effects of climate change, would not result in CP3 having a significant cumulative effect.

CP4 – 18.5-Foot Dam Raise, Anadromous Fish Focus With Water Supply Reliability

When combined with other past, present, and reasonably foreseeable future projects, it is likely there would be a change in river flows and reservoir elevations. Since Shasta Reservoir is operated to meet flow and water quality requirements in the Sacramento River and Delta, any new project or program along the Sacramento River and in the Delta could potentially impact the CVP and SWP facility hydropower generation and consumption of CP4. With the implementation of many of the projects, Shasta Reservoir could be reoperated,

which would result in changes to the Sacramento River flow regime and reservoir elevations, and could cause a potentially significant impact on CVP/SWP facility hydropower generation and consumption.

As stated previously, effects of climate change on operations of Shasta Lake could include increased inflows and releases at certain times of the year, and decreased inflows and storage at other times. The additional storage associated with CP4 would potentially diminish these effects and allow Shasta Lake to capture some of the increased runoff in the winter and early spring for release in late spring and summer. Additionally, the increased storage volume would allow Shasta Lake to maintain greater storage and potentially greater hydropower generation. Therefore, the addition of anticipated effects of climate change, would not result in CP4 having a significant cumulative effect.

CP5 – 18.5-Foot Dam Raise, Combination Plan

When combined with other past, present, and reasonably foreseeable future projects, it is likely there would be a change in river flows and reservoir elevations. Since Shasta Reservoir is operated to meet flow and water quality requirements in the Sacramento River and Delta, any new project or program along the Sacramento River and in the Delta could potentially impact the CVP and SWP facility hydropower generation and consumption of CP5. With the implementation of many of the projects, Shasta Reservoir could be reoperated, which would result in changes to the Sacramento River flow regime and reservoir elevations, and could cause a potentially significant impact on CVP/SWP facility hydropower generation and consumption.

As stated previously, effects of climate change on operations of Shasta Lake could include increased inflows and releases at certain times of the year, and decreased inflows and storage at other times. The additional storage associated with CP5 would potentially diminish these effects and allow Shasta Lake to capture some of the increased runoff in the winter and early spring for release in late spring and summer. Additionally, the increased storage volume would allow Shasta Lake to maintain greater storage and potentially greater hydropower generation. Therefore, the addition of anticipated effects of climate change, would not result in CP5 having a significant cumulative effect.

Chapter 24
Environmental Justice

24.1 Affected Environment

24.1.1 Minority and Low-Income Populations

The environmental setting of a project area can be viewed from both a geographic perspective and a human perspective. The physical environment provides a geographical context for the populations to be evaluated in this Environmental Impact Statement. The human perspective encompasses race, ethnic origin, and economic status of affected groups.

The intent of an environmental justice evaluation under Executive Order 12898, *Federal Actions to Address Environmental Justice in Minority and Low Income Populations* (1994), is to identify communities and groups that meet environmental justice criteria, and suggest strategies to reduce potential adverse impacts of projects on affected groups.

In its guide to environmental justice under NEPA, the Council on Environmental Quality (CEQ) (1997) encourages agencies to consider all of the following groups in the scoping process:

- Religious organizations
- Newspapers, radio, and other media
- Civic associations
- Minority business associations
- Environmental and environmental justice organizations
- Legal aid providers
- Homeowners', tenants', and neighborhood watch groups
- Federal, State, local, and tribal governments
- Rural cooperatives
- Business and trade organizations
- Community and social service organizations
- Universities, colleges, vocational, and other schools
- Labor organizations

- Civil rights organizations
- Local schools and libraries
- Senior citizens' groups
- Public health agencies and clinics

Shasta Lake and Vicinity

This evaluation reviews minority and low-income communities situated near the reservoir, and those that directly depend on it for social, economic, cultural, historic, occupational, recreational, or other needs deemed significant by these communities.

Table 24-1 depicts a historically white population that is slowly diversifying and income levels consistently below the statewide average, resulting in relatively higher poverty rates among all ethnic groups. In 2005, the population of Shasta County was approximately 14.3 percent minority (nonwhite) and approximately 19.6 percent low-income, compared to statewide populations of 55.6 percent minority and 18.6 percent low-income. The slightly higher local poverty rate is not meaningfully greater than the statewide rate.

Lakehead-Lakeshore Community The Lakehead-Lakeshore community is located along Shasta Lake's northernmost reach, the Sacramento River Arm. Lakehead, an unincorporated seasonal community of approximately 1,200 residents (U.S. Census Bureau 2002a), is adjacent to Interstate 5 and includes typical services found near a major interstate highway. Lakehead provides a variety of campgrounds, boat ramps, and marinas. The Lakehead community includes low-income and minority residents and workers who could be affected by project construction and changes in outdoor recreation patterns resulting from the project.

Tourism and Outdoor Recreation Industry Shasta Lake and its vicinity are recreation destinations that draw visitors from throughout California. Most facilities in the area depend on Shasta Lake to draw visitors and customers. The tourism and outdoor recreation service industries are included in this discussion because this group includes a community of lower-paid service workers that could be affected by project actions related to Shasta Dam. A change in recreation opportunities could affect employment and revenue patterns, as well as social and recreational opportunities for minority or low-income residents. With the exception of Lakehead, the settlement and recreation-related development along Shasta Lake falls within unincorporated Shasta County. Residents and workers are dispersed throughout Shasta County, and affected minority and low-income communities are reflected in demographic data for Shasta County as shown in Table 24-1.

Table 24-1. Ethnicity, Income, and Poverty Trends in Shasta and Tehama Counties and California

Topic		Shasta County	Tehama County	State of California
Race/Ethnicity	White, 2005	153,771	46,375	16,408,477
	White, 2000–2005 (% change)	7.0	4.6	1.7
	Black or African American, 2005	1,278	313	2,255,281
	Black or African American, 2000–2005 (% change)	5.5	2.9	1.6
	American Indian, including Alaskan Natives, 2005	4,477	1,077	215,044
	American Indian, including Alaskan Natives, 2000–2005 (% change)	8.3	4.2	13.5
	Asian or Pacific Islander, 2005	4,600	514	4,393,010
	Asian or Pacific Islander, 2000–2005 (% change)	28.1	1.4	11.9
	Two or more races (total), 2005	5,054	1,468	779,784
	Two or more races (total), 2000–2005 (% change)	18.7	19.3	18.3
	Hispanic Origin (any race), 2005	10,302	11,207	12,905,840
	Hispanic Origin (any race), 2000–2005 (% change)	11.8	21.1	14.3
Income/Poverty	Median Household Income, 2000	$34,335	$31,206	$47,493
	Median Household Income, 2005	$42,227	$34,520[a]	$53,629
	% Change, 2000–2005	23.0	10.6	12.9
	% of Individuals Below Poverty Level, 2000	15.4	17.3	14.2
	% of Individuals Below Poverty Level, 2005	13.2	14.5[a]	13.3
	% Change, 2000–2005	-2.2	-2.8	-0.9
	% of Children (< 18) Below Poverty Level, 2000	21.0	24.0	19.0
	% of Children (< 18) Below Poverty Level, 2005	19.6	21.7[a]	18.6
	% Change, 2000–2005	-1.4	-2.3	-0.4

Sources: U.S. Census Bureau 2002a, 2002b, 2002c, 2006a, 2006b

Note:
[a] Because of limited data availability, income/poverty data for Tehama County are for 2004.

Areas of Native American Concern As described in Chapter 14, "Cultural Resources," the Sacramento River and its major tributaries, particularly the Pit and McCloud rivers, were the focus of intensive Native American occupation during historic times, with a variety of religious, economic, historic, and other values identified here for Native American groups. Ten groups, including those listed by the Native American Heritage Commission, represent Native American interests in the study area. They include Grindstone Indian Rancheria, Paskenta Band of Nomlaki Indians, Pit River Environmental Council, Pit River Tribe of California, Redding Rancheria, Shasta Nation, United Tribe of Northern California, Inc., Winnemem Wintu Tribe, Wintu Educational and Cultural Council, and the Wintu Tribe of Northern California.

The Winnemem Wintu have identified important localities within the study area, many of which are locations where ceremonies are regularly conducted. Along the McCloud River, these include Children's Rock, Coyote Rock, Dekkas Rock, doctoring pools near Nawtawaket Creek, Eagle Rock and Samwel Cave, Hirz Bay, *Kaibai* village, North Gray Rocks, Puberty Rock, Saddle Rock, and *Watawacket* village and spiritual area. Along the Sacramento River, important localities include the Antlers area, Delta area, Doney Creek, Gregory Creek, LaMoine area, Packers Bay, Pollard's area, middle Salt Creek, and Sims area. The Winnemem Wintu have strong traditional and contemporary connections with the land, and their ongoing use of many archaeological and religious sites is fundamental to the well-being of their culture, particularly the education of their youth.

The Winnemem Wintu have also documented the location of some 155 ancestral villages within the Shasta Lake area. At least 81 village locations are known along the lower McCloud River and lower Pit River. An additional 73 villages are known to have existed on the east side of the Sacramento River. These village locations once contained between one and 30 houses each, some had associated cemeteries and each had a power place. Some of these villages are already under the waters of Shasta Lake, while others are just above the current Shasta Lake water level. The Winnemem Wintu have estimated that 120 of the known villages are still accessible (above the current high-water line).

Members of the Pit River Madesi Band stated that 22 ethnographic villages and associated burial grounds are located within the existing reservoir and proposed reservoir areas. One Tribal Member also noted that several Traditional Cultural Properties (TCP) exist within the Pit 6 and Pit 7 Dam areas.

Upper Sacramento River (Shasta Dam to Red Bluff)

Many social and public services are provided and a range of resource-dependent cultural activities take place in the cities of Shasta Lake, Redding, Anderson, Cottonwood, and Red Bluff. Each of these communities could be affected during project operation as a result of improved flood protection, enhanced water supply reliability, and increased recreational opportunities and spending related to improved salmonid habitat. Redding and Shasta County may be most

affected because local residents, businesses, public services, and fiscal resources likely would also be affected by construction-related spending and activities.

Groups affected by the project could include minority and low-income populations such as transient and seasonal workers, Native American and Hispanic/Latino populations, and low-income water and electric utility customers. In 2005, the population of Tehama County was approximately 23.9 percent minority (nonwhite) and 21.7 percent (2004) low-income, compared to statewide populations of 55.6 percent minority and 18.6 percent low-income (Table 24-1). Poverty levels are declining in Shasta County and are expected to soon reach statewide levels.

These groups often share the need for a reliable income and low costs of living, access to steady jobs, the need to protect the profitability of businesses that affect their personal income, access to high-quality public services, access to affordable and diverse housing, and a desire to enjoy a high quality of life.

Minority and low-income populations in the upper Sacramento River portion of the primary study area, many of which are employed by local agricultural operations, are especially susceptible to changes in employment opportunities. Changes in water and power supply reliability or delivery costs can have a major effect on the cost of living and on the operating costs and financial health of local businesses and employers. Changes in the frequency and duration of flooding along the Sacramento River and in the Delta also could affect agricultural operations and business owners and employees.

Lower Sacramento River and Delta

As discussed in Chapter 16, "Socioeconomics, Population, and Housing," this portion of the extended study area includes Red Bluff, the largest city in Tehama County with a population of 13,535 in 2006 (DOF 2007), and nine counties to the south. In 2006, the population of those nine counties totaled 4,056,430. The minority population was 47 percent overall and exceeded 50 percent in Colusa, San Joaquin, and Solano counties. In 2006, poverty levels in the region ranged from 7 percent to 18 percent, with low-income populations exceeding the 13.3 percent state poverty level in Butte, Glenn, San Joaquin, and Yolo counties (U.S. Census Bureau 2006b, 2006c, 2007a, 2007b, 2007c).

Regional employment and labor trends are generally consistent with statewide trends. In 2005, approximately 5.3 percent of the labor force was unemployed, compared to 5.4 percent statewide. Butte, San Joaquin, Glenn, Sutter and Colusa counties registered higher unemployment rates than California as a whole. The counties with the highest unemployment rates in 2005 were characterized by greater dependence on the agricultural industry and less industrial diversity. Four of the five counties with unemployment rates above the statewide average maintained more than 60 percent of their land mass in agricultural production. Unemployment rates tend to be higher in rural areas than in urban areas because farm work is typically seasonal or temporary.

The lower Sacramento River region becomes increasingly urbanized as the river flows past the city of Sacramento and toward the Delta. Along its course, the river passes through low-density agricultural and suburban metropolitan areas and near high-density centers of commerce and culture such as Sacramento. In the Delta, a complex network of highways and urban infrastructure is integrated with canals, dikes, and levees. Heavily engineered water control and conveyance systems have promoted and sustained a successful agriculture industry and protected the region against damaging floods.

CVP/SWP Service Areas

The CVP and SWP service areas include 36 of California's 58 counties, accounting for 91 percent (37,444,385 residents) of California's population in 2006 (U.S. Census Bureau 2006b). Minority groups have been steadily increasing and such ethnic diversification is expected to continue. Almost all of the minority groups (except African American) experienced double-digit population growth between 2000 and 2005 (U.S. Census Bureau 2002a, 2006b). Hispanics are the most numerous minority group in California, and many members of this ethnic group work on farms that receive some or all of their water from the CVP. In general, rural agricultural counties have smaller minority populations than urban counties.

Poverty levels for both individuals and children decreased slightly between 2000 and 2005. This trend would not be expected to continue indefinitely. Instead, the percentage of people below the poverty level would be expected to follow national and statewide economic trends. Generally, poverty rates tend to be higher in rural counties than in urban counties. Despite these differences, each of California's major urban areas has pockets of low-income neighborhoods with high poverty (and unemployment) rates. Minority and low-income communities that might be affected by the project include communities adjacent to construction projects, gateway and service communities providing support to construction-related activities, and low-income customers of water and power utilities who might experience higher rates as a result of costs of project-related system improvements.

These residents and workers may be most vulnerable to increases in CVP water and power costs and, conversely, would benefit from improved flood protection and CVP water and power supply reliability. Central Valley farm workers and other workers employed by businesses in the region that supply goods and services to agricultural operations also could benefit.

24.2 Regulatory Framework

24.2.1 Federal

Executive Order 12898

The purpose of Executive Order 12898 (part of which is excerpted in the introduction to this chapter) is to identify and address the disproportionate placement of adverse environmental, economic, social, or health impacts from Federal actions and policies on minority and/or low-income communities. This order requires lead agencies to evaluate impacts on minority or low-income populations during preparation of environmental and socioeconomic analyses of projects or programs that are proposed, funded, or licensed by Federal agencies.

In addition to the direction referenced above, Executive Order 12898 includes the following requirements:

- Each Federal agency shall conduct its programs, policies, and activities that substantially affect human health or the environment, in a manner that ensures that such programs, policies, and activities do not have the effect of excluding persons (including populations) from participation in, denying persons (including populations) the benefits of, or subjecting persons (including populations) to discrimination under, such programs, policies, and activities, because of their race, color, or national origin. *(Section 2-2)*

- Each Federal agency shall work to ensure that public documents, notices, and hearings relating to human health or the environment are concise, understandable, and readily accessible to the public. *(Section 5-5(c))*

In addition, the presidential memorandum accompanying the executive order states that "(e)ach Federal agency shall analyze the environmental effects, including human health, economic and social effects, of Federal actions, including effects on minority communities and low-income communities, when such analysis is required by the NEPA of 1969."

Two documents provide some measure of guidance to agencies required to implement Executive Order 12898. The first is *Environmental Justice Guidance Under the National Environmental Policy Act* (December 1997), published by CEQ. The second document, the *Final Guidance for Incorporating Environmental Justice Concerns* (April 1998) published in the U.S. Environmental Protection Agency's NEPA Compliance Analysis, serves as a guide for incorporating environmental justice goals into preparation of the Environmental Impact Statement under NEPA. These documents provide specific guidelines for assessing environmental justice effects associated with a proposed Federal project.

24.2.2 State

There are no State plans, policies, regulations, or laws related to environmental justice applicable to the project. However, Senate Bill 115 (Chapter 690, Statutes of 1999), signed into law in 1999, defined environmental justice in statute and established the Governor's Office of Planning and Research as the coordinating agency for State environmental justice programs (California Government Code, Section 65040.12). This law further required the California Environmental Protection Agency to develop a model environmental justice mission statement for boards, departments, and offices within the agency by January 1, 2001 (Public Resources Code, Sections 72000 to 72001). The purpose of this program is to inform decision-makers by providing guidance on environmental justice issues.

24.2.3 Regional and Local

There are no regional or local plans, policies, regulations, or laws related to environmental justice applicable to the project.

24.3 Environmental Consequences and Mitigation Measures

This section describes the potential environmental consequences of the project alternatives as they relate to environmental justice. This analysis relies on demographic data provided in the *Socioeconomics, Population, and Housing Technical Report* and incorporates that information as necessary to describe potential effects on minority and low-income communities.

24.3.1 Methods and Assumptions

According to CEQ and U.S. Environmental Protection Agency guidelines established to assist Federal and State agencies, a minority population is present in a project area if (1) the minority population of the affected area exceeds 50 percent, or (2) the minority-population percentage of the affected area is meaningfully greater than the minority-population percentage in the general population or other appropriate unit of geographic analysis. By the same rule, a low-income population exists if the project area consists of 50 percent or more people living below the poverty threshold, as defined by the U.S. Census Bureau, or is meaningfully greater than the poverty percentage of the general population or other appropriate unit of geographic analysis.

The CEQ guidance indicates that when agencies determine whether environmental effects are disproportionately high and adverse, they are to consider whether there is or would be an impact on the natural or physical environment (as defined by NEPA) that would adversely affect a minority population or low-income population.

None of the published guidelines define the term "disproportionately high and adverse," but CEQ includes a nonquantitative definition stating that an effect is

disproportionate if it appreciably exceeds the risk or rate to the general population (CEQ 1997).

The following population characteristics are considered in this analysis:

- Race and ethnicity
- Per-capita income as it relates to the poverty level

The relevant demographic data were obtained from the U.S. Census Bureau and the California Department of Finance. Data are presented at the county level to accommodate the geographic size of each portion of the study area.

In this analysis, a county is considered to have a minority population if its nonwhite population is greater than 50 percent or is meaningfully larger than the general (statewide) nonwhite population. Low-income areas are defined as counties in which the percentage of the population below poverty status exceeds 50 percent, or is meaningfully greater than the general population (average statewide poverty level).

Native American Outreach

Public and stakeholder coordination meetings were conducted on behalf of Reclamation with Native American tribal groups whose traditional territories overlap the primary study area. Seven tribal groups were invited to an information meeting held on April 4, 2007, in Redding, California. The purpose of the meeting was to provide general information about the project, initiate Section 106 consultation with groups desiring to participate in the project, and introduce Elena Nilsson as the Native American Tribal Coordination study lead. Invitations were sent to the Grindstone Rancheria, Paskenta Rancheria, Pit River Tribe, Redding Rancheria, Shasta Nation, Winnemem Wintu, and the Wintu Tribe and Toyon-Wintu Center. The meeting was attended by representatives from the Winnemem Wintu and the Madesi Band of the Pit River Tribe.

Between August 2007 and March 2008, nine meetings were held with Native American groups whose traditional territories overlap with the primary study area. These included meetings and/or workshops with groups and individuals representing major tribes and/or extended family groups in the Shasta/Redding area regarding potential effects on cultural resources from a plan to enlarge Shasta Dam. The purposes of the meetings were to solicit, clarify, and document major concerns and issues regarding the project, and to establish a preferred method/approach to maintaining effective communication during the remainder of the project study and in future endeavors. Five groups participated in these meetings: Grindstone Indian Rancheria (one meeting), Paskenta Band of Nomlaki Indians (one meeting), Pit River Tribe (three meetings), Shasta Nation (one meeting), and Winnemem Wintu (three meetings).

24.3.2 Criteria for Determining Disproportionately High and Adverse Effects

To make a finding that disproportionately high and adverse effects would likely fall on minority or low-income populations, three conditions must be met simultaneously:

- There must be a minority or low-income population in the impact zone.
- A high and adverse impact must exist.
- The impact must be disproportionately high and adverse on the minority or low-income population.

24.3.3 Topics Eliminated from Further Consideration

No topics related to environmental justice that are included in the significance criteria listed above have been eliminated from further consideration. All relevant topics are analyzed below.

Effects on sites considered sacred by local Native American communities in the upper Sacramento River portion of the primary study area and the lower Sacramento River and Delta and CVP and SWP service areas have been eliminated from further discussion. No impacts are anticipated to these resources as a result of changes in Shasta Dam operations (i.e., storage and release scenarios). Furthermore, any construction activities near sites considered sacred by local Native American communities would require mitigation as stated in Chapter 14, including compliance with Section 106 of the NHPA. As a result, no disproportionately high and adverse effects on Native American populations would be expected; therefore, potential effects related to this topic in these geographic regions are not discussed further in this PDEIS.

24.3.4 Direct and Indirect Effects

No-Action Alternative

Shasta Lake and Vicinity

Impact EJ-1 (No-Action): Potential Disproportionate Effect on Minority and Low-Income Populations in the Vicinity of Shasta Lake Communities at Shasta Lake and in the vicinity would remain below minority and low-income thresholds as they relate to environmental justice. Adverse construction-related impacts would be avoided, and construction-related employment opportunities and gains within local economies would not be realized. Existing adverse effects on minority or low-income populations do not constitute a disproportionately high and adverse impact. No disproportionately high and adverse effects on minority or low-income populations would occur.

Shasta County would maintain its steady population growth under the No-Action Alternative. Since 1990, the population has increased by 22.3 percent, with total population projected to reach 224,000 by 2020 (DOF 2007). The

minority (nonwhite) population, including the Winnemem Wintu Tribe and other Native Americans, is projected to account for 16.6 percent of the total population in Shasta County in 2020, slightly more than the current 14.3 percent representation, but less than the 62.5 percent minority population projected statewide for 2020 (DOF 2007; U.S. Census Bureau 2006a).

As described in Table 24-1, the poverty level in Shasta County decreased by 2.2 percent during 2000 to 2005, and unemployment rates in Shasta County were mostly steady during 2000 to 2005, fluctuating between 6.0 and 7.5 percent. This trend should continue as long as statewide trends continue and strong employment opportunities continue to be provided in the region by major employment sectors such as trade, transportation, and utilities; government; educational, and health services; and leisure and hospitality industries (see Chapter 16, "Socioeconomics, Population, and Housing"). Professional and business services and education and health services are projected to be the leading growth industries in Shasta County; these are also the top two anticipated growth industries statewide. No disproportionately high or adverse impacts on minority or low-income communities are anticipated under the No-Action Alternative. Mitigation is not required for the No-Action Alternative.

Impact EJ-2 (No-Action): Potential Disproportionate Effect on Native American Populations from Disturbance or Loss of Sacred Locations in the Vicinity of Shasta Lake Shasta Dam would not be enlarged; no infrastructure would be removed, modified, or relocated; and no changes in Reclamation's Shasta Lake operations would occur. No disproportionately high and adverse effects on Native American populations would occur.

Under the No-Action Alternative, Shasta Dam would not be enlarged; no infrastructure would be removed, modified, or relocated; and no changes in Reclamation's Shasta Lake operations would occur. Therefore, there would be no effect on several locations in the vicinity of Shasta Lake that are considered sacred by local Native American communities. No disproportionately high and adverse effects on Native American populations would occur. Mitigation is not required for the No-Action Alternative.

Upper Sacramento River (Shasta Dam to Red Bluff)

Impact EJ-3 (No-Action): Potential Disproportionate Effect on Minority and Low-Income Populations in the Upper Sacramento River Area Communities in the upper Sacramento River portion of the primary study area would remain below minority and low-income thresholds for environmental justice. The No-Action Alternative would not cause long-term operational changes; therefore, communities adjacent to the Sacramento River would not be affected by long-term changes to environmental and recreational conditions. Construction-related gains within this area would not be realized. Existing adverse effects on minority or low-income populations would not be disproportionately high and adverse. No disproportionately high and adverse effects on minority or low-income populations would occur.

Tehama County would maintain its steady population growth under the No-Action Alternative. Since 1990, the population has increased by 22.9 percent, with total population projected to reach 79,000 by 2020 (DOF 2007). The minority (nonwhite) population is projected to account for 31 percent of the total population in Tehama County in 2020, an increase of nearly 7 percent from the current 23.9 percent level, but less than the 62.5 percent minority population projected statewide for 2020 (DOF 2007).

As described in Chapter 16, "Socioeconomics, Population, and Housing," during 2000 to 2005, the poverty level in Tehama County decreased by 2.8 percent and unemployment rates in Tehama County fluctuated between 6.4 and 7.6 percent. Tehama County is similar to neighboring Shasta County in employment and income trends, and dominant employment sectors. Projected growth industries differ between the two counties, however; Tehama County is projected to experience strong economic growth in construction and information services (see Chapter 16, "Socioeconomics, Population, and Housing"). These sectors are the third and fifth largest anticipated growth areas statewide.

Because the No-Action Alternative would not change existing or projected future conditions, it would not have a disproportionately high or adverse effect on minority or low-income communities. Mitigation is not required for the No-Action Alternative.

Lower Sacramento River and Delta

Impact EJ-4 (No-Action): Potential Disproportionate Effect on Minority and Low-Income Populations in the Lower Sacramento River and Delta Area

Some communities within the lower Sacramento River and Delta portion of the extended study area contain minority and low-income populations above environmental justice thresholds; however, continuing the existing and projected future conditions under the No-Action Alternative would not affect those populations. No disproportionately high and adverse effects on minority or low-income populations would occur.

The lower Sacramento River and Delta portion of the extended study area includes Butte, Colusa, Contra Costa, Glenn, Sacramento, San Joaquin, Solano, Sutter, and Yolo counties. In 2006, the population of the nine-county region was 4,056,430. This number is expected to grow by 24.8 percent to 5,063,392 by 2020 (DOF 2007; U.S. Census Bureau 2006b, 2006c, 2007a, 2007b, 2007c, 2007d, 2007e, 2007f). The minority (nonwhite) population is projected to account for 63.8 percent of the total population in the lower Sacramento River and Delta area by 2020, with minority populations exceeding 50 percent in Colusa, Sacramento, San Joaquin, Solano, Sutter, and Yolo counties. Although the minority population in the lower Sacramento River and Delta area is projected to exceed 50 percent by 2020, the 63.8 percent representation would not be meaningfully greater than the statewide minority population, which is projected to be 62.5 percent.

In 2006, poverty levels in the nine-county region ranged from 7 percent to 18 percent, with low-income populations exceeding the 13.3 percent statewide poverty level in Butte, Glenn, San Joaquin, and Yolo counties (U.S. Census Bureau 2006b, 2006c, 2007a, 2007d, 2007g). Employment and labor trends in the lower Sacramento River and Delta portion of the extended study area are generally consistent with statewide trends. In 2005, approximately 5.3 percent of the labor force was classified as unemployed, compared to a statewide total of 5.4 percent. Butte, San Joaquin, Glenn, Sutter, and Colusa counties registered higher unemployment rates than the state as a whole in 2005. Generally, the counties with the highest unemployment rates in 2005 were characterized by greater dependence on the agricultural industry and less industrial diversity. Four of the five counties with unemployment rates above the statewide average maintained more than 60 percent of their land mass in agricultural production. Unemployment rates tend to be higher in rural areas than in urban areas because farm work is typically seasonal or temporary.

The lower Sacramento River and Delta portion of the extended study area has some low-income populations and some counties with a higher unemployment rate than the statewide average. However, the No-Action Alternative would not change the existing or projected future conditions. Therefore, the No-Action Alternative would not have disproportionately high and adverse effects on minority or low-income populations. Mitigation is not required for the No-Action Alternative.

CVP/SWP Service Areas

Impact EJ-5 (No-Action): Potential Disproportionate Effect on Minority and Low-Income Populations in the CVP/SWP Service Areas Some communities within the CVP and SWP service areas contain minority and low-income populations above environmental justice thresholds; however, adverse effects on CVP and SWP customers within these communities do not constitute a disproportionately high and adverse impact. Continuing the existing and projected future conditions under the No-Action Alternative would not affect these populations. No disproportionately high and adverse effects on minority or low-income populations would occur.

The CVP and SWP service areas are so expansive that they may be considered synonymous with the entire state of California for environmental justice purposes. Together, the CVP and SWP service areas include 36 of California's 58 counties, accounting for 91 percent (37,444,385 residents) of California's population in 2006. The state's population has increased by almost 25 percent since 1990 and is projected to increase by approximately 17 percent to more than 44 million people by 2020 (DOF 2007). Continued ethnic diversification is expected. Minority groups have been steadily increasing their proportion of the state population. Almost all minority groups (except African Americans) experienced double-digit population growth between 2000 and 2005 (U.S. Census Bureau 2002a, 2006b). Hispanics are the most numerous minority group in California, and many members of this ethnic group work on farms that

receive some or all of their water from the CVP. In general, rural agricultural counties have smaller minority populations than urban counties.

Poverty levels for both individuals and children in California decreased slightly between 2000 and 2005. This trend would not be expected to continue indefinitely. Instead, the percentage of people below the poverty level would be expected to follow national and statewide economic trends. Generally, poverty rates tend to be higher in rural counties than in urban counties. Despite these overall differences, each of the state's major urban areas has pockets of low-income neighborhoods with high poverty rates.

California's total labor force increased just over 2 percent from 2002 to 2005, adding between 100,000 and 200,000 individuals each year. Between 2004 and 2005, the labor force increased by approximately 188,000 individuals. This was the largest annual increase over the 4-year period. California's total labor force exceeded 17.7 million in 2005. The state's unemployment rate was lowest in 2000 (5.0 percent), and has been increasing since 2003. Unemployment in 2005 registered at 5.4 percent, equal to the state's 2001 unemployment rate. This observed decrease in the unemployment rate at the state level has coincided with similar national employment trends. Like poverty, unemployment rates tend to be lower in urban areas than in rural areas of the state; however, high unemployment rates are often found in low-income neighborhoods of major urban centers.

Although the CVP and SWP service areas have some low-income populations, the No-Action Alternative would not change the existing or projected future conditions. Therefore, no disproportionately high and adverse effects on minority or low-income populations would occur. Mitigation is not required for the No-Action Alternative.

CP1 – 6.5-Foot Dam Raise, Anadromous Fish Survival and Water Supply Reliability

Shasta Lake and Vicinity

Impact EJ-1 (CP1): Potential Disproportionate Effect on Minority and Low-Income Populations in the Vicinity of Shasta Lake Communities adjacent to the project construction site may experience temporary or short-term adverse environmental effects because of construction activities and changes in project conditions and operations. However, neither construction-related nor operational effects would disproportionately affect minority or low-income populations in the vicinity of Shasta Lake. Increased employment and income opportunities could also result from project construction activities, and would not be disproportionately distributed among minority and low-income populations. No disproportionately high and adverse effects on minority or low-income populations would occur.

Under this alternative, the dam would be raised by 6.5 feet over a 36-month construction period. Residents near Shasta Dam, as well as others who may

commute or otherwise travel near construction sites, would be exposed to a range of potentially adverse environmental and public health effects over a 36-month construction period (Reclamation 2007). Temporary and/or short-term adverse noise, visual, and air quality effects could result; in addition, motorists could be delayed, and access to recreation opportunities or local businesses could be temporarily reduced. Negative health effects could also result if hazardous materials were to be accidentally released into the environment during construction.

Nonwhite individuals, including the Winnemem Wintu Tribe and other Native Americans, accounted for 14.3 percent of Shasta County's total population in 2005, well below the 50 percent threshold for a minority population. This percentage is also substantially less than the 2005 statewide nonwhite population of 55.6 percent. Likewise, the poverty rate in Shasta County was 13.2 percent in 2005, well below the 50 percent threshold and slightly less than the 13.3 percent statewide poverty rate. Therefore, the percentages of minority and low-income individuals in populations in Shasta County are well below threshold levels for a minority or low-income population. Therefore, minority and low-income populations would not be disproportionately affected by these adverse effects.

Increased employment and income opportunities may result from construction under CP1, which could benefit minority and low-income populations. Project construction under CP1 could increase the number of jobs available, or could improve business conditions and incomes for workers who are already employed by businesses that would directly or indirectly benefit from project-related construction spending. The project would require a labor force of 350 people drawn directly from the Shasta Lake area. Most (85 percent) of the construction materials and supplies would be purchased in the vicinity; these materials and supplies would constitute 60 percent of total construction costs (Reclamation 2007). As described above, the percentages of minority and low-income individuals in Shasta County populations are well below threshold levels for minority and low-income populations, and employment effects would not be disproportionately distributed among these groups. Selected minority and low-income individuals may be potentially affected. Such economic and job-related impacts would be beneficial. Mitigation for this impact is not needed, and thus not proposed.

Impact EJ-2 (CP1): Potential Disproportionate Effect on Native American Populations from Disturbance or Loss of Sacred Locations in the Vicinity of Shasta Lake The local Native American community has identified several locations in the vicinity of Shasta Lake that they consider to be sacred. Notable among these locations are the Winnemem Wintu's Puberty Rock and the doctoring pools near Nawtawaket Creek and the Pit River Madesi Band's ethnographic villages, associated burial grounds, and several TCPs. CP2 would have a substantial adverse effect on several of these locations in the vicinity of Shasta Lake. Because the Winnemem Wintu and Pit River Madesi Band

members attach religious and cultural significance to these locations, the disturbance or loss of resources associated with these locations would result in a disproportionately high and adverse effect on Native American populations in the vicinity of Shasta Lake.

Two tribes, the Winnemem Wintu and the Pit River Madesi Band, live within the vicinity of Shasta Lake, where they continue to actively practice many aspects of their traditional culture. Both groups have related that a complex cultural landscape of village sites, ceremonial areas, sacred sites, burial sites, and resource areas would be affected directly by CP1.

Two particularly important Winnemem Wintu locations that would be affected by CP1 are Puberty Rock and the doctoring pools near Nawtawaket Creek. CP1 could submerge Puberty Rock, restricting the Winnemen Wintu from holding the puberty ceremony at this important location. Relocating the rock to higher ground is not possible; in the Winnemem worldview, its location is preordained and connected with the nearby "two sisters" mountain (Bolliboka Mountain). Puberty Rock also marks the location of an extensive village with housepits and burials, situated at Kabyai Creek, west of the McCloud River near the McCloud Campground. CP1 would inundate additional burials at this location, which would require removal and relocation. The Winnemem Wintu have estimated that 120 ancestral villages are still accessible above the current high-water line of Shasta Lake and would be adversely affected by CP1.

The Pit River Madesi Band members state that 22 ethnographic villages, associated burial grounds, and several TCPs are located within the existing reservoir and proposed inundation or fluctuation areas.

The Winnemem Wintu and Pit River Madesi Band members attach religious and cultural significance to several locations in the vicinity of Shasta Lake; therefore, the disturbance and loss of resources associated with these locations would result in a disproportionately high and adverse effect on Native American populations in the vicinity of Shasta Lake. Mitigation for this impact is not proposed because no feasible mitigation is available.

Upper Sacramento River (Shasta Dam to Red Bluff)

Impact EJ-3 (CP1): Potential Disproportionate Effect on Minority and Low-Income Populations in the Upper Sacramento River Area Effects from project-related construction are not anticipated in the upper Sacramento River area downstream from Shasta Dam. In the long term, operational changes resulting from CP1 could reduce the risk of flooding and enhance environmental and recreational conditions in this area. These operational effects would not constitute a disproportionately high and adverse impact on minority and low-income populations. No disproportionately high and adverse effects on minority or low-income populations would occur.

In Tehama County, nonwhite individuals accounted for 23.9 percent of the total population in 2005. This is roughly half of the 50 percent threshold for a minority population. This level also is substantially less than the statewide nonwhite population of 55.6 percent. The poverty level in Tehama County was 14.5 percent in 2005, also well below the 50 percent threshold and slightly higher than the 13.3 percent statewide poverty rate. From 2000 to 2004, poverty levels in Tehama County decreased at a rate of 2.8 percent, outpacing the statewide poverty reduction rate (0.9 percent) by 1.9 percent over approximately the same time. If this trend continues, poverty levels will soon be lower than statewide levels (if they are not already). Based on this trend, and the comparatively consistent poverty rates between Tehama County and the statewide population, poverty levels in Tehama County are not meaningfully greater than poverty levels statewide. Therefore, the percentages of minority and low-income individuals in populations in Tehama County are well below threshold levels for minority and low-income populations. Thus, disproportionately high and adverse effects on minority or low-income populations would not occur.

Communities along the upper Sacramento River portion of the primary study area would not be exposed to direct construction-related impacts associated with CP1.

Raising Shasta Dam would add 256,000 acre-feet of cold-water storage to the overall capacity of the reservoir. This operational change would be beneficial for two reasons. CP1 would reduce the risk of flooding downstream from Shasta Dam and consequently reduce potentially adverse social, economic, and environmental effects because of flooding for property owners, businesses, and workers. In addition, CP1 would improve environmental and recreational conditions by enhancing habitat for fish and wildlife, benefiting anglers, hunters, and wildlife viewers.

These beneficial impacts would not be disproportionately distributed among minority and low-income populations, because representation of these groups in the population of Tehama County is well below threshold levels. Selected minority and low-income individuals may be potentially affected; however, these environmental and recreational effects would be beneficial. Mitigation for this impact is not needed, and thus not proposed.

Lower Sacramento River and Delta

Impact EJ-4 (CP1): Potential Disproportionate Effect on Minority and Low-Income Populations in the Lower Sacramento River and Delta Area

Operational effects of CP1 would be similar to those described for the upper Sacramento River portion of the primary study area under Impact EJ-2 (CP1). However, because the beneficial effects (reduction of flooding risk and improved environmental and recreational conditions) would diminish with distance from the project site, the benefits in this area would be less. No

disproportionately high or adverse effects on minority or low-income populations would occur.

Operational effects of CP1 on minority and low-income populations in the lower Sacramento River and Delta portion of the extended study area would be similar to those described for the upper Sacramento River portion of the primary study area under Impact EJ-2 (CP1). However, benefits in the lower Sacramento River and Delta area resulting from the reduced risk of flooding and improved environmental and recreational conditions would be less than described for the upper Sacramento River area because the lower Sacramento River and Delta is located at a greater distance from the project site. Minority and low-income populations would not be disproportionately affected. No disproportionately high or adverse effects on minority or low-income populations would occur. Mitigation for this impact is not needed, and thus not proposed.

CVP/SWP Service Areas

Impact EJ-5 (CP1): Potential Disproportionate Effect on Minority and Low-Income Populations in the CVP/SWP Service Areas Direct construction-related impacts are not anticipated in the CVP and SWP service areas. The project could result in adverse indirect impacts because of water and power rate increases for customers within the CVP and SWP service areas. Employment opportunities and personal incomes may increase because of operational changes that improve the reliability of the water supply and power for businesses and others. Minority and low-income populations would not be disproportionately affected. No disproportionately high and adverse effects on minority or low-income populations would occur.

Utility customers in communities within the CVP and SWP service areas may experience indirect, adverse effects through rate increases as a result of CP1. Project-related water storage and hydroelectric facility improvements may be funded partly through increased rates for water and power services. However, such adverse effects would not disproportionately affect minority or low-income populations.

Operational changes resulting from CP1 may increase employment opportunities and water and power reliability in the CVP and SWP communities, which would be beneficial for individual utility customers and businesses. Selected minority and low-income individuals may be beneficially affected by increased employment opportunities. Such beneficial employment-related impacts would not disproportionately affect minority and low-income populations. Thus, no disproportionately high and adverse effects on minority or low-income populations would occur. Mitigation for this impact is not needed, and thus not proposed.

CP2 – 12.5-Foot Dam Raise, Anadromous Fish Survival and Water Supply Reliability

Shasta Lake and Vicinity

Impact EJ-1 (CP2): Potential Disproportionate Effect on Minority and Low-Income Populations in the Vicinity of Shasta Lake Communities adjacent to the project construction site may experience temporary and/or short-term adverse environmental effects because of construction activities and changes in project conditions and operations. However, neither construction-related nor operational effects would disproportionately affect minority or low-income populations in the vicinity of Shasta Lake. Therefore, no disproportionately high and adverse effects on minority or low-income populations would occur.

Effects on minority and low-income populations would be similar to those described above for Impact EJ-1 (CP1), except that the dam would be raised by 12.5 feet and the construction period likely would extend for up to 6 additional months. The beneficial effects and less than significant adverse impacts would be similar to those described under Impact EJ-1 (CP1) because the types of work and the predicted workforce would be similar under each alternative. As described under Impact EJ-1 (CP1), the percentages of minority and low-income individuals in populations in Shasta County are well below threshold levels for a minority or low-income population. Therefore, disproportionately high and adverse effects on minority or low-income populations would not occur. Mitigation for this impact is not needed, and thus not proposed.

Impact EJ-2 (CP2): Potential Disproportionate Effect on Native American Populations from Disturbance or Loss of Sacred Locations in the Vicinity of Shasta Lake The local Native American community has identified several locations in the vicinity of Shasta Lake that they consider to be sacred. Notable among these locations are the Winnemem Wintu's Puberty Rock and the doctoring pools near Nawtawaket Creek and the Pit River Madesi Band's ethnographic villages, associated burial grounds, and several TCPs. CP2 would have a substantial adverse effect on several of these locations in the vicinity of Shasta Lake. Because the Winnemem Wintu and Pit River Madesi Band members attach religious and cultural significance to these locations, the disturbance or loss of resources associated with these locations would result in a disproportionately high and adverse effect on Native American populations in the vicinity of Shasta Lake.

This impact would be similar to but slightly greater than Impact EJ-2 (CP1) because the inundation area under CP2 would be slightly greater than under CP1. A disproportionately high and adverse effect on Native American populations would occur. Mitigation for this impact is not proposed because no feasible mitigation is available.

Upper Sacramento River (Shasta Dam to Red Bluff)

Impact EJ-3 (CP2): Potential Disproportionate Effect on Minority and Low-Income Populations in the Upper Sacramento River Area Effects from project-

related construction are not anticipated in the upper Sacramento River area downstream from Shasta Dam. In the long term, operational changes resulting from CP2 could reduce the risk of flooding and enhance environmental and recreational conditions in this area. These operational effects would not constitute a disproportionately high and adverse impact on minority and low-income populations. No disproportionately high and adverse effects on minority or low-income populations would occur.

This impact would be similar to Impact EJ-3 (CP1). CP2 would provide 187,000 acre-feet more cold-water storage capacity than CP1. Greater storage capacity would reduce the risk of flooding and, along with increased cold water, would benefit downstream fisheries and recreation resources and users. Also, as described under Impact EJ-3 (CP1), the percentages of minority and low-income individuals in populations in Tehama County are well below threshold levels for minority and low-income populations. Thus, disproportionately high and adverse effects on minority or low-income populations would not occur. Mitigation for this impact is not needed, and thus not proposed.

Lower Sacramento River and Delta

Impact EJ-4 (CP2): Potential Disproportionate Effect on Minority and Low-Income Populations in the Lower Sacramento River and Delta Area

Operational effects of CP2 would be similar to those described for the upper Sacramento River portion of the primary study area under Impact EJ-4 (CP2). However, because the beneficial effects (reduction of flooding risk and improved environmental and recreational conditions) would diminish with distance from the project site, the benefits in this area would be less. No disproportionately high or adverse effects on minority or low-income populations would occur.

This impact would be similar to Impact EJ-4 (CP1). Under CP2, reduced flooding and beneficial effects on fisheries and recreation resources also would occur in the lower Sacramento River and Delta portion of the extended study area. However, the beneficial effects would be less than along the upper Sacramento River because benefits would diminish with increasing distance from the project site. As in the upper Sacramento River portion of the primary study area, the additional 187,000 acre-feet of reservoir storage would provide somewhat greater benefits under CP2 than under CP1. Minority and low-income populations would not be disproportionately affected. No disproportionately high or adverse effects on minority or low-income populations would occur. Mitigation for this impact is not needed, and thus not proposed.

CVP/SWP Service Areas

Impact EJ-5 (CP2): Potential Disproportionate Effect on Minority and Low-Income Populations in the CVP/SWP Service Areas Direct construction-related impacts are not anticipated in the CVP and SWP service areas. The project could result in adverse indirect impacts because of water and power rate

increases for customers within the CVP and SWP service areas. Employment opportunities and personal incomes may increase because of operational changes that improve the reliability of the water supply and power for businesses and others. Minority and low-income populations would not be disproportionately affected. No disproportionately high and adverse effects on minority or low-income populations would occur.

This impact would be similar to Impact EJ-5 (CP1). Construction costs under CP2 would be greater than under CP1, because of the increased need for construction materials and an additional 12 months of construction. These increased costs would result in slightly greater increases in water and power rates than under CP1. However, such adverse effects would not disproportionately affect minority and low-income populations. Operational benefits would be similar to those of CP1, and minority or low-income populations would not be disproportionately affected. Therefore, no disproportionately high and adverse effects on minority or low-income populations would occur. Mitigation for this impact is not needed, and thus not proposed.

CP3 – 18.5-Foot Dam Raise, Anadromous Fish Survival and Water Supply

Shasta Lake and Vicinity

Impact EJ-1 (CP3): Potential Disproportionate Effect on Minority and Low-Income Populations in the Vicinity of Shasta Lake Communities adjacent to the project construction site may experience temporary and/or short-term adverse environmental effects because of construction activities and changes in project conditions and operations. However, neither construction-related nor operational effects would disproportionately affect minority or low-income populations in the vicinity of Shasta Lake. No disproportionately high or adverse effects on minority or low-income populations would occur.

This impact would be similar to Impact EJ-1 (CP1). Under CP3, the effects on minority and low-income populations would be similar to those described above for Impact EJ-1 (CP1), except that the dam would be raised by 18.5 feet and the construction period would extend for at least 12 additional months. The beneficial impacts and less than significant adverse impacts would be similar to those described under CP1 because the types of work and the predicted workforce would be similar under each alternative. As described under Impact EJ-1 (CP1), the percentages of minority and low-income individuals in populations in Shasta County are well below threshold levels for a minority or low-income population. Therefore, disproportionately high effects on minority or low-income populations would not occur (nor would disproportionately high and beneficial effects). Mitigation for this impact is not needed, and thus not proposed.

Impact EJ-2 (CP3): Potential Disproportionate Effect on Native American Populations from Disturbance or Loss of Sacred Locations in the Vicinity of Shasta Lake The local Native American community has identified several

locations in the vicinity of Shasta Lake that they consider to be sacred. Notable among these locations are the Winnemem Wintu's Puberty Rock and the doctoring pools near Nawtawaket Creek and the Pit River Madesi Band's ethnographic villages, associated burial grounds, and several TCPs. CP3 would have a substantial adverse effect on several of these locations in the vicinity of Shasta Lake. Because the Winnemem Wintu and Pit River Madesi Band members attach religious and cultural significance to these locations, the disturbance or loss of resources associated with these locations would result in a disproportionately high and adverse effect on Native American populations in the vicinity of Shasta Lake.

This impact would be similar to but slightly greater than Impact EJ-2 (CP2) because the inundation area under CP3 would be slightly greater than under CP2. A disproportionately high and adverse effect on Native American populations would occur. Mitigation for this impact is not proposed because no feasible mitigation is available.

Upper Sacramento River (Shasta Dam to Red Bluff)

Impact EJ-3 (CP3): Potential Disproportionate Effect on Minority and Low-Income Populations in the Upper Sacramento River Area Effects from project-related construction are not anticipated in the upper Sacramento River area downstream from Shasta Dam. In the long term, operational changes resulting from CP3 could reduce the risk of flooding and enhance environmental and recreational conditions in this area. These beneficial operational effects would not be disproportionately distributed among minority and low-income populations. No disproportionately high and adverse effects on minority or low-income populations would occur.

This impact would be similar to Impact EJ-3 (CP1). CP3 would provide 378,000 acre-feet more cold-water storage capacity than CP1. Greater storage capacity would reduce the risk of flooding and, along with increased cold water, would benefit downstream fisheries and recreation resources and users. Also, as described under Impact EJ-3 (CP1), the percentages of minority and low-income individuals in populations in Tehama County are well below threshold levels for minority and low-income populations. Thus, disproportionately high and adverse effects on minority or low-income populations would not occur. Mitigation for this impact is not needed, and thus not proposed.

Lower Sacramento River and Delta

Impact EJ-4 (CP3): Potential Disproportionate Effect on Minority and Low-Income Populations in the Lower Sacramento River and Delta Area
Operational effects of CP3 would be similar to those described for the upper Sacramento River portion of the primary study area under Impact EJ-3 (CP3). However, because the beneficial effects (reduction of flooding risk and improved environmental and recreational conditions) would diminish with distance from the project site, the benefits in this area would be less. No

disproportionately high or adverse effects on minority or low-income populations would occur.

This impact would be similar to Impact EJ-4 (CP1). Under CP3, reduced flooding and beneficial effects on fisheries and recreation resources also would occur in the lower Sacramento River and Delta portion of the extended study area. However, the beneficial effects would be less than along the upper Sacramento River because benefits would diminish with increasing distance from the project site. As in the upper Sacramento River portion of the primary study area, the additional 378,000 acre-feet of reservoir storage would provide somewhat greater benefits under CP3 than under CP1. Minority and low-income populations would not be disproportionately affected. No disproportionately high or adverse effects on minority or low-income populations would occur. Mitigation for this impact is not needed, and thus not proposed.

CVP/SWP Service Areas

Impact EJ-5 (CP3): Potential Disproportionate Effect on Minority and Low-Income Populations in the CVP/SWP Service Areas Direct construction-related impacts are not anticipated in the CVP and SWP service areas. The project could result in adverse indirect impacts because of water and power rate increases for customers within the CVP and SWP service areas. Employment opportunities and personal incomes may increase because of operational changes that improve the reliability of the water supply reliability and power for businesses and others. Minority and low-income populations would not be disproportionately affected. No disproportionately high or adverse effects on minority or low-income populations would occur.

This impact would be similar to Impact EJ-5 (CP1). Construction costs under CP3 would be greater than under CP1 because of the increased need for construction materials and an additional 12 months of construction. These increased costs would result in slightly greater increases in water and power rates than under CP1. However, such adverse effects would not disproportionately affect minority and low-income populations. Operational benefits would be similar to those of CP1, and minority and low-income populations would not be disproportionately affected. Therefore, no disproportionately high and adverse effects on minority or low-income populations would occur. Mitigation for this impact is not needed, and thus not proposed.

CP4 – 18.5-Foot Dam Raise, Anadromous Fish Focus with Water Supply Reliability

Shasta Lake and Vicinity

Impact EJ-1 (CP4): Potential Disproportionate Effect on Minority and Low-Income Populations in the Vicinity of Shasta Lake Communities adjacent to the project construction site may experience temporary and/or short-term adverse environmental effects because of construction activities and changes in

project conditions and operations. However, neither construction-related nor operational effects would be disproportionately distributed among minority or low-income populations in the vicinity of Shasta Lake. No disproportionately high and adverse effects on minority or low-income populations would occur.

This impact would be similar to Impact EJ-1 (CP1). Under CP4, the effects on minority and low-income populations would be similar to those described above for Impact EJ-1 (CP1), except that the dam would be raised by 18.5 feet and the construction period would extend for at least 12 additional months. The beneficial effects and less than significant adverse impacts would be similar to those described under CP1 because the types of work and the predicted workforce would be similar under each alternative. As described under Impact EJ-1 (CP1), the percentages of minority and low-income individuals in populations in Shasta County are well below threshold levels for a minority or low-income population. Therefore, adverse and beneficial effects would not be disproportionately distributed among minority or low-income populations. No disproportionately high and adverse effects on minority or low-income populations would occur. Mitigation for this impact is not needed, and thus not proposed.

Impact EJ-2 (CP4): Potential Disproportionate Effect on Native American Populations from Disturbance or Loss of Sacred Locations in the Vicinity of Shasta Lake The local Native American community has identified several locations in the vicinity of Shasta Lake that they consider to be sacred. Notable among these locations are the Winnemem Wintu's Puberty Rock and the doctoring pools near Nawtawaket Creek and the Pit River Madesi Band's ethnographic villages, associated burial grounds, and several TCPs. CP2 would have a substantial adverse effect on several of these locations in the vicinity of Shasta Lake. Because the Winnemem Wintu and Pit River Madesi Band members attach religious and cultural significance to these locations, the disturbance or loss of resources associated with these locations would result in a disproportionately high and adverse effect on Native American populations in the vicinity of Shasta Lake.

This impact would be similar to Impact EJ-2 (CP3), but the frequency and timing of inundation may vary. Disproportionately high and adverse effects on Native American populations would occur. Mitigation for this impact is not proposed because no feasible mitigation is available.

Upper Sacramento River (Shasta Dam to Red Bluff)

Impact EJ-3 (CP4): Potential Disproportionate Effect on Minority and Low-Income Populations in the Upper Sacramento River Area Effects from project-related construction are not anticipated in the upper Sacramento River area downstream from Shasta Dam. In the long term, operational changes resulting from CP4 could reduce the risk of flooding and enhance environmental and recreational conditions in this area. These beneficial operational effects would not constitute a disproportionately high and adverse impact on minority and

low-income populations. No disproportionately high and adverse effects on minority or low-income populations would occur.

This impact would be similar to Impact EJ-3 (CP1). CP4 would provide 378,000 acre-feet more cold-water storage capacity than CP1. Greater storage capacity would reduce the risk of flooding and, along with increased cold water, would benefit downstream fisheries and recreation resources and users. Also, as described under Impact EJ-3 (CP1), the percentages of minority and low-income individuals in populations in Tehama County are well below threshold levels for minority and low-income populations. Minority and low-income populations would not be disproportionately affected. No disproportionately high and adverse effects on minority or low-income populations would occur. Mitigation for this impact is not needed, and thus not proposed.

Lower Sacramento River and Delta

Impact EJ-4 (CP4): Potential Disproportionate Effect on Minority and Low-Income Populations in the Lower Sacramento River and Delta Area

Operational effects of CP4 would be similar to those described for the upper Sacramento River portion of the primary study area under Impact EJ-3 (CP4). However, because the beneficial effects (reduction of flooding risk and improved environmental and recreational conditions) would diminish with distance from the project site, the benefits in this area would be less. No disproportionately high and adverse effects on minority or low-income populations would occur.

This impact would be similar to Impact EJ-4 (CP1). Under CP4, reduced flooding and beneficial effects on fisheries and recreation resources also would occur in the lower Sacramento River and Delta portion of the extended study area. However, the beneficial effects would be less than along the upper Sacramento River because benefits would diminish with increasing distance from the project site. As in the upper Sacramento River portion of the primary study area, the additional 378,000 acre-feet of reservoir storage would provide somewhat greater benefits under CP4 than under CP1. Minority and low-income populations would not be disproportionately affected. No disproportionately high or adverse effects on minority or low-income populations would occur. Mitigation for this impact is not needed, and thus not proposed.

CVP/SWP Service Areas

Impact EJ-5 (CP4): Potential Disproportionate Effect on Minority and Low-Income Populations in the CVP/SWP Service Areas Direct construction-related impacts are not anticipated in the CVP and SWP service areas. The project could result in adverse indirect impacts because of water and power rate increases for customers within the CVP and SWP service areas. Employment opportunities and personal incomes may increase because of operational changes that improve the reliability of the water supply and power to businesses and others. Minority and low-income populations would not be

disproportionately affected. No disproportionately high and adverse effects on minority or low-income populations would occur.

This impact would be similar to Impact EJ-5 (CP1). Construction costs under CP4 would be greater than under CP1 because of the increased need for construction materials and an additional 12 months of construction. These increased costs would result in slightly greater increases in water and power rates than under CP1. However, such adverse effects would not disproportionately affect minority and low-income populations. Operational benefits would be similar to those under CP1, and minority and low-income populations would not be disproportionately affected. Therefore, no disproportionately high and adverse effects on minority or low-income populations would occur. Mitigation for this impact is not needed, and thus not proposed.

CP5 – 18.5-Foot Dam Raise, Combination Plan

Shasta Lake and Vicinity

Impact EJ-1 (CP5): Potential Disproportionate Effect on Minority and Low-Income Populations in the Vicinity of Shasta Lake Communities adjacent to the project construction site may experience temporary adverse environmental effects because of construction activities and changes in project conditions and operations. However, the construction activity in any specific area would be short-term, and neither construction-related nor operational effects would constitute a high and adverse impact on minority or low-income populations in the vicinity of Shasta Lake. No disproportionately high and adverse effects on minority or low-income populations would occur.

This impact would be similar to Impact EJ-1 (CP1). Under CP5, the effects on minority and low-income populations would be similar to those described above for Impact EJ-1 (CP1), except that the dam would be raised by 18.5 feet and the construction period would extend for at least 12 additional months. The beneficial effects and less than significant adverse impacts would be similar to those described under CP1 because the types of work and the predicted workforce would be similar under each alternative. As described under Impact EJ-1 (CP1), the percentages of minority and low-income individuals in populations in Shasta County are well below threshold levels for a minority or low-income population. Therefore, minority and low-income populations would not be disproportionately affected. No disproportionately high and adverse effects on minority or low-income populations would occur. Mitigation for this impact is not needed, and thus not proposed.

Impact EJ-2 (CP5): Potential Disproportionate Effect on Native American Populations from Disturbance or Loss of Sacred Locations in the Vicinity of Shasta Lake The local Native American community has identified several locations in the vicinity of Shasta Lake that they consider to be sacred. Notable among these locations are the Winnemem Wintu's Puberty Rock and the doctoring pools near Nawtawaket Creek and the Pit River Madesi Band's

ethnographic villages, associated burial grounds, and several TCPs. CP2 would have a substantial adverse effect on several of these locations in the vicinity of Shasta Lake. Because the Winnemem Wintu and Pit River Madesi Band members attach religious and cultural significance to these locations, the disturbance or loss of resources associated with these locations would result in a disproportionately high and adverse effect on Native American populations in the vicinity of Shasta Lake.

This impact would be the same as Impact EJ-2 (CP3). Disproportionately high and adverse effects on Native American populations would occur. Mitigation for this impact is not proposed because no feasible mitigation is available.

Upper Sacramento River (Shasta Dam to Red Bluff)

Impact EJ-3 (CP5): Potential Disproportionate Effect on Minority and Low-Income Populations in the Upper Sacramento River Area Effects from project-related construction are not anticipated in the upper Sacramento River area downstream from Shasta Dam. In the long term, operational changes resulting from CP5 could reduce the risk of flooding and enhance environmental and recreational conditions in this area. These operational effects would not constitute a disproportionately high and adverse impact on minority and low-income populations. No disproportionately high and adverse effects on minority or low-income populations would occur.

This impact would be similar to Impact EJ-3 (CP1). CP5 would provide 378,000 acre-feet more cold-water storage capacity than CP1. Greater storage capacity would reduce the risk of flooding and, along with increased cold water, would benefit downstream fisheries and recreation resources and users. Also, as described under Impact EJ-3 (CP1), the percentages of minority and low-income individuals in populations in Tehama County are well below threshold levels for minority and low-income populations. Therefore, minority and low-income populations would not be disproportionately affected. No disproportionately high and adverse effects on minority or low-income populations would occur. Mitigation for this impact is not needed, and thus not proposed.

Lower Sacramento River and Delta

Impact EJ-4 (CP5): Potential Disproportionate Effect on Minority and Low-Income Populations in the Lower Sacramento River and Delta Area
Operational effects of CP5 would be similar to those described for the upper Sacramento River portion of the primary study area under Impact EJ-3 (CP5). However, because the beneficial effects (reduction of flooding risk and improved environmental and recreational conditions) would diminish with distance from the project site, the benefits in this area would be less. No disproportionately high and adverse effects on minority or low-income populations would occur.

This impact would be similar to Impact EJ-4 (CP1). Under CP5, reduced flooding and beneficial effects on fisheries and recreation resources also would occur in the lower Sacramento River and Delta portion of the extended study area. However, the beneficial effects would be less than along the upper Sacramento River because benefits would diminish with increasing distance from the project site. As in the upper Sacramento River portion of the primary study area, the additional 378,000 acre-feet of reservoir storage would provide somewhat greater benefits under CP5 than under CP1. Minority and low-income populations would not be disproportionately affected. No disproportionately high or adverse effects on minority or low-income populations would occur. Mitigation for this impact is not needed, and thus not proposed.

CVP/SWP Service Areas

Impact EJ-5 (CP5): Potential Disproportionate Effect on Minority and Low-Income Populations in the CVP/SWP Service Areas Direct construction-related impacts are not anticipated in the CVP and SWP service areas. The project could result in adverse indirect impacts because of water and power rate increases for customers within the CVP and SWP service areas. Employment opportunities and personal incomes may increase because of operational changes that improve the reliability of the water supply and power for businesses and others. Minority and low-income populations would not be disproportionately affected. Therefore, no disproportionately high and adverse effects on minority or low-income populations would occur.

This impact would be similar to Impact EJ-5 (CP1). Construction costs under CP5 would be greater than under CP1 because of increased materials and an additional 12 months of construction. These increased costs would result in slightly greater increases in water and power rates than under CP1. However, such adverse effects would not disproportionately affect minority and low-income populations. Operational benefits would be similar to those under CP1, and minority and low-income populations would not be disproportionately affected. Therefore, no disproportionately high and adverse effects on minority or low-income populations would occur. Mitigation for this impact is not needed, and thus not proposed.

24.3.5 Mitigation Measures

Table 24-2 presents a summary of effects and mitigation measures for environmental justice.

Table 24-2. Summary of Mitigation Measures for Environmental Justice

Impact		No-Action Alternative	CP1	CP2	CP3	CP4	CP5
Impact EJ-1: Potential Disproportionate Effect on Minority and Low-Income Populations in the Vicinity of Shasta Lake	Effect before Mitigation	NDHA	NDHA	NDHA	NDHA	NDHA	NDHA
	Mitigation Measure	None required.	None needed; thus, none proposed.				
	Effect after Mitigation	NDHA	NDHA	NDHA	NDHA	NDHA	NDHA
Impact EJ-2: Potential Disproportionate Effect on Native American Populations in the Vicinity of Shasta Lake	Effect before Mitigation	NDHA	DHA	DHA	DHA	DHA	DHA
	Mitigation Measure	None required.	None available.				
	Effect after Mitigation	NDHA	DHA	DHA	DHA	DHA	DHA
Impact EJ-3: Potential Disproportionate Effect on Minority and Low-Income Populations in the Upper Sacramento River Area	Effect before Mitigation	NDHA	NDHA	NDHA	NDHA	NDHA	NDHA
	Mitigation Measure	None required.	None needed; thus, none proposed.				
	Effect after Mitigation	NDHA	NDHA	NDHA	NDHA	NDHA	NDHA
Impact EJ-4: Potential Disproportionate Effect on Minority and Low-Income Populations in the Lower Sacramento River and Delta Area	Effect before Mitigation	NDHA	NDHA	NDHA	NDHA	NDHA	NDHA
	Mitigation Measure	None required.	None needed; thus, none proposed.				
	Effect after Mitigation	NDHA	NDHA	NDHA	NDHA	NDHA	NDHA
Impact EJ-5: Potential Disproportionate Effect on Minority and Low-Income Populations in the CVP/SWP Service Areas	Effect before Mitigation	NDHA	NDHA	NDHA	NDHA	NDHA	NDHA
	Mitigation Measure	None required.	None needed; thus, none proposed.				
	Effect after Mitigation	NDHA	NDHA	NDHA	NDHA	NDHA	NDHA

Key:
DHA = Disproportionately high and adverse
NDHA = Not disproportionately high and adverse

No-Action Alternative

No mitigation measures are needed for this alternative.

CP1 – 6.5-Foot Dam Raise, Anadromous Fish Survival and Water Supply Reliability

No mitigation measures are needed for Impacts EJ-1 (CP1), EJ-3 (CP1), EJ-4 (CP1), or EJ-5 (CP1). No feasible mitigation is available for Impact EJ-2 (CP1). The disturbance or loss of resources associated with locations considered by the Winnemem Wintu and Pit River Madesi Band members to have religious and cultural significance would result in an unmitigable disproportionately high and adverse effect on Native American populations in the vicinity of Shasta Lake.

CP2 – 12.5-Foot Dam Raise, Anadromous Fish Survival and Water Supply Reliability

No mitigation measures are needed for Impacts EJ-1 (CP2), EJ-3 (CP2), EJ-4 (CP2), or EJ-5 (CP2). No feasible mitigation is available for Impact EJ-2 (CP2). The disturbance or loss of resources associated with locations considered by the Winnemem Wintu and Pit River Madesi Band members to have religious and cultural significance would result in an unmitigable disproportionately high and adverse effect on Native American populations in the vicinity of Shasta Lake.

CP3 – 18.5-Foot Dam Raise, Anadromous Fish Survival and Water Supply

No mitigation measures are needed for Impacts EJ-1 (CP3), EJ-3 (CP3), EJ-4 (CP3), or EJ-5 (CP3). No feasible mitigation is available for Impact EJ-2 (CP3). The disturbance or loss of resources associated with locations considered by the Winnemem Wintu and Pit River Madesi Band members to have religious and cultural significance would result in an unmitigable disproportionately high and adverse effect on Native American populations in the vicinity of Shasta Lake.

CP4 – 18.5-Foot Dam Raise, Anadromous Fish Focus with Water Supply Reliability

No mitigation measures are needed for Impacts EJ-1 (CP4), EJ-3 (CP4), EJ-4 (CP4), or EJ-5 (CP4). No feasible mitigation is available for Impact EJ-2 (CP4). The disturbance or loss of resources associated with locations considered by the Winnemem Wintu and Pit River Madesi Band members to have religious and cultural significance would result in an unmitigable disproportionately high and adverse effect on Native American populations in the vicinity of Shasta Lake.

CP5 – 18.5-Foot Dam Raise, Combination Plan

No mitigation measures are needed for Impacts EJ-1 (CP5), EJ-3 (CP5), EJ-4 (CP5), or EJ-5 (CP5). No feasible mitigation is available for Impact EJ-2 (CP5). The disturbance or loss of resources associated with locations considered by the Winnemem Wintu and Pit River Madesi Band members to have religious and cultural significance would result in an unmitigable disproportionately high and adverse effect on Native American populations in the vicinity of Shasta Lake.

24.3.6 Cumulative Effects

In the primary study area (i.e., Shasta Lake and vicinity and the upper Sacramento River from Shasta Dam to Red Bluff), minority and low-income populations are not disproportionately represented. Identified construction effects would be less than significant, and minority and low-income populations would not be disproportionately affected.

Some communities within the extended study area (i.e., the lower Sacramento River and Delta and the CVP and SWP service areas) exceed minority and low-income thresholds. These communities, along with the general population, would benefit from project effects that would reduce future water shortages by improving water supply reliability for both average and drought years. The greatest benefit would be provided by CP3, CP4, and CP5, which would provide an additional 634,000 acre-feet of storage capacity. CP1 and CP2 would provide only 256,000 and 443,000 acre-feet of increased storage capacity, respectively, with correspondingly reduced benefits.

Alternatives that would incorporate the greatest increase to dam height would result in the greatest project cost because of higher costs for construction materials and longer construction periods. These increased costs may be reflected in increased utility rates that could be combined with other utility rate increases. Such rate increases would be incremental and would be experienced by the general population, along with minority and low-income communities.

Therefore, the project would not contribute to disproportionate placement of environmental impacts on low-income and minority populations or communities, and no cumulatively considerable impacts would result.

The disturbance or loss of resources associated with locations considered by the Winnemem Wintu and Pit River Madesi Band members to have religious and cultural significance would result in a disproportionately high and adverse effect on Native American populations in the vicinity of Shasta Lake. Therefore, the project would contribute to disproportionate placement of environmental impacts on Native American populations and would result in a cumulatively considerable incremental contribution to a significant and unavoidable cumulative impact.

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Chapter 25
Wild and Scenic River Considerations for McCloud River

This chapter describes the effects of the dam and reservoir modifications proposed under the SLWRI on the wild and scenic river values of the lower McCloud River, one of the major tributaries to Shasta Lake.

This chapter differs from the other chapters in this PDEIS in that it concerns only the McCloud River and does not discuss other portions of the primary study area nor the extended study area. The study area for this chapter consists of the lower McCloud River from the McCloud River Bridge to the confluence with Little Bollibokka Creek (Figure 25-1).

The primary focus of this chapter is the wild and scenic river values of the lower McCloud River, particularly the reach that would periodically be newly inundated if Shasta Dam and Shasta Lake were enlarged. The discussion and analysis concentrate on the values for which the McCloud River has been determined eligible for listing under the Federal Wild and Scenic Rivers Act (Federal WSRA; Public Law 90-542, as amended; 16 U.S. Code 1271-1287) and for which a portion of the river is protected under the California Public Resources Code, Section 5093.542 (State PRC). Section 5093.542 was established through enactment of the California Wild and Scenic Rivers Act, as amended (Sections 5093.50 – 5093.70).

This chapter also differs from the other chapters in that it first provides background information and then discusses the regulatory framework to provide context for the affected environment section.

25.1 Background

Segments of the McCloud River have been determined eligible for listing under the Federal WSRA and are protected under the State PRC. The river has not been formally listed as wild and scenic under either the Federal WSRA or State PRC.

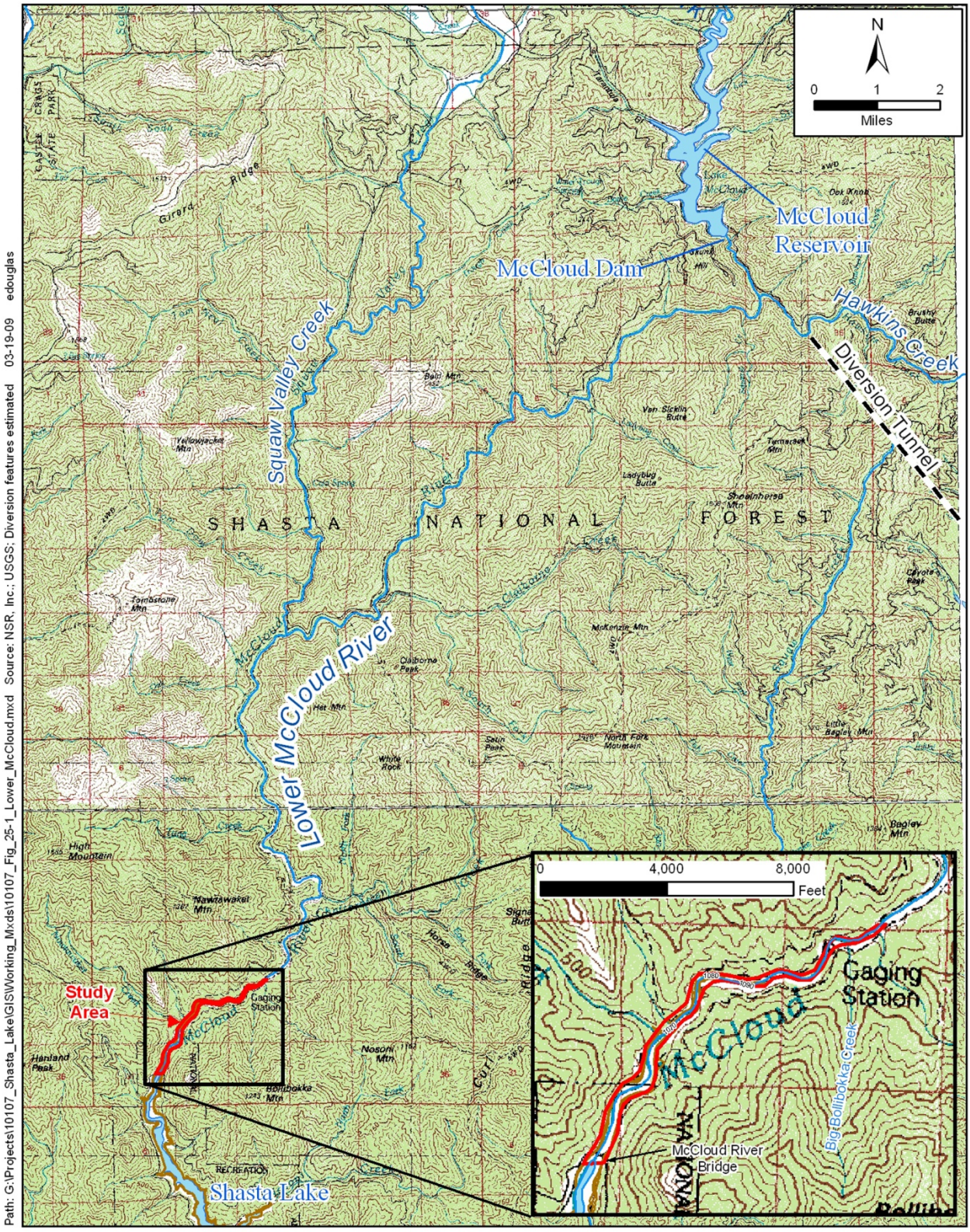


Figure 25-1. Lower McCloud River Study Area

The USFS evaluated the eligibility of the McCloud River for listing as wild and scenic under the Federal WSRA during preparation of the Shasta-Trinity National Forest (STNF) Land and Resource Management Plan (LRMP) in 1994 (USFS 1994). Although the LRMP found the McCloud River eligible for listing, the LRMP direction was to not formally designate any reach of the river as wild and scenic. Instead, the direction was to manage the lower McCloud River under a Coordinated Resource Management Plan (CRMP; USFS 1995a). The coordinated resource management plan (CRMP) is a coordinated effort between landowners and stakeholders with a vested interest in the river. The CRMP requires its signatories to protect the values that make it eligible for Federal designation as wild and scenic and contains a provision stating that the USFS reserves the right to pursue designation if the CRMP is terminated or fails to protect these values.

The California Resources Agency (Resources Agency) evaluated the McCloud River in the late 1980s (Jones & Stokes Associates 1988) to determine whether it was eligible for listing under the State PRC. The Resources Agency study found it eligible, but the California legislature declined to add the river to the California wild and scenic river system. The legislature instead passed an amendment to the California Wild and Scenic Rivers Act to protect the river's free-flowing condition and the river's fishery below McCloud Dam through the State PRC.

As described in more detail under "Regulatory Framework," the State PRC and Federal WSRA share several similar components: the establishment of a wild and scenic rivers system; the purpose of protecting certain rivers in their "free-flowing" condition; the identification of extraordinary or outstandingly remarkable values (ORV) that make such rivers eligible for protection; a study process and procedure for including rivers in the system; and classifications of "wild," "scenic," and "recreational." Both the Federal WSRA and State PRC prohibit new water impoundments on designated rivers, and both contain directives to government agencies to use their powers to further the policies of the legislation.

The Federal WSRA establishes a larger wild and scenic river corridor—typically at least 0.25 mile on each side of the river—than the State PRC and requires Federal agencies to manage the public lands in the corridor to protect the river's free-flowing character and ORVs. In addition, the managing Federal agency for rivers that are Federally designated as wild and scenic is required to develop and implement a management plan that will ensure the river's protection. In contrast, the State PRC provides protection only to the first line of permanent riparian vegetation and does not require a management plan.

The length of the lower McCloud River determined eligible for wild and scenic river status was different in the Federal and State evaluations. The USFS defined the lower McCloud River more narrowly than the Resources Agency, considering the portion of the river that is currently periodically inundated by

Shasta Lake – referred to in this chapter as the *transition reach* – as part of the lake rather than part of the river. The USFS defined the lower river as extending from McCloud Dam downstream to an elevation of 1,070 feet mean sea level (msl) (approximately 22 total river miles), which corresponds to the current full-pool elevation of Shasta Lake. The Resources Agency's study report included approximately 5,400 feet of the transition reach (down to the McCloud River Bridge) as part of the lower river's segments (approximately 23 total river miles).

In its evaluation, the USFS divided the McCloud River into 10 segments encompassing 46 total river miles: three segments along the upper McCloud River (24 river miles above McCloud Reservoir) and seven segments along the lower McCloud River (22 river miles below McCloud Dam). Numbering of the upper McCloud River segments began at the headwaters and counted downstream, but numbering of the lower McCloud River segments began at the downstream extent and counted upstream. The USFS concluded that all 10 segments of the McCloud River were eligible for listing as a Federal wild and scenic river because they are free flowing, possess good water quality, and exhibit ORVs in the areas of cultural and historical resources, fisheries, geology, and scenic resources. Part of the lowermost segment – Segment 4 – would be periodically inundated if Shasta Lake is expanded. Segment 4 extends from about 5,400 feet upstream from the McCloud River Bridge, beginning at an elevation of 1,070 feet msl, to about Little Bollibokka Creek. The lower extent of this segment corresponds with the current full-pool elevation of Shasta Lake based on Reclamation geographic information system data. Figure 25-2 shows the downstream extent of Segment 4.

The Resources Agency's report also identified 10 segments, but its evaluation encompassed only 43 total river miles and the numbering of segments began at the headwaters and counted downstream along the entire river. The segments included six along the upper river (20 river miles above McCloud Reservoir) and four along the lower river (23 river miles below McCloud Dam). Eight of the 10 segments were determined eligible for State wild and scenic river status. Segment 10 extends from the McCloud River Bridge to the northern border of Section 9, Township 36 North, Range 3 West, which is just upstream from the river's confluence with Tuna Creek. Approximately 5,400 feet of the transition reach is included in Segment 10; the portion of the transition reach downstream from the bridge was determined ineligible. The downstream extent of Segment 10 is shown on Figure 25-2.

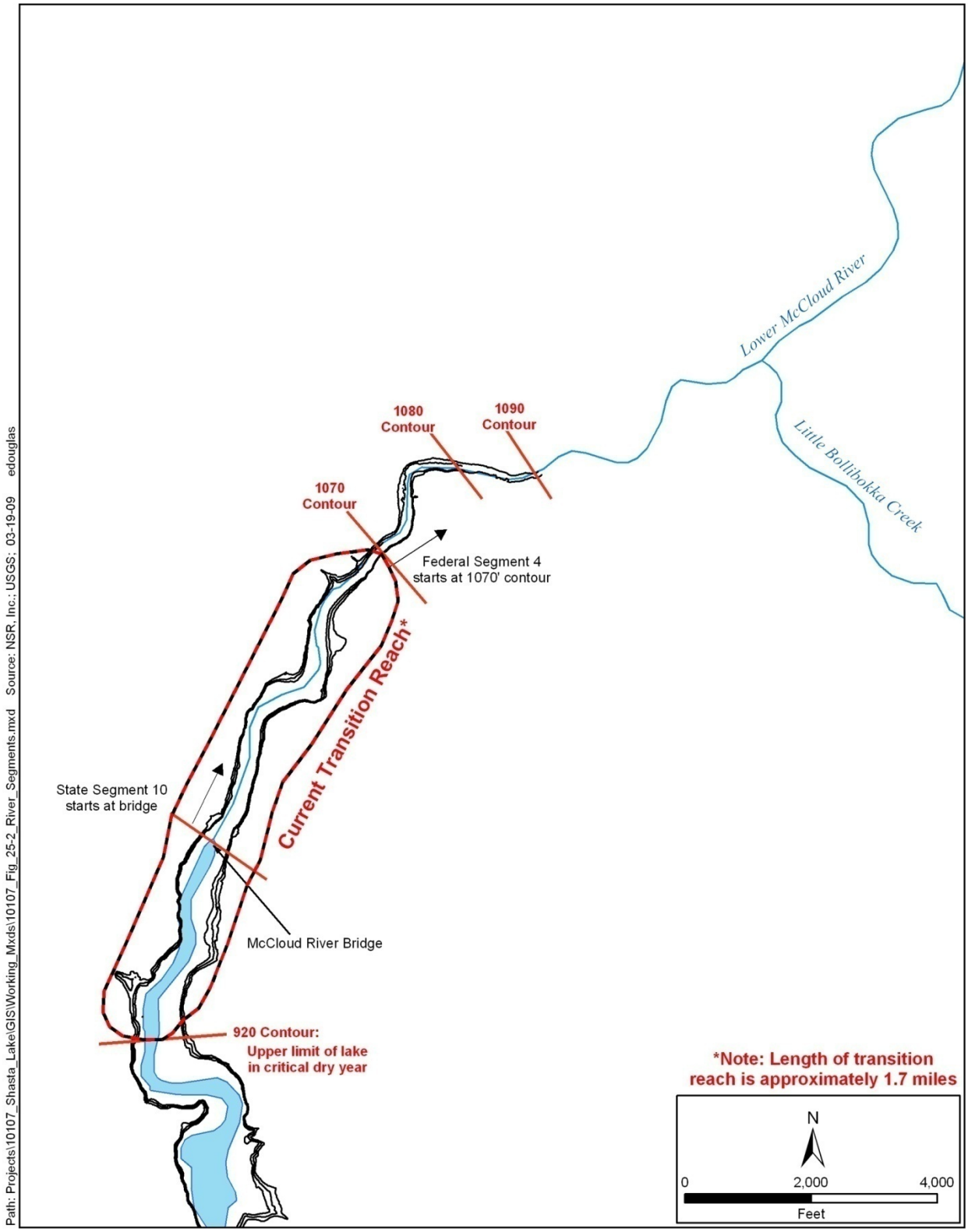


Figure 25-2. Differences in State and Federal Segments and Transition Reach

25.2 Regulatory Framework

25.2.1 Federal

Federal Wild and Scenic Rivers Act

The Federal WSRA, enacted in 1968, established the National Wild and Scenic Rivers System "to preserve rivers with outstanding natural, cultural, and recreational values in a free-flowing condition for the enjoyment of present and future generations." To be eligible for inclusion in the system, a river must be free-flowing and exhibit ORVs. Free-flowing means "existing or flowing in a natural condition without impoundment, diversion, straightening, rip-rapping, or other modification of the waterway" (16 USC Section 1286). ORVs are scenic, recreational, geologic, fish and wildlife, historic, cultural, or other similar values (16 USC Section 1271). Depending on the specific conditions of a river, it may be designated as "wild," "scenic," or "recreation." Different segments of a single river can receive different designations; in other words, some segments can be designated wild, some scenic, and some recreation or combinations of these designations.

Through the development and approval of the STNF LRMP, the USFS determined that segments of the McCloud River are eligible for inclusion in the national system; however, the river has not been formally designated and thus is not afforded protections under the Federal WSRA. Instead, the McCloud River CRMP was developed "to protect the [river's] unique and outstandingly remarkable features," thereby maintaining its eligibility.

The USFS evaluation concluded that the lower McCloud River, from McCloud Dam downstream about 22 miles to the river's transition to Shasta Lake at about 1,070 feet msl, provides outstanding cultural, fisheries, and geologic values, and its corridor has been classified as a highly sensitive visual area by the USFS (USFS 1994 and 1995b). The entire river corridor contains prehistoric and historic sites from past use by Indian tribes, late 1800 and early 1900 resorts, and logging activities. The lower river provides habitat for trout species (bull trout/Dolly Varden, which is believed to be extinct, and rainbow trout, which has been transplanted all over the world) and is considered a "blue ribbon trout fishery" (USFS 1994). Outstanding geologic values include rock outcrops, cascades, and pools. Based on the ORVs, the STNF determined that the lower McCloud River meets the eligibility requirements for designation under the Federal WSRA.

Shasta-Trinity National Forest Land and Resources Management Plan

The STNF LRMP is a forest-wide land use plan developed to guide resource management within the forest (USFS 1995b). For planning purposes, the STNF is divided into six land allocations for which specific management prescriptions are identified. The land allocations include Congressionally Reserved Areas, Late-Successional Reserves, Administratively Withdrawn Areas, Riparian Reserves and Key Watersheds, Matrix Lands, and Adaptive Management Areas.

Management areas were identified within the STNF to establish management direction in response to the issues and resources of each distinct area. The Management Area defined for the McCloud River provides resource direction for recreational use, specifically fishing and viewing waterfalls, and management of old-growth habitat. Management of the wild and scenic river ORVs of the McCloud River is deferred to the CRMP.

Coordinated Resource Management Plan

In 1990, certain public agencies and private parties with interests in the management of lands adjacent to the McCloud River executed a memorandum of understanding to pursue preparation of a CRMP. The memorandum was signed by representatives of the USFS, DFG, The Nature Conservancy, Pacific Gas and Electric Company (PG&E), the Bollibokka Land Company, Crane Mills, McCloud River Co-Tenants, Sierra Pacific Industries, and the Hearst Corporation. In 1991, the same signatories, along with California Trout Inc., signed another memorandum of understanding to establish the framework for and approve the CRMP. The CRMP was adopted in July 1991. In 2007, the property owned by the Bollibokka Land Company was sold to Westlands Water District, which is not a party to the CRMP.

The CRMP provides a framework for the coordination of management activities among the participants to ensure that the characteristics of the river that make it eligible for Federal wild and scenic river designation are protected. The CRMP provides specific conditions for the USFS' management of the river and states that the USFS "reserves the right to pursue [Federal wild and scenic river] designation" if the CRMP is terminated or significantly impaired or if the CRMP fails to protect the values that make the river suitable for such designation.

25.2.2 State

California Public Resource Code, Sections 5093.50-5093.70

Sections 5093.50–5093.70 were added to the State PRC in 1972, through enactment of the California Wild and Scenic Rivers Act, to preserve certain rivers that possess extraordinary scenic, recreational, fishery, or wildlife values in their free-flowing state. The State PRC identifies, classifies, and provides protection for specific rivers or river segments, as approved by the legislature. Rivers or river segments that are specifically identified and classified in the PRC comprise the State Wild and Scenic Rivers System. As described in Section 5093.50, rivers or river segments included in the State system must possess "extraordinary scenic, recreational, fishery, or wildlife values"; the PRC does not define what constitutes "extraordinary."

Various amendments to the California Wild and Scenic Rivers Act have been passed, adding related legislation to the PRC. In 1986, Assembly Bill (AB) 3101 (Statutes 1986, Chapter 894) established a study process to help determine eligibility for potential additions to the State system (PRC Section 5093.547 and

Section 5093.548). Additionally, protection for river segments can be provided without formally identifying them as part of the State system.

In 1989, an amendment to the California Wild and Scenic Rivers Act was passed, adding Section 5093.542 to the PRC to protect the McCloud River fishery, which it describes as "one of the finest wild trout fisheries in the state." It further declares that "The continued management of river resources in their existing natural condition represents the best way to protect the unique fishery of the McCloud River" and that "maintaining the McCloud River in its free-flowing condition to protect its fishery is the highest and most beneficial use of the waters of the McCloud River." The amendment provides protection to the McCloud River fishery and its "natural" and "free-flowing" condition from Algoma to the confluence with Huckleberry Creek (upper McCloud River), and 0.25 mile downstream from the McCloud Dam to the McCloud River Bridge (lower McCloud River). Although the Legislature declared that the McCloud River possessed "extraordinary resources" in the context of the State PRC, the Legislature's action stopped short of formally designating the river as wild and scenic.

25.3 Affected Environment

This section defines "affected environment" as the wild and scenic characteristics of the lower McCloud River that could be affected by the proposed modifications to Shasta Dam and Shasta Lake. It briefly describes the McCloud River from its headwaters to the McCloud Arm of Shasta Lake. It then describes the wild and scenic values of Segment 4 identified in the USFS evaluation and the values provided protection in the State PRC.

Descriptions of the river and its characteristics were derived primarily from the following sources:

- Wild and Scenic Rivers Evaluation, Appendix E to the Environmental Impact Statement for the Shasta-Trinity National Forest Land and Resources Management Plan (USFS 1994)
- Lower McCloud River and McCloud Arm Watershed Analyses (USFS 1998a and 1998b)
- McCloud River Wild and Scenic River Report (Jones & Stokes Associates 1988)
- Lower McCloud River Wild Trout Area Fishery Management Plan, 2004 through 2009 (Rode and Dean 2004)
- Lower McCloud River Habitat Typing Report (USFS 2001)

25.3.1 The McCloud River

McCloud River Basin

The McCloud River basin drains an area of approximately 800 square miles (USFS 1998a) in northern Shasta County and southern Siskiyou County, southeast of Mount Shasta. The river originates in an area of the STNF near Colby Meadows at approximately 4,250 feet above msl (Rode and Dean 2004). From its headwaters to Shasta Lake, the river is approximately 59 miles long. McCloud Reservoir, part of PG&E's McCloud-Pit Hydroelectric Project, separates the upper river from the lower river. The lower McCloud River transitions into the McCloud Arm of Shasta Lake upstream from the McCloud River Bridge (Figure 25-3).

Upper McCloud River

The upper McCloud River is an approximately 36-mile reach from the river's origins at Colby Meadows downstream to the transition with McCloud Reservoir. The river basin above the reservoir drains an area of approximately 403 square miles. Mean monthly flows in the upper McCloud River range from 766 cubic feet per second (cfs) in October to over 1,000 cfs in March, April, and May (PG&E 2006).

McCloud Reservoir

The McCloud Reservoir is a major component of PG&E's McCloud-Pit Hydroelectric Project, which was constructed in 1965 and operates under license from the Federal Energy Regulatory Commission (FERC). The McCloud Reservoir is approximately 5 miles long and has a storage capacity of approximately 35,200 acre-feet of water. The McCloud-Pit Hydroelectric Project diverts approximately 75 percent of the upper McCloud River's flow through a pipeline to Iron Canyon Reservoir, then conveys it downslope and discharges it into the Pit River at the Pit 6 powerhouse, upstream from the Pit River Arm of Shasta Lake (PG&E 2006). The remaining 25 percent of flows provide base flow for the lower McCloud River, a considerable reduction from historic flow volumes (Jones & Stokes Associates 1988).

Lower McCloud River

The lower McCloud River flows southwesterly through a deep canyon with steep slopes approximately 22 miles from McCloud Dam downstream to the transition with Shasta Lake. Vegetation along the lower river is predominately mixed-conifer and Douglas-fir forest. This stretch of river receives runoff from a 404-square-mile area of the lower McCloud River basin and the 95-square-mile Squaw Valley Creek basin. It provides exceptional fishing opportunities and includes two long-established fishing clubs, the Bollibokka Club and the McCloud River Club. The Nature Conservancy's McCloud River Preserve also encompasses a portion of the lower McCloud River.

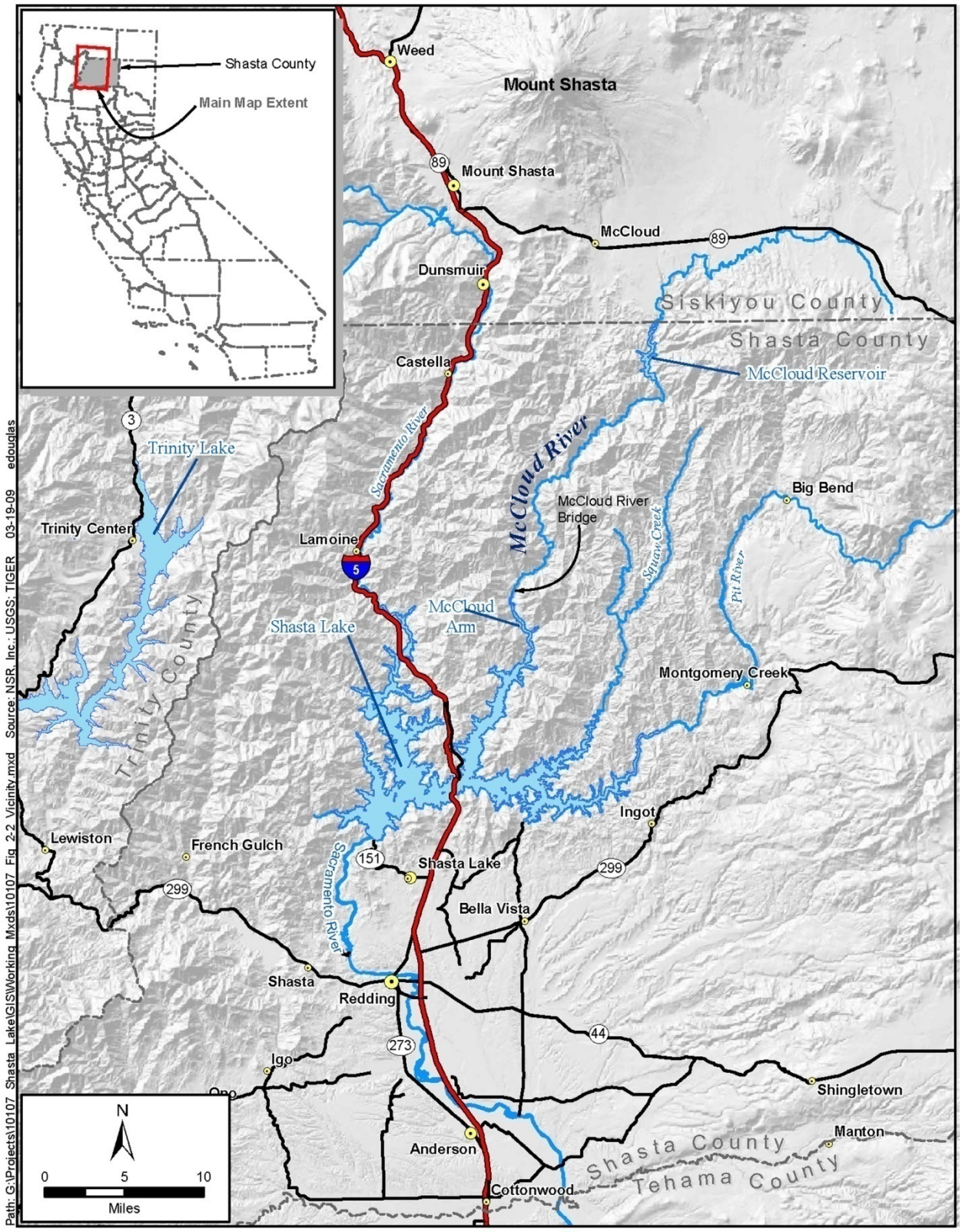


Figure 25-3. Regional Location

Flows in the lower McCloud River have been controlled by releases from McCloud Dam since 1965 (PG&E 2006). Under its current FERC license, PG&E's McCloud-Pit Hydroelectric Project maintains a minimum instream flow of 50 cfs from May through November and 40 cfs from December through April through controlled releases. Accordingly, flows in the lower McCloud River are highly regulated, and annual flows in the river below McCloud Dam do not follow a pattern typical of an unimpaired mountain river in northern California. Prior to dam construction, flows in the lower river were considerably higher, estimated to be in the range of 924 to 1,245 cfs (mean monthly flows) from June to October (Jones & Stokes Associates 1988, citing U.S. Geological Survey (USGS) for the period of 1967 to 1985).

McCloud Arm of Shasta Lake

The construction of Shasta Dam between 1938 and 1945 converted part of the lower McCloud River into the McCloud Arm of Shasta Lake. The McCloud Arm is more than 16 miles long, with approximately 70 miles of shoreline. It drains an area of approximately 41,000 acres (USFS 1998b). Water levels in the arm fluctuate with the lake's water levels, and during periods of lower water levels, a water line, known as the "bathtub ring," is evident along the banks. During extended periods of lower water levels, vegetation may become established on the exposed banks.

The upper extent of the lake encompasses the transition reach, which varies between about 920 and 1,070 feet msl. Because of the effects of Shasta Lake on the McCloud Arm, the STNF determined that the transition reach did not meet the eligibility requirements of a wild and scenic river (USFS 1994). The USFS defined the upper limit of the McCloud Arm as an elevation of 1,070 feet, or approximately 5,400 feet above the McCloud River Bridge. This elevation corresponds to the lower limit of Segment 4. A portion of the transition reach – from the McCloud River Bridge to the 1,070-foot elevation – is included in the segments of the river provided protection under the State PRC.

The transition reach provides a corridor for fish migrating between Shasta Lake and the lower McCloud River and contributes to the unique fishery of the river. Common fish in the McCloud Arm include rainbow trout, spotted bass, riffle sculpin, and speckled dace (North State Resources, Inc. 2008).

Water temperatures in the McCloud Arm become warmer as the river transitions to Shasta Lake. The warmer temperatures associated with Shasta Lake support warmwater fish, but the cooler temperatures of the transition reach may prevent some fish from migrating upstream into the lower river. Water temperatures in the transition reach may be suitable for warmwater species.

25.3.2 The McCloud River's Wild and Scenic Values

This section focuses on the wild and scenic river characteristics and ORVs of the lower McCloud River identified by the USFS in the wild and scenic river evaluation performed for the STNF LRMP (USFS 1994) and the wild and

scenic river characteristics and extraordinary value protected under the State PRC.

The McCloud River's fishery and its free-flowing condition are identified in both the USFS evaluation and the State PRC. These characteristics are discussed first, followed by a discussion of the wild and scenic characteristics and values – water quality, geology, cultural/historical resources, and visual quality/scenery – that are identified only in the USFS evaluation.

Specific information is lacking concerning the river reach that could periodically be inundated if Shasta Dam and Shasta Lake were enlarged because the lands along this part of the river are privately owned and access for biological and other surveys has been limited; therefore, general information concerning the lower McCloud River as a whole is provided for some resource areas. This section also includes a brief description of the current transition reach (see Figure 25-1) because the reach of the river that would be newly inundated would likely take on the characteristics of the existing transition reach.

Fishery

The fishery of the lower McCloud River is unique; the river is considered a premier trout fishery, despite the ongoing effects of McCloud Dam and Shasta Lake on the river's flows and water quality. To characterize the fishery, this section includes descriptions of the aquatic habitat in USFS Segment 4, the Resources Agency's Segment 10, and the transition reach as well as the fish species that inhabit the study area.

Aquatic Habitat The lower McCloud River is characterized as a series of alternating riffles, pools, and cascading pocket water occurring along a broad, boulder-studded river channel within a confined, heavily timbered valley. A narrow band of montane riparian vegetation (typically less than 25 feet wide) dominated by willows, white alders, and Oregon ash occurs along the river banks adjacent to steep hill slopes with mixed conifer-Douglas-fir forest (USFS 2001).

In 2001, the USFS prepared a Habitat Typing Report to characterize aquatic habitats in the lower McCloud River from the McCloud River Bridge to McCloud Dam. The report divided the lower river into four reaches: McCloud Dam to Ladybug Creek, Ladybug Creek to Clairborne Creek, Clairborne Creek to Tuna Creek, and Tuna Creek to McCloud River Bridge. The reach from Tuna Creek to McCloud River Bridge includes all of Segment 4 and nearly all of Segment 10, including the portion of the transition reach that is part of Segment 10. Data are not available for the transition reach below the McCloud River Bridge downstream to Shasta Lake.

The dominant aquatic habitat in the reach of the lower river from Tuna Creek to McCloud River Bridge includes runs (20 percent), mid-channel pool (18

percent), low-gradient riffles (18 percent), lateral scour pool from bedrock (11 percent), and pocket water (10 percent) (USFS 2001). This reach provides most of the corner pool (100 percent), glide (89 percent), and cascade (50 percent) habitats in the lower river.

The portion of the transition reach upstream from McCloud River Bridge is dominated by low-gradient riffles and mid-channel pools, with some pocket water, glides, runs, and lateral scour pools. Glide habitat is the dominant aquatic habitat between the 1,070-foot and 1,080-foot elevations, and pocket water is the dominant aquatic habitat between the 1,080-foot and 1,090-foot elevations. The habitat within the current transition reach represents a fraction of the total available aquatic habitat within the lower McCloud River and provides a small portion of the habitats within the reach from the McCloud River Bridge to Tuna Creek.

The diversity of riffles, flatwater habitat, and pools is influenced by the presence of boulders and cobble substrate and variations in flow conditions. The lower river is dominated by boulders with pockets of gravel present at pool tailouts and in velocity breaks behind large boulders. The riffles are generally higher gradient channel sections with turbulent surface flow and uniform cobble and boulder substrates. While swift pocket water in the lower McCloud River often appears more like a riffle than a run, the habitable eddies, or pockets, created behind the boulders that characterize this habitat type make it functionally more similar to the other flatwater habitats (USFS 2001). Typically, flatwater and pools are the principal habitats used by the trout in the McCloud River for rearing and feeding (Wales 1939, Rode and Dean 2004, USFS 2001).

The USFS (2001) reported that the aquatic habitat within the transition reach has undergone type conversions caused by aggradation and scour of sediments for about 3,700 feet upstream from the McCloud River Bridge. When Shasta Lake is drawn down, large, wide, low-gradient riffles with channel braiding dominate in this reach. When the lake is at full pool and at intermediate levels of drawdown, the transition reach becomes inundated, but a unidirectional current created by the lower McCloud River's inflow is detectable throughout the inundation zone, slowing as it approaches the flat water of Shasta Lake. To varying degrees, this fluctuating backwater effect converts this reach to a deep, wide, slow-moving riverine habitat transitioning to lacustrine habitat near the bottom of the transition reach.

Fish Species The current composition and distribution of fish species inhabiting the lower McCloud River and Shasta Lake reflect the historic fishery, the operational effects of Shasta Dam and McCloud Dam, and the introduction of nonnative fish species into the river and Shasta Lake. The completion of Shasta Dam in 1945 eliminated all runs of anadromous fish in the river (Rode and Dean 2004). The historic fishery included Chinook salmon (*Oncorhynchus tshawytscha*), steelhead (*O. mykiss irideus*), rainbow trout (*O. mykiss*), and the

only known California occurrence of the bull trout (*Salvelinus confluentus*). The bull trout is believed to have been extirpated from the lower McCloud River and is possibly extinct in California. Today, the fishery is dominated by rainbow trout and brown trout (*Salmo trutta*), an introduced species that migrates between Shasta Lake and the lower McCloud River. Other nonnative species also migrate up the lower McCloud River, including spotted bass (*Micropterus punctulatus*), but bass have not been confirmed upstream from Tuna Falls, a high-gradient rapid at the confluence with Tuna Creek. Despite the change in fish species in this 22-mile reach, the lower McCloud River is still considered one of California's premier trout streams.

Fish observed in the river downstream from the Tuna Creek confluence during a survey conducted in summer 2007 included rainbow trout, spotted bass, speckled dace (*Rhinichthys osculus*), sculpin spp. (*Cottus* spp.), Sacramento sucker (*Catostomus occidentalis*), and Sacramento pikeminnow (*Ptychocheilus grandis*) (North State Resources, Inc. 2008). Other fish that occur in this reach include brown trout, brook trout (*Salvelinus fontinalis*), hardhead (*Mylopharodon conocephalus*), and smallmouth bass (*Micropterus dolomieui*). The status of the riverine fish species of the lower McCloud River is identified in Table 25-1.

Rainbow Trout Fluvial and adfluvial populations of rainbow trout use the habitat available throughout the lower McCloud River. The McCloud River rainbow trout became known as "the rainbow of the fish culturist" because eggs from that population accounted for transplants of rainbow trout in the 1880s to the eastern states and several other countries.

The rainbow trout that inhabit the McCloud River are a vigorous, active fish that primarily inhabit swifter portions of pool and pocket water habitats. Adults migrate into the lower McCloud River from Shasta Lake in the spring and fall months, presumably to spawn. Suitable spawning habitat in the study area is limited, and the trout likely migrate further upstream to spawn (North State Resources, Inc. 2008).

Although the genetic origin of these fish has not been evaluated, the numerous strains of rainbow trout planted in Shasta Lake over the years have likely resulted in some introgression among migratory rainbow trout in the lower McCloud River. The degree to which this migratory population of rainbow trout contributes to the native trout fishery of the river is not specifically known; however, available data do not indicate that it is substantial.

Rainbow trout typically mature in their second to third year and move upstream to spawn in the lower McCloud River and its tributaries from February to June. The eggs typically hatch in 3 to 4 weeks, depending on water temperature, and fry emerge 2 to 3 weeks later. The fry remain in quiet waters close to shore, among cobbles, or under overhanging vegetation for several weeks. As the fish grow, they move into swifter water habitats.

Table 25-1. Riverine Fish Species of the Lower McCloud River

Species	Current Status	Comments
Sacramento sucker (Catostomus occidentalis)	Common	Native, non-game species, observed during 2007 surveys
Riffle sculpin (Cottus gulosus)	Common	Native, non-game species, observed during 2007 surveys
Smallmouth bass (Micropterus dolomieui)	Uncommon	Introduced sport species in Shasta Lake, moves into lower river from lake, warmwater species
Spotted bass (Micropterus punctulatus)	Uncommon	Introduced sport species in Shasta Lake, moves into lower river from lake, observed during 2007 surveys, warmwater species
Hardhead (Mylopharodon conocephalus)	Uncommon	Native, non-game species
Rainbow trout (Oncorhynchus mykiss)	Abundant	Native trout species, subject to special angling regulations, coldwater species, observed during 2007 surveys
Sacramento squawfish (=pikeminnow) (Ptychocheilus grandis)	Common	Native, non-game species, observed during 2007 surveys
Speckled dace (Rhinichthys osculus)	Common	Observed during 2007 surveys
Brown trout (Salmo trutta)	Common	Introduced sport species found throughout the river, migrates from Shasta Lake to spawn in lower river, subject to special angling regulations, coldwater species
Bull trout (Salvelinus confluentus)	CE; Extinct	Native, believed extirpated from entire river by mid-1970s, a few restoration experiments performed in upper river tributaries, coldwater species
Brook trout (Salvelinus fontinalis)	Rare	Introduced sport species, stocking in upper river and tributaries discontinued, very rarely observed in lower river, coldwater species

Sources: Wales 1939, Tippets and Moyle 1978, Rode and Dean 2004, Moyle 2002, DFG, unpublished data, North State Resources, Inc. 2008

Key:

CE = California Endangered

In the river, this species forms feeding station hierarchies, which they aggressively defend, and prey on aquatic and terrestrial insects drifting in the current. They also eat active bottom invertebrates. It has been reported that McCloud River rainbow trout tend to be more bottom-oriented when feeding than rainbow trout elsewhere.

In reservoirs, rainbow trout form loose schools and feed on both invertebrates and other fish, although fish dominate their diet as they grow larger. Preferred prey in Shasta Lake is the threadfin shad. Trout growth in Shasta Lake is more rapid than for fluvial trout. The optimum temperature range for growth and for completion of most life stages of rainbow trout is between 50 and 70 degree Fahrenheit (°F), though they seem to prefer and thrive at temperatures in the lower two-thirds of this range. Rainbow trout in lakes and streams seldom live for more than 6 years.

Brown Trout Like the rainbow trout, fluvial and adfluvial populations of brown trout use habitat throughout the lower McCloud River, but this species migrates more between the lake and river. It is not as abundant as the rainbow trout. DFG biologists suggest that this species occupies an ecological niche previously occupied by bull trout in the lower McCloud River (Rode and Dean 2004).

Only some of the brown trout migrating from Shasta Lake that passed a lower river counting weir were observed upstream in the Wild Trout Management Area (segments 7, 8, 9, and 10), so the actual extent of the spawning grounds of migratory brown trout is not fully known.

Brown trout mature in their second or third year. Some fish may mature in the river while others may migrate to Shasta Lake to feed, returning to spawn on a recurring basis. The stimulus for upstream migration is often a rise in stream flow or changing lake temperatures. Spawning takes place from November through December when water temperatures fall below 50°F. Eggs typically hatch within 7 to 8 weeks, depending on water temperature. Fry emerge from the gravel 3 to 6 weeks later. The habitats used by juvenile brown trout are similar to those used by rainbow trout; however, as brown trout grow, they tend to select habitats with slower water and more cover. In the riverine environment, brown trout prefer slow, deep pools with abundant boulder and bedrock ledge cover. The timing of emigration of juvenile brown trout to Shasta Lake is not known.

Fluvial brown trout have diets similar to those of rainbow trout, but appear to feed more on the stream bottom for benthic prey than rainbows. As brown trout grow, their diet expands to include larger invertebrate prey and fish. Larger brown trout are voracious predators, especially on fish, including young salmonids. In Shasta Lake, adult brown trout prefer threadfin shad as a staple prey.

Brown trout growth in the lower McCloud River appears to increase after age 3, which has been attributed to their migration to Shasta Lake to exploit the forage fish populations. Brown trout growth is best at temperatures ranging from 45 to 69°F, though they seem to prefer and dominate other trout species near the upper half of this range.

Spotted Bass and Smallmouth Bass Black basses and other sunfishes dominate in the littoral zones of Shasta Lake. Spotted bass and smallmouth bass are now the most common black basses in Shasta Lake, with spotted bass having become most frequent over the past 20 years. Both spotted and smallmouth bass occupy shallow, low-gradient habitat offered by Shasta Lake and its tributaries. They can be found throughout Shasta Lake and in the lower ends of the main tributary streams, including the lower McCloud River. However, the extent to which black bass have colonized the lower McCloud River is not currently known.

Smallmouth bass and spotted bass share similar life histories, and these similarities may account for their persistence in Shasta Lake compared to that of largemouth bass, which have declined in numbers. Both smallmouth and spotted bass mature in their second or third year and spawn in the late spring. Smallmouth will spawn at cooler temperatures (55 to 61°F) than spotted bass (greater than or equal to 65°F). Both species seek quiet shallow areas over mud, sand, gravel, and rocky, debris-littered bottoms to spawn in both lakes and streams. This type of spawning habitat is available in the transition reach of the lower McCloud River, especially when lake levels are high.

Juvenile bass feed on small invertebrates until they are large enough to prey on small fish and large invertebrates. Temperature preferences and optimal growth for both species of black basses is attained in the range from 68 to 81°F. Because of the year-round cool temperatures (less than or equal to 68°F) of the lower McCloud River, temperatures preferred by bass only occur during the late summer and early fall months upstream from the transition reach. Therefore, the temperature regime of the lower McCloud River may limit intrusions of bass from the lake. However, spotted bass were observed in the lower river below the confluence of Tuna Creek during summer fish surveys (North State Resources, Inc. 2008).

Free-Flowing Condition

The Federal WSRA defines *free flowing* as "existing or flowing in natural condition without impoundment, diversion, straightening, rip-rapping, or other modification of the waterway" (16 USC Section 1286). The State PRC defines free-flowing as "existing or flowing without artificial impoundment, diversion, or other modification of the river." It states, however, that the "presence of low dams, diversion works, and other minor structures does not automatically bar a river's inclusion in the system."

Base flows in the lower McCloud River are partially controlled by releases from McCloud Reservoir in accordance with PG&E's FERC license and include precipitation and inflow from tributaries. The lower McCloud River experiences seasonal fluctuations and large variations in base flows (USFS 1998a). Releases from McCloud Reservoir into the lower river are heavily regulated, with a minimum release requirement of 50 cfs from May through November and 40 cfs from December through April; the releases are typically well above these minimum requirements and tend to stay above 100 cfs (USFS 1998a). Tributary contributions are the most noticeable flows during storm events, but are substantially reduced during low-flow conditions. Because of the minimum release requirements from McCloud Reservoir, spring and summer flows are considerably more stable than they would be under unregulated conditions.

PG&E monitors lower McCloud River flows in accordance with its FERC license at a gaging station in Segment 4 upstream from Shasta Lake (0.2 mile downstream from Big Bollibokka Creek); the most recent available water data record covers the water year October 2006–September 2007 (USGS 2007). For

this period, measured mean monthly flows ranged from 235 cfs in August to a high of 1,185 cfs in February, with maximum flows as high as 5,010 cfs.

Over the course of the year, the transition from lake to river expands and contracts over a distance of about 1.7 miles due to changing water levels in Shasta Lake (Figure 25-2). During April and May of wet years, the transition reach extends about 1 mile (5,400 feet) upstream from the McCloud River Bridge to the full pool elevation of 1,070 feet msl, the downstream boundary of Segment 4. As described in Chapter 6, "Hydrology, Hydraulics, and Water Management" Shasta Lake reaches full-pool elevation about one year in five.

Despite upstream and downstream dams and diversions, the lower McCloud River meets the definition of a free-flowing river under both the Federal WSRA and State PRC.

Water Quality

The water quality of the lower McCloud River is influenced by natural processes and land use activities, including PG&E's McCloud-Pit Hydroelectric Project, timber management activities, and roads. Overall, the water quality of the river is rated as good (USFS 1998). Glacial silt gives the river "a beautiful turquoise color typical of rivers draining glacial valleys in British Columbia and Alaska" (Jones & Stokes Associates 1998).

Turbidity and water temperature are two important factors that influence the water quality of the river and affect aquatic habitat. Turbidity is caused by suspended sediment transported from upstream waters and in surface runoff, particularly from disturbed landscapes, such as timber harvest areas or roads. Water temperature is affected by a variety of conditions, such as river flows, solar radiation, and density of vegetation along the river, but is closely tied to the temperature of the flows released from the McCloud Reservoir.

The turbidity of the lower McCloud River is influenced by the water quality and water levels of the McCloud Reservoir and runoff from upland areas throughout the basin. Turbidity levels are generally low during most of the year, ranging from 5–10 nephelometric turbidity units, but can spike to more than 900 units during periods of intense rainfall and flood flows (PG&E 2006).

Sediment becomes trapped at McCloud Dam and is released into the lower river during large storm events, temporarily increasing turbidity levels, especially in the upper segments of the lower river. Testing of the McCloud Dam bypass valve can cause high turbidity for a short period when sediment is discharged from the reservoir into the lower McCloud River. Surface runoff, especially after the first storms of the wet season, can contribute large amounts of turbid runoff from upland areas.

The length of the transition reach depends on the water year type. As the transition reach moves upstream, sediment within the reach is remobilized and

turbidity levels respond accordingly. Periodic fluctuations in water levels can result in erosion along the banks and localized increases in turbidity levels in the transition reach and the McCloud Arm.

The year-round cool water temperature regime of the lower McCloud River inhibits the productivity of its fishery, but provides high-quality holding habitat for salmonids, contributing to the river's unique value as a tributary to Shasta Lake. The controlled releases from McCloud Dam appear to have a direct bearing on the water temperatures downstream. Water temperatures tend to be higher in Segment 4 than immediately below McCloud Dam. Data recorded at PG&E's monitoring station on the river just upstream from Shasta Lake (0.2 mile downstream from Big Bollibokka Creek) indicate that water temperature ranges from the high 30s to the upper 60s (°F), with lower temperatures in the winter and higher temperatures in the summer (PG&E 2006).

The infusion of cooler water from the lower McCloud River influences water temperatures in the transition reach throughout the year. The degree of influence depends on the amount of discharge from the river and Shasta Lake levels. The temperatures throughout the lower McCloud River also control to some degree the distribution of the warmwater fishery known to occupy the river below Tuna Falls.

Outstandingly Remarkable Values Identified in USFS Evaluation

Cultural/Historical Resources Cultural resources include archaeological sites, historical structures and sites, and areas of religious or cultural significance to Native Americans. Significant resources that provide important information on the prehistory and history of an area or that are considered sacred to Native Americans can contribute to wild and scenic river values.

The McCloud River basin was part of a major center of occupation by the Wintu people, who occupied the McCloud River area at the time of Euro-American contact in the 1800s. Although much of the Wintu territory was overrun with miners and other opportunistic Euro-Americans, the lower McCloud River was left largely untouched due in part to a lack of easily mined materials and the ruggedness of the terrain (Yoshiyama and Fisher 2001), but also because of the resistance of the Wintu to incursions into their territory. Because of its generally undisturbed nature, the significance of the lower McCloud River to prehistoric and ethnographic records of this area of California's history is considered to be great (Jones & Stokes Associates 1988).

Within the 0.25-mile corridor deemed eligible by the USFS, three formally recorded sites and other known sites contribute to the lower river's ORVs because they provide important information on the use of the area from before the Late Archaic Period (1300 to 150 before present, calibrated using radiocarbon dating) to the Historic Era (1840 to present). Three Wintu villages, called Tsekerenwaitsogi, Klolwakut, and Boloibaki, are thought to have been located in the general area of the present-day Bollibokka Club headquarters

(Guilford-Kardell 1980), which is part of the former Wintu territory. These villages likely represent the typical lifestyle of the Wintu at the time of Euro-American contact, when they lived in permanent villages near rivers and streams and were semi-sedentary, foraging people (DuBois 1935). As part of the Wintu occupation of this area, prehistoric, historic, and modern Traditional Cultural Properties, sacred locations, and important use areas are located throughout the lower McCloud River basin (outside of the 0.25 mile corridor), including features such as mountains, unique landforms, caves, distinctive rock outcrops, waterfalls, pools, springs, and resource gathering areas.

Point McCloud Bridge (known as McCloud River Bridge in this chapter) is a historical resource that was constructed in 1940 and altered in 1986; the bridge would be subject to relocation in conjunction with SLWRI activities. The Bollibokka Club is a historical resource located on the north bank of the river between the confluence of Big Bollibokka Creek on the east and Wittawaket Creek on the west. Buildings associated with the club were built between the 1860s and 1920s by Austin and Rueben Hills, the founders of Hill's Brothers Coffee, and previous owners (Lucas and Stienstra 2007). A log cabin dates from the 1860s, and other structures date from the ownership of the Hills Family, including the clubhouse built in 1924 and a structure built of river cobble in 1915 (Whitney 2004). Although these resources could be eligible for listing on the National Register of Historic Places, they have not been formally evaluated.

The fishery of the lower McCloud River was also very important to prehistoric and historic uses of the area. The Native Americans in the lower McCloud River basin conducted communal fish drives of salmon or steelhead at night, which brought together many communities and provided opportunities for trade and social networking, including the parsing out of the catch among the people and villages involved (DuBois 1935). Fish, including salmon, steelhead, Sacramento sucker, freshwater shellfish, and lamprey, were an important part of the Native American diet in this area. When the northern mines opened in the 1800s, settlers moved into the area, and the McCloud River and other rivers' fisheries provided important sources of food. In the early years of settlement, fish and game in the area were used for subsistence; however, this changed with the formation of the State of California and increased fishery management and recreational fishing.

Geology The lower McCloud River flows through a number of geologic formations, including the McCloud Limestone formation. This formation contains fossilized remains of invertebrate and vertebrate fauna that provide important scientific information on the history of California, and it has a high potential for research. According to the USFS (1998b), the limestone features exposed at a number of locations around Shasta Lake are unique and contribute to worldwide paleontological knowledge. The McCloud Limestone contains 36 species of corals, some of which may form the basis of a new taxonomic group.

Because of its very diverse fossil faunas, the mountainous terrain between the McCloud and Pit arms of Shasta Lake is perhaps California's single most important area for paleontological research (Munthe and Hirschfield 1978, cited in USFS 1998b). The limestone outcrops on the ridge immediately northwest of McCloud River Bridge (several hundred vertical feet above Shasta Lake) have produced several large Mississippian and Pennsylvanian invertebrate faunas. Because this period is poorly represented on the West Coast, this fossiliferous limestone is important to understanding the late Paleozoic evolution in this part of the country (USFS 1998b). Limestone outcrops adjacent to the McCloud Arm also provide habitat for several special-status species, such as Shasta salamander, Shasta eupatorium, Howell's cliff-maids, and Shasta snow-wreath (Reclamation 2003).

Exposed outcrops of the limestone formation are visible from the lower McCloud River in and upslope of the transition reach and contribute to its scenic values.

Visual Quality/Scenery The visual setting of the lower McCloud River upstream from Shasta Lake includes views of the river, limestone rock outcrops, adjacent coniferous and oak forests, and infrastructure associated with the Bollibokka and McCloud River clubs. A USGS stream gage has also been in place for a number of years. The pristine nature of the lower river provides for high-quality scenic views. However, the scenic views of the lower McCloud River are enjoyed by only a limited number of viewers, consisting primarily of private landowners, club members, and their guests.

Views of the river include "picturesque cascading whitewater, and deep, long, green- or turquoise-colored pools," with Douglas-fir and black and canyon oaks dominating the steep slopes and hillsides along the river (Jones & Stokes Associates 1988). Several buildings are present at the Bollibokka Club headquarters, but these structures blend in with the visual setting. The transition reach exhibits some evidence of fluctuating surface water elevations associated with changes in water levels of Shasta Lake. Areas that are noticeably affected by the reservoir levels exhibit "a bathtub ring of steep, treeless slopes with occasional deposits of alluvium."

The scenic views make most of the lower McCloud River, including Segment 4, eligible as a scenic river under the Federal WSRA (USFS 1994). To be classified as a scenic river, the river must be free of impoundments, be accessible in places by roads, and have a river basin/shoreline that is largely undeveloped. Segment 4 does not contain any human-made or other impoundments that affect its free-flowing conditions. Roads to the Bollibokka Club provide access to portions of Segment 4 for members of the club and their guests. Currently, public access is limited to pedestrians on USFS lands along the shoreline of Shasta Lake. For these reasons, the USFS has determined that this segment meets the eligibility requirements of a scenic river under the Federal WSRA.

25.4 Environmental Consequences and Mitigation Measures

This section identifies how the characteristics of the lower McCloud River that make it eligible for listing under the State PRC and Federal WSRA could be affected by each alternative and whether the alternatives would conflict with the provisions of the STNF LRMP and the CRMP.

25.4.1 Methods and Assumptions

This analysis of environmental consequences focuses on the effects of proposed modifications to Shasta Dam and Shasta Lake on the McCloud River's free-flowing conditions, its water quality, and the ORVs (cultural resources, fisheries, geology, and scenery) that make it eligible for listing as a wild and scenic river under the Federal WSRA. In large part, the environmental effects are based on computer modeling of water levels and the anticipated changes in the environment due to fluctuations in water levels and expansion of the transition reach. Physical effects to the free-flowing conditions, water quality, and ORVs are analyzed in terms of their effects on the eligibility of the river for wild and scenic river designation. While aquatic habitat data are used to quantify the relative impact to fishery values, a qualitative analysis is provided for most resources because of a lack of quantitative data and the subjective nature of the values. Information to support the analysis was generated from available literature and planning documents and technical studies prepared as part of the SLWRI as well as other chapters in this PDEIS.

CalSim Modeling

The CalSim-II computer model was used to assist in the evaluation of the potential impacts of the project alternatives on water-related resources. The model used historical data on California hydrology to represent the variety of weather and hydrologic patterns, including wet periods and droughts, under which water storage and conveyance facilities would be operated. Two scenarios (base cases) of demands for, and storage and conveyance of, water were used in model runs: 2005 facilities and demands ("existing conditions") and forecasted 2030 demands and reasonably foreseeable projects and facilities ("future conditions"). A model run was conducted for each of these base cases combined with each alternative so that the effects of the No-Action Alternative and the action alternatives could be evaluated for both existing and future conditions.

The analysis focuses on the environmental effects in the portion of segment 4 that would periodically be inundated. These effects are discussed in the following section.

Gage Data

PG&E, in coordination with USGS, monitors McCloud River flows in accordance with its FERC license for the McCloud-Pit Hydroelectric Project at a gaging station just upstream from the McCloud River Bridge, approximately 0.2 mile downstream from Big Bollibokka Creek (USGS 11368000 McCloud

River above Shasta Lake, California). The station measures mean, minimum, and maximum monthly flows in the lower McCloud River. The most recent available water data record covers the water year of October 2006 to September 2007 (USGS 2007). Data from the 2006 to 2007 water year were used to describe flow conditions in the lower river.

Water Quality Monitoring

Current and historical water quality monitoring data for the McCloud River have been collected by federal and state agencies as well as PG&E and The Nature Conservancy. The California Department of Water Resources maintains water quality information on the McCloud River in the California Data Exchange Center database. The Nature Conservancy monitors water quality at the McCloud River Preserve. Water quality monitoring of the lower McCloud River includes measures of water temperature, dissolved oxygen, pH, specific conductance, and turbidity, as well as correlated data on weather, air temperature, and debris movement. PG&E monitors water quality in compliance with its FERC license. Available information on water quality was used to describe the setting of the lower river and assess changes in water quality that would occur as a result of the Shasta Dam modification alternatives.

Habitat Typing

The USFS stream habitat typing performed in 1999 and 2000 (STNF, December 2001 unpublished data report, as found in USFS 2001) was used to describe aquatic habitat in the lower McCloud River and to assess the changes in aquatic habitat from implementation of the Shasta Dam modification alternatives. The habitat typing data were used in conjunction with the CalSim-II modeling results, digitized orthophotographs, and high-resolution topographic data to provide habitat maps and graphic depictions of the distribution of aquatic habitat in the lower river below Little Bollibokka Creek. A longitudinal profile, using water surface elevations, was generated to illustrate habitats; it does not provide an accurate representation of channel geometry.

A quantitative evaluation of the aquatic habitats was performed using digital images and the USFS habitat typing data in an integrated geographic information systems environment. Longitudinal habitat delineation was determined from the habitat typing data, with minor adjustments to match photo-interpreted habitat, and incorporated into the geographic information systems in conjunction with water surface elevations generated through the CalSim-II modeling results. Estimates of aquatic habitat areas were generated from digitized wetted stream perimeters. These measurements were based on orthophotographs taken April 25, 2001. While the absolute amount of riverine habitat can vary with flow, the relative proportions of different types of habitat remain relatively constant. Therefore, we used the relative proportions of aquatic habitat types to compare impacts to the transition reach with the entire lower river.

25.4.2 Criteria for Determining Significance of Effects

The following significance criteria were developed based on guidance provided by the State CEQA Guidelines, other Federal and State guidance, and consider the context and intensity of the environmental effects as required under NEPA. (Please see Chapter 3, "Considerations for Describing the Affected Environment and Environmental Consequences) for an explanation of the distinction between significance under NEPA and significance under CEQA.) Impacts of an alternative on the wild and scenic river values of the lower McCloud River would be significant if project implementation would:

- Affect the eligibility for Federal listing as a wild and scenic river of any portion of the lower McCloud River above the 1,070-foot elevation
- Conflict with the Shasta-Trinity National Forest Land and Resource Management Plan or with management of the McCloud River under the Coordinated Resource Management Plan
- Conflict with the protection provided the lower McCloud River under the State PRC

25.4.3 Direct and Indirect Effects

No-Action Alternative

Under the No-Action Alternative, Reclamation would not pursue an action to enlarge Shasta Dam to help increase anadromous fish survival in the upper Sacramento River and address the growing water supply reliability issues in California. Water levels in Shasta Lake and the transition reach would continue to fluctuate similar to current conditions. USFS Segment 4 and the Resources Agency's Segment 10 would not be affected by this alternative.

Impact WASR-1 (No-Action): Effect on McCloud River's Eligibility for Listing as a Federal Wild and Scenic River Under the No-Action Alternative, the current maximum elevation of water levels in the transition reach would not be increased, and Segment 4 would not be affected. Fluctuations in water levels would continue to be similar to current conditions, with water levels reaching the maximum elevation of 1,070 feet msl – the downstream boundary of Segment 4 – in the transition reach for a brief period (typically a few days in May) during wet years.

The average monthly water surface of Shasta Lake would continue to fluctuate based on the water year, with a maximum elevation of 1,053 feet msl in April of an average water year and 1,070 feet msl in April and May of a wet year. These fluctuations would not affect the free-flowing conditions and water quality of Segment 4. The ORVs that make the river eligible for designation as a Federal wild and scenic river would continue to be affected only by ongoing natural processes and land use activities, and all of Segment 4 would remain eligible for

listing under the Federal WSRA. Therefore, there would be no impact. Mitigation is not required for the No-Action Alternative.

Impact WASR-2 (No-Action): Conflict with Shasta-Trinity National Forest Land and Resource Management Plan or Coordinated Resource Management Plan Under the No-Action Alternative, the STNF LRMP and CRMP would continue to be implemented as they have in the past, with no changes in the management of the McCloud River's free-flowing condition, water quality, and ORVs. Therefore, there would be no impact. Mitigation is not required for the No-Action Alternative.

Impact WASR-3 (No-Action): Conflict with the California Public Resources Code, Section 5093.542 Under the No-Action Alternative, the protections afforded the McCloud River by the State PRC would not be affected. River conditions would not be modified, and the provisions of the PRC would continue to protect the river. Therefore, there would be no impact. Mitigation is not required for the No-Action Alternative.

CP1 – 6.5-Foot Dam Raise, Anadromous Fish Survival and Water Supply Reliability

CP1 would involve a 6.5-foot raise of Shasta Dam, which would increase the lake's gross pool by 8.5 feet and enlarge the total storage space in the lake by 256,000 acre-feet. This increase would equate to an increase of about 1,100 acres of surface area occupied by Shasta Lake when the lake is full. CP1 also includes measures to increase water supply reliability while contributing to increased survival of anadromous fish. Under CP1, operational guidelines for Shasta Dam would continue unchanged, with the additional storage retained for water supply reliability and increased survival of anadromous fish.

Impact WASR-1 (CP1): Effect on McCloud River's Eligibility for Listing as a Federal Wild and Scenic River Under CP1, the increased gross pool of Shasta Lake would expand the current transition reach up to the 1,078-foot elevation, resulting in adverse effects on the characteristics of approximately 1,470 feet of Segment 4. The rest of the McCloud River would remain eligible for designation as a Federal wild and scenic river.

Under CP1, approximately 1,470 feet, or 11 percent, of Segment 4 would be periodically inundated. This increase in the transition reach to a maximum elevation of 1,078feet msl would equate to a 16 percent increase over the current transition reach. The length of time during the year when the transition reach is inundated and the maximum elevation of the inundation area would vary by the type of water year (wet, above normal, below normal, average, dry, or critical).

Within the expanded transition reach, flow conditions and fisheries would periodically be affected, with the timing and duration of the effects similar to those that occur in the current transition reach. Over time, the expansion of the

bathtub ring would affect water quality, geology, and visual quality/scenery in the affected portion of Segment 4. Erosion of soils along the river could expose buried cultural resources, and periodic inundation could permanently alter cultural resource values and features in the transition reach important to Native Americans. These effects could reduce the total length of the lower McCloud River that is eligible for wild and scenic river designation by about 1,470 feet (approximately 1.2 percent of the total length of the lower river).

Free-Flowing Conditions Under CP1, the currently free-flowing section of the lower McCloud River would be reduced by about 1,470 feet or about 1.2 percent. The flow characteristics of the affected portion of Segment 4 would periodically be modified, resulting in slower moving waters and a wider river channel. When inundated, the affected portion would retain some current, but flow velocities would decrease with distance downstream. This modification would not meet the definition of a free-flowing river under the WSRA.

Because free-flowing conditions are a fundamental requirement for wild and scenic river eligibility, the 1,470-foot reach of Segment 4 that would be affected by CP1 would become ineligible for listing under the WSRA.

Water Quality As Shasta Lake's water levels rise, vegetation and soils along the banks of the affected portion of Segment 4 would become inundated. Most or all of the vegetation that is inundated would eventually die and be washed or fall into the river, bringing with it sediment and other materials that could affect water quality. Soils in the affected portion of Segment 4 would erode as water levels rise and fall, causing an increase in turbidity. These effects would likely be most noticeable during the initial inundation periods, since the river corridor is likely to eventually stabilize as the soil is eroded to bedrock.

Within the approximately 1,470-foot reach of Segment 4 that would be affected under CP1, water temperatures would fluctuate relative to temperatures immediately upstream. Similar to flow, these changes would vary by water year type. Increased turbidity and warmer water temperatures would be most noticeable along the affected portion of Segment 4 because this area has not been previously exposed to periodic inundations.

Adverse effects on water quality would be associated with the periodic fluctuations in the water levels of Shasta Lake. Because water quality is a fundamental requirement for wild and scenic river eligibility, the 1,470-foot reach of Segment 4 that would be affected by CP1 would become ineligible for listing under the WSRA.

Outstandingly Remarkable Values As described above under Affected Environment, the ORVs that make Segment 4 of the McCloud River eligible for listing as a wild and scenic river are cultural/historical resources, fisheries, geology, and visual quality/scenery.

Cultural/Historical Resources Under CP1, erosion of rock outcrops and expansion of the bathtub ring in an approximately 1,470-foot reach of Segment 4 could expose buried or previously undiscovered prehistoric cultural resources associated with Wintu occupation of the area and historic recreational uses of the area. As this reach becomes inundated, any exposed resources would be susceptible to the effects of water, which could damage or otherwise alter their values, affecting their eligibility for listing on the National Register of Historic Places and reducing their importance for providing information on past use within the corridor. As the water recedes, exposed resources would be susceptible to wind and rain and could be visible, potentially exposing them to theft or vandalism. These adverse effects would be localized along the corridor of the affected portion of Segment 4 and would likely only affect a small portion of the cultural resources that may be associated with the lower McCloud River basin.

The historic structures associated with the Bollibokka Club occur outside of the area that would be affected by the expanded transition reach and would not be affected. However, unrecorded resources associated with the Wintu village locations may occur within the corridor along the river and could be subjected to periodic inundation, deposition, and scour within the upper portions of the expanded transition reach. Portions of three other recorded sites could also be subject to similar impacts within the expanded transition reach, which could result in damage to resources within the sites. Although these sites may provide information on the area's history or prehistory, none of these sites has been formally listed on the National Register of Historic Places.

Sacred sites important to Native Americans have not been specifically identified, and access to lands adjacent to the reach that would be periodically inundated under CP1 is limited because all of these lands are privately owned.

The cultural resources located along the 1,470-foot reach of Segment 4 that would be affected under CP1 would be subject to the effects of periodic inundation.

Fisheries Aquatic habitat in the 1,470-foot expansion of the transition reach would be affected during periodic inundations, resulting in potential adverse effects on the fish that occur in the river. Potential adverse effects on fish could include a reduction in spawning habitat for trout in the expanded transition reach and an increase in the range of warmwater fish in the lower McCloud River. Fishing opportunities would not be affected more than they are now with the periodic fluctuations in river levels.

Under CP1, the transition reach would be extended by about 1,470 feet to the 1,078-foot elevation, resulting in a larger inundation area when Shasta Lake water levels are the highest. Aquatic habitat in the affected portion of Segment 4 consists primarily of flatwater habitat (52 percent glide, 19 percent mid-channel pool, and 13 percent run), with pocket water (11 percent) and a small, low-

gradient riffle (5 percent) in the lower portion of the segment. With the periodic inundations, sediment deposition could cause flatwater habitat to convert to riffle habitat, resulting in a reduction in flatwater habitat of less than 3 percent of the total lower McCloud River's flatwater habitat. During the inundation period, riffle and pool habitat (approximately 1.2 percent of the total lower McCloud River) would be converted to flatwater habitat. Also, riparian vegetation along the newly inundated banks of the affected portion of Segment 4 would be expected to die, which could affect water temperatures and reduce cover for fish in this reach. The extent of these effects would depend on the frequency, duration, and surface elevation of the inundation, which would vary depending on the type of water year and water levels of Shasta Lake.

The migration of fish, especially trout, between the lower McCloud River and Shasta Lake is an important attribute of the unique trout fishery. Many of the rainbow and brown trout that occupy the lower McCloud River spend part of their lives rearing in Shasta Lake, feeding on the abundant prey in the lake and attaining large sizes that would not be possible if they reared only in the river. Upon returning to the river to spawn, these lake-reared fish provide the trophy-sized trout, particularly brown trout, for which the lower McCloud River is renowned (Rode and Dean 2004). Based on a survey that extended up to Tuna Falls (North State Resources, Inc. 2008), the reach of Segment 4 that would periodically be inundated does not contain any barriers or impediments to fish movement or migration, and CP1 would not create any. Consequently, trout migration through the transition reach to upstream spawning areas would not be impaired.

Conversely, warmwater fish movement between the lake and river is not likely to be facilitated by the expanded transition reach. Warmwater fish from Shasta Lake, such as spotted bass, have been observed throughout the lower McCloud River, at least up to the confluence with Tuna Creek (North State Resources, Inc. 2008). Nonnative warmwater species inhabiting Shasta Lake (e.g., smallmouth bass and spotted bass) are known to exploit riverine and transitional habitats and are effective predators of juvenile trout. No barriers have been observed in the transition reach that could prevent warmwater fish from moving upstream, and no barriers would be created by the expansion of the transition reach. Warmwater fish would continue to be able to move between the lake, the transition reach, and lower McCloud River (Segment 4).

Aquatic habitat changes could affect how fluvial resident trout use habitat within the affected portion of Segment 4. General effects may range from temporary displacement of trout to upstream habitats at high water levels to degraded riverine habitat suitability within the transition reach.

Suitable spawning habitat for rainbow and brown trout in the expanded transition reach is limited because of the few pools and riffles available during the spring and fall when these species spawn. Based on the USFS habitat data and more recent reconnaissance surveys, the amount of spawning gravels in the

expanded transition reach represents only a small percentage of the suitable spawning habitat in the lower McCloud River. However, any effect on spawning habitat would be considered adverse.

Geology During periods of maximum inundation in the 1,470-foot portion of Segment 4 that would be affected under CP1, some rock outcrops may become inundated and could erode, but the overall geologic value of the McCloud Limestone features would not be adversely affected.

Visual Quality/Scenery The visual quality of the affected portion of Segment 4 would decrease as the vegetation along the banks becomes inundated and eventually dies, the bathtub ring expands, and evidence of flow is reduced. These conditions would be similar to those in the current transition reach. The affected portion of Segment 4 would no longer have the qualities that contributed to its classification by the USFS as "scenic."

CP1 would result in making approximately 1,470 feet of the lower McCloud River ineligible for listing as wild and scenic. This impact would be significant and unavoidable. Mitigation for this impact is not currently available. Additional studies will be conducted to determine if feasible mitigation measures could be developed.

Impact WASR-2 (CP1): Conflict with Shasta-Trinity National Forest Land and Resource Management Plan or Coordinated Resource Management Plan The inundation of approximately 1,470 feet of Segment 4 would conflict with the provisions in the STNF Land and Resource Management Plan and the CRMP to protect the ORVs that make the McCloud River eligible for listing under the WSRA. The raising of Shasta Dam would have an adverse impact on the ORVs of the lower McCloud River, as discussed under Impact WASR-1 (CP1). Effects on the ORVs would not affect the overall eligibility of the river for designation as a wild and scenic river, although the total length of the river that could be recommended for listing could decrease by approximately 1,470 feet (approximately 1.2 percent of the total lower river). Management of the river's ORVs under the STNF LRMP and CRMP would not be affected. No land use changes would occur along the river, and the USFS and signatories to the CRMP would be able to continue implementing provisions of their plans that apply to the river. Nonetheless, this impact would be significant and unavoidable. Mitigation for this impact is not currently available. Additional studies will be conducted to determine if feasible mitigation measures could be developed.

Impact WASR-3 (CP1): Conflict with the California Public Resources Code, Section 5093.542 The State PRC includes provisions that protect the McCloud River fishery and its "natural" and "free-flowing" condition. Implementation of proposed modifications to Shasta Dam and Shasta Lake could conflict with these provisions.

The proposed modifications to Shasta Dam and Shasta Lake would result in temporary and periodic fluctuations in water levels within the expanded transition reach, affecting about 1.2 percent of the lower McCloud River. Under CP1, the transition reach would be extended by about 1,470 feet, a 16 percent increase over the current transition reach; this entire area would be inundated only during peak water levels in the spring of wet years. The free-flowing conditions of the river would not be adversely affected beyond the upstream extension of the transition reach. The primary impact of the expansion of the transition reach would be conversion of aquatic habitat in a manner similar to that described under Impact WASR-1 and Impact WASR-2 and comparable to the habitat conversion that can be observed in the current transition reach downstream. While the overall impacts to the existing natural condition, particularly hydrology and aquatic/riparian ecology, are small in the context of the entire lower McCloud River, the impacts would conflict with the PRC. This impact would be significant and unavoidable. Mitigation for this impact is not currently available. Additional studies will be conducted to determine if feasible mitigation measures could be developed.

CP2 – 12.5-Foot Dam Raise, Anadromous Fish Survival and Water Supply Reliability

CP2 would involve a 12.5-foot raise of Shasta Dam, which would increase the lake's gross pool by 14.5 feet and enlarge the total storage space in the lake by 443,000 acre-feet. This increase would equate to an increase of about 1,850 acres of surface area when the lake is full. CP2 also includes measures to increase water supply reliability while contributing to increased survival of anadromous fish. Under CP2, operational guidelines for Shasta Dam would continue unchanged, with the additional storage retained for water supply reliability and increased survival of anadromous fish.

Impact WASR-1 (CP2): Effect on McCloud River's Eligibility for Listing as a Federal Wild and Scenic River Impact WASR-1 (CP2) would be similar to Impact WASR-1 but would affect 1270 feet more of Segment 4 than CP1. Implementation of CP2 would reduce the total length of the McCloud River that is eligible for wild and scenic river designation by about 2,740 feet (approximately 2.3 percent of the total length of the lower river). The rest of the lower McCloud River would remain eligible for listing.

Under CP2, approximately 2,740 feet, or 21 percent, of Segment 4 would be periodically inundated. The transition reach would increase to a maximum elevation of 1,084 feet msl, which would extend it by about 2,740 feet (a 30 percent increase over the current transition reach), inundating a larger portion of the lower McCloud River within the study area and Segment 4. The inundated area would increase to approximately 51 total acres (an increase of 18 acres over existing conditions and 9 acres more than CP1 conditions), with a maximum width of approximately 530 feet (an increase of 60 feet over existing conditions) and a total length of approximately 11,740 linear feet (2.22 miles). The extension of the transition reach by approximately 2,740 feet would affect

approximately 21 percent of Segment 4. Additional impacts under CP2 compared with CP1 would be minimal and would be limited to the additional 440-foot extension of the transition reach and about 15 additional feet on both sides of the river.

During a wet year, the maximum average water surface elevation of Shasta Lake would be 1,080 feet msl, with a peak elevation of 1,084 feet msl during May. This is an increase of 15 feet above the existing maximum average. During an average water year, the maximum average water surface elevation would increase to 1,051 feet msl, an increase of 11 feet above existing conditions. During dry and critical water years, the change would be on the order of 5 to 9 feet in elevation.

The increased gross pool of Shasta Lake would expand the current transition reach up to the 1,084-foot elevation, a 30 percent increase. Flow conditions and fisheries in the 2,740-foot reach of Segment 4 would periodically be affected, with the timing and duration of the effects similar to those in the current transition reach. Over time, the expansion of the bathtub ring would adversely affect water quality, geology, and visual quality/scenery. Erosion of soils along the river could expose buried cultural resources, and periodic inundation could permanently alter cultural resource values and features in the transition reach important to Native Americans.

Free-Flowing Conditions As discussed under Impact WASR-1 (CP1), the flow characteristics of the extended transition reach under CP2 would be periodically modified, resulting in slower moving waters and a wider river channel. This modification would not meet the definition of a free-flowing river under the WSRA. The width of the transition reach would be increased by approximately 30 feet on both sides of the river. Flow conditions and the river's free-flowing nature upstream from the expanded transition reach would remain similar to current conditions.

Because free-flowing conditions are a fundamental requirement for wild and scenic river eligibility, the 2,740-foot reach of Segment 4 that would be affected by CP2 would become ineligible for listing under the WSRA.

Water Quality Under CP2, increased turbidity and warmer water temperatures would be most noticeable along the expanded 2,740 feet of the transition reach and in the 30-foot corridor on either side of the transition reach because these areas have not been previously exposed to periodic inundations. As discussed under Impact WASR-1 (CP1), effects on water quality would be associated with the periodic increases in water levels of Shasta Lake.

Because water quality is a fundamental requirement for wild and scenic river eligibility, the 2,740-foot reach of Segment 4 that would be affected by CP2 would become ineligible for listing under the WSRA.

Outstandingly Remarkable Values As described above under Affected Environment, the ORVs that make Segment 4 of the McCloud River eligible for listing as a wild and scenic river are cultural/historical resources, fisheries, geology, and visual quality/scenery.

Cultural/Historical Resources Impacts would be the same as discussed under Impact WASR-1 (CP1); however, a slightly larger portion of the three recorded sites and possible resources associated with the known Wintu villages would be inundated.

The cultural resources located along the 2,740-foot reach of Segment 4 that would be affected under CP2 would be subject to the effects of periodic inundation.

Fisheries Aquatic habitat in the affected 2,740-foot segment consists of pocket water and a lateral scour pool. The potential conversion of flatwater habitat to riffle habitat in the 2,740-foot segment would be similar to but greater than under WASR-1 (CP1), and overall impacts to aquatic habitat and fish would be similar to those discussed under Impact WASR-1 (CP1).

Geology Impacts would be the same as discussed under Impact WASR-1 (CP1); the geologic values of the lower McCloud River would not be adversely affected.

Visual Quality/Scenery Impacts would be the same as discussed under Impact WASR-1 (CP1). The affected portion of Segment 4 would no longer have the qualities that contributed to its classification by the USFS as "scenic."

CP2 would result in making approximately 2,740 feet of the lower McCloud River ineligible for listing as wild and scenic. This impact would be significant and unavoidable. Mitigation for this impact is not currently available. Additional studies will be conducted to determine if feasible mitigation measures could be developed.

Impact WASR-2 (CP2): Conflict with Shasta-Trinity National Forest Land and Resource Management Plan or Coordinated Resource Management Plan The inundation of approximately 2,740 feet of Segment 4 would conflict with the provisions in the STNF Land and Resource Management Plan and the CRMP to protect the ORVs that make the McCloud River eligible for listing under the WSRA. This impact would be significant and unavoidable. Mitigation for this impact is not currently available. Additional studies will be conducted to determine if feasible mitigation measures could be developed.

Impact WASR-3 (CP2): Conflict with the California Public Resources Code, Section 5093.542 The impact would be similar to WASR-3 (CP1) but the magnitude of the impact would be greater under CP2 because of the longer transition reach. Under CP2, the proposed modifications to Shasta Dam and Shasta Lake would result in temporary and periodic fluctuations in water levels

within the expanded transition reach, affecting about 2.3 percent of the lower McCloud River. Under CP2, the reach affected by Shasta Lake water levels would be extended by about 2,740 feet, a 30 percent increase over the current transition reach; this entire area would be inundated only during peak water levels in the spring of wet years. The free-flowing conditions of the river would not be adversely affected beyond the upstream extension of the transition reach. The primary impact of the expansion of the transition reach would be conversion of aquatic habitat in a manner similar to the habitat conversion that can be observed in the current transition reach downstream. While the overall impacts to the existing natural condition, particularly hydrology and aquatic/riparian ecology, are small in the context of the lower McCloud River, the impacts would conflict with the PRC. This impact would be significant and unavoidable. Mitigation for this impact is not currently available. Additional studies will be conducted to determine if feasible mitigation measures could be developed.

CP3, 4, 5 – 18.5-Foot Dam Raise, with Variations

CP3, CP4, and CP5 would involve an 18.5-foot raise of Shasta Dam, which would increase the lake's gross pool by 20.5 feet and enlarge the total storage space in the lake by 634,000 acre-feet. This increase would equate to an increase of about 2,500 acres of surface area when the lake is full. CP3, CP4, and CP5 include variations in measures to increase water supply reliability while contributing to increased survival of anadromous fish. CP3 involves measures to increase water supply reliability and survival of anadromous fish. The primary function of CP4 is to address the survival of anadromous fish by increasing the volume of cold water available to the temperature control device through lake reoperations, while still improving water supply reliability. CP5 involves (1) implementing environmental restoration features along the lower reaches of major tributaries to Shasta Lake, (2) constructing shoreline fish habitat around Shasta Lake, and (3) constructing either additional or improved recreation features at various locations around Shasta Lake to increase the value of the recreational experience.

Impacts associated with CP3, CP4, and CP5 would be very similar to those described for CP1 and CP2, but the increased water levels of Shasta Lake would affect a longer reach of the lower McCloud River. Because of their similarities, and in an effort to reduce redundancy, only the differences between the plans are described below.

Impact WASR-1 (CP3,4,5): Effect on McCloud River's Eligibility for Listing as a Federal Wild and Scenic River Implementation of CP3, CP4, and CP5 would reduce the total length of the McCloud River that is eligible for wild and scenic river designation by about 3,550 feet (less than 3 percent of the total length of the lower river). The rest of the lower McCloud River would remain eligible for listing.

Under CP3, 4, and 5, the extent of the transition reach would increase to a maximum elevation of 1,090 feet msl, which would extend the current transition reach by about 3,550 feet (a 39 percent increase over the current transition reach), inundating a larger portion of the lower McCloud River within the study area and Segment 4. The inundated area would increase to approximately 60 total acres (an increase of 27 acres over existing conditions, and 9 acres more than CP2 conditions), with a maximum width of approximately 610 feet (an increase of 140 feet over existing conditions) and a total length of approximately 12,550 linear feet (2.38 miles). The extension of the transition reach by approximately 3,550 feet would affect approximately 26 percent of Segment 4. Additional impacts under CP3, 4, and 5 compared with CP1 and CP2 would be minimal and would be limited to the additional 810-foot extension of the transition reach and about 20 additional feet on either side of the river.

During a wet year, the maximum average water surface elevation of Shasta Lake would be 1,086 feet msl, with a peak elevation of 1,090 feet msl during May. This is an increase of 21 feet above the existing maximum average. During an average water year, the maximum average water surface elevation would increase to 1,054 feet msl, an increase of 14 feet above existing conditions. During dry and critical water years, the change would be on the order of 6 to 13 feet in elevation.

The increased gross pool of Shasta Lake would expand the current transition reach by approximately 3,550 feet (810 feet beyond CP2's effects) up to the 1,090-foot elevation, resulting in a 39 percent increase in the transition reach. Within the expanded transition reach, flow conditions and fisheries would periodically be affected, with the timing and duration of the effects similar to those in the current transition reach. Over time, the expansion of the bathtub ring would affect water quality, geology, and visual quality/scenery. Erosion of soils along the river could expose buried cultural resources, and periodic inundation could permanently alter cultural resource values and features in the transition reach important to Native Americans.

Free-Flowing Conditions As discussed under Impact WASR-1 (CP1), the flow characteristics of the extended transition reach under CP3, CP4, and CP5 would be temporarily modified, resulting in slower moving waters and a wider river channel. This modification would not meet the definition of a free-flowing river under the WSRA. The width of the transition reach would be increased by approximately 70 feet on either side of the river. Flow conditions and the river's free-flowing nature upstream from the expanded transition reach would remain similar to current conditions.

Because free-flowing conditions are a fundamental requirement for wild and scenic river eligibility, the 3,550-foot reach of Segment 4 that would be affected by CP1 would become ineligible for listing under the WSRA.

Water Quality Under CP3, 4, and 5, increased turbidity and warmer water temperatures would be most noticeable along the expanded 3,550-foot reach of the transition reach and in the 70-foot corridor on either side of the transition reach because these areas have not been previously exposed to periodic inundations. Under these plans, the wider affected river corridor could result in greater temporary effects on water quality because more vegetation would be temporarily inundated and more soils would be exposed. As discussed under Impact WASR-1 (CP1), effects on water quality would be associated with the periodic increases in water levels of Shasta Lake.

Because water quality is a fundamental requirement for wild and scenic river eligibility, the 3,550-foot reach of Segment 4 that would be affected by CP3, CP4, and CP5 would become ineligible for listing under the WSRA.

Outstandingly Remarkable Values As described above under Affected Environment, the ORVs that make Segment 4 of the McCloud River eligible for listing as a wild and scenic river are cultural/historical resources, fisheries, geology, and visual quality/scenery.

Cultural/Historical Resources Impacts would be similar to those discussed under Impact WASR-1 (CP1). Under CP3, CP4, and CP5, the wider affected river corridor could result in greater effects on cultural resources because of the wider inundated area and increased erosion. Larger portions of the three recorded sites and known Wintu villages would become inundated.

The cultural resources located along the 3,550-foot reach of Segment 4 that would be affected under CP3, CP4, and CP5 would be subject to the effects of periodic inundation.

Fisheries Aquatic habitat in the additional 810-foot segment under CP3, CP4, and CP5 consists of a mid-channel pool and a lateral scour pool. The potential conversion of flatwater habitat to riffle habitat in the 3,550-foot reach of Segment 4 that would be affected under these plans be similar to but greater than under WASR-1 (CP1), and overall impacts to aquatic habitat and fish would be similar to those discussed under Impact WASR-1 (CP1).

Geology Impacts would be the same as discussed under Impact WASR-1 (CP1), except additional rock outcrops could become inundated because of the wider affected corridor.

Visual Quality/Scenery Impacts would be similar to those discussed under Impact WASR-1 (CP1). Under these plans, the wider affected river corridor could result in greater effects on the visual setting because of the wider inundated area and increased impacts on vegetation. The water line would also be visible at a higher elevation and could be more noticeable. The affected portion of Segment 4 would no longer have the qualities that contributed to its classification by the USFS as “scenic.”

CP3, 4, and 5 would result in making approximately 3,550 feet of the lower McCloud River ineligible for listing as wild and scenic. This impact would be significant and unavoidable. Mitigation for this impact is not currently available. Additional studies will be conducted to determine if feasible mitigation measures could be developed.

Impact WASR-2 (CP3,4,5): Conflict with Shasta-Trinity National Forest Land and Resource Management Plan or Coordinated Resource Management Plan The inundation of approximately 3,550 feet of Segment 4 would conflict with the provisions in the STNF Land and Resource Management Plan and the CRMP to protect the ORVs that make the McCloud River eligible for listing under the WSRA. This impact would be significant and unavoidable. Mitigation for this impact is not currently available. Additional studies will be conducted to determine if feasible mitigation measures could be developed.

Impact WASR-3 (CP3,4,5): Conflict with the California Public Resources Code, Section 5093.542 The impact would be similar to WASR-3 (CP1) but the magnitude of the impact would be greater under CP3, CP4, and CP5 because of the longer transition reach. Under CP3, CP4, and CP5, the proposed modifications to Shasta Dam and Shasta Lake would result in temporary and periodic fluctuations in water levels within the expanded transition reach, affecting about 3 percent of the lower McCloud River. Under CP3, CP4, and CP5, the reach affected by Shasta Lake water levels would be extended by about 3,550 feet, a 39 percent increase over the current transition reach; this entire area would be inundated only during peak water levels in the spring of wet years. The free-flowing conditions of the river would not be adversely affected beyond the upstream extension of the transition reach. The primary impact of the expansion of the transition reach would be conversion of aquatic habitat in a manner similar to the habitat conversion that can be observed in the current transition reach downstream. While the overall impacts to the existing natural condition, particularly hydrology and aquatic/riparian ecology, are small in the context of the lower McCloud River, the impacts would conflict with the PRC. This impact would be significant and unavoidable. Mitigation for this impact is not currently available. Additional studies will be conducted to determine if feasible mitigation measures could be developed.

25.4.4 Mitigation Measures

Table 25-2 presents a summary of mitigation measures for wild and scenic rivers.

No mitigation measures are proposed because none are available that would reduce the impacts to a less than significant level.

Table 25-2. Summary of Mitigation Measures for Wild and Scenic Rivers

Impact		No-Action Alternative	CP1	CP2	CP3	CP4	CP5
Impact WASR-1: McCloud River's Eligibility for Listing as a Federal Wild and Scenic River	LOS before Mitigation	NI	SU	SU	SU	SU	SU
	Mitigation Measure	None required.	No feasible mitigation available to reduce impact.				
	LOS after Mitigation	NI	SU	SU	SU	SU	SU
Impact WASR-2: Conflict with STNF LRMP or CRMP	LOS before Mitigation	NI	SU	SU	SU	SU	SU
	Mitigation Measure	None required.	No feasible mitigation available to reduce impact.				
	LOS after Mitigation	NI	SU	SU	SU	SU	SU
Impact WASR-3: Conflict with California Public Resources Code, Section 5093.542	LOS before Mitigation	NI	SU	SU	SU	SU	SU
	Mitigation Measure	None required.	No feasible mitigation available to reduce impact.				
	LOS after Mitigation	NI	SU	SU	SU	SU	SU

Key:
LOS = level of significance
NI = no impact
SU = significant and unavoidable

25.4.5 Topics Eliminated from Further Consideration

No topics related to the eligibility of the McCloud River for listing under the Federal WSRA, the compatibility of the alternatives with the STNF LRMP or the CRMP, or their compatibility with the State PRC providing protection to the McCloud River were eliminated from further consideration.

25.4.6 Cumulative Effects

Significant effects were identified related to the compatibility of the project with the State PRC, Section 5093.542. The potential effects would be of greater magnitude and duration with the larger dam raises (i.e., CP3 through CP5 would have greater potential effects than CP1 and CP2). These impacts may also be associated with one other reasonably foreseeable action that could affect the McCloud River, the relicensing of PG&E's McCloud-Pit Project. However, the relicensing process is ongoing; until it is completed, its potential effects on the McCloud River are unknown. Therefore, the potential for project-related impacts to be cumulatively considerable would be less than significant.

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Chapter 26
Other Required Disclosures

26.1 Significant Adverse Effects that Cannot be Avoided If a Project is Implemented

Section 21100(b)(2)(A) of CEQA provides that an environmental impact report (EIR) will include a detailed statement setting forth "any significant effect on the environment that cannot be avoided if the project is implemented." Chapters 4–25 of this PDEIS analyze in detail all of the project's potentially significant environmental impacts, including cumulative impacts; list feasible mitigation measures that could reduce or avoid the project's significant impacts; and specify whether these mitigation measures would reduce these impacts to a less than significant level. If there is no feasible mitigation measure available to reduce a significant impact to a less than significant level, then the impact is considered to be a significant and unavoidable impact. The SLWRI would have the following significant and unavoidable environmental impacts (direct, indirect, and cumulative):

- Loss or diminished availability of known mineral resources.
- Loss or diminished soil biomass productivity.
- Soil erosion or loss of topsoil due to shoreline processes.
- Conversion of forest land to nonforest uses in the vicinity of Shasta Lake.
- Conflict with existing land use goals and policies of affected jurisdictions (Shasta Lake and vicinity and upper Sacramento River).
- Disruption of existing land uses (Shasta Lake and vicinity and upper Sacramento River).
- Loss of sensitive plant communities and special-status plant species resulting from induced growth (cumulative).
- Effects on air quality with respect to short-term construction emissions: temporary emissions of reactive organic gases, oxides of nitrogen, and particulate matter with an aerodynamic resistance diameter of 10 micrometers or less (commonly known as PM_{10}).

- Effects on prehistoric and historic-era cultural resources.
- Consistency with guidelines for visual resources in the *Shasta-Trinity National Forest Land and Resource Management Plan*.
- Degradation and/or obstruction of a scenic view from key observation points.
- Generation of increased daytime glare and/or nighttime lighting.
- Effect on the McCloud River's eligibility for listing as a Federal Wild and Scenic River.
- Conflict with the California Public Resources Code, Section 5093.542.
- Effects on power and energy with respect to decreases in Shasta, CVP and SWP, and Pit 7 powerplant energy generation.
- Effects on power and energy with respect to increases in CVP and SWP pumping plant energy.
- Cumulative effects on south Delta water levels, X2 position, and Delta outflow.

Where feasible mitigation exists, it has been included to reduce these impacts; however, the application of all feasible mitigation would not be sufficient to reduce these impacts to a less than significant level.

26.2 Relationship of Short-Term Uses and Long-Term Productivity

NEPA requires consideration of "the relationship between short-term uses of man's environment and the maintenance and enhancement of long-term productivity" (40 Code of Federal Regulations 1502.16). This involves using all practicable means and measures, including financial and technical assistance, in a manner calculated to foster and promote the general welfare, to create and maintain conditions under which man and nature can exist in productive harmony, and fulfill the social, economic, and other requirements of present and future generations of Americans.

All action alternatives analyzed in this PDEIS involve new construction such as raising Shasta Dam, constructing seismic and static retrofits, replacing bridges, and relocating/reconstructing recreational facilities adversely affected by higher reservoir levels. Specific activities would modify the Pit River Bridge, replace seven other bridges, relocate 45-130 structures, and inundate numerous small segments of existing paved and unpaved roads. Approximately 20 buildings

associated with marinas or resorts would be affected directly, and about 25 other buildings associated with ancillary facilities could be affected indirectly because of their proximity to the new water surface at full pool.

All of the action alternatives would result in indirect and induced employment, which may be to support hiring in businesses that provide materials to the construction effort; in service-related industries that provide food, beverages, and other goods to construction workers; or in more technical industries, such as consulting firms and other businesses (see Chapter 16, "Socioeconomics, Population, and Housing"). Sales and profits for businesses that support the construction industry in the primary study area would result in increased profits over the 36- to 60-month construction period.

Potential habitat- and recreation-related losses caused by enlarging the dam and reservoir would irreversibly affect habitats and developments near the dam inundation area. Impacts on habitat areas within the dam inundation area would be mitigated by preservation of habitats elsewhere. Construction activities would include short-term uses of capital, labor, fuels, and construction materials, habitats, and recreation areas. General commitments of construction materials are largely irreversible, because most of the construction materials are unsalvageable.

Potential benefits of the action alternatives include an increase in the reliability of the water supply and a reduction in the probability of experiencing a potential flood-related loss of resources, property, and human life. Environmental uses and habitat for a variety of aquatic and terrestrial species along the Sacramento River and waterways within the primary and extended study areas would be maintained, and potentially enhanced with proposed mitigation. There are no adverse effects that would pose a long-term risk to health and safety.

26.3 Irreversible and Irretrievable Commitments of Resources

The State CEQA Guidelines require a discussion of the significant irreversible environmental changes that would be caused by a proposed action should it be implemented. In addition, an Environmental Impact Statement (EIS) prepared under NEPA must analyze irreversible and irretrievable commitments of resources such as soils, wetlands, waterfowl habitat, and cultural resources (40 Code of Federal Regulations 1502.16).

The irreversible and irretrievable commitment of resources is the permanent loss of resources for future or alternative purposes. Irreversible and irretrievable resources are those that cannot be recovered or recycled, or those that are consumed or reduced to unrecoverable forms. The action alternatives would result in the irreversible and irretrievable commitment of the following energy and material resources during project construction and maintenance:

- Construction materials, including such resources as soil and rocks
- Land area committed to new/expanded project facilities and water inundation areas
- Energy expended in the form of electricity, gasoline, diesel fuel, and oil for equipment and transportation vehicles that would be needed for project construction and maintenance

Nonrenewable resources are expected to account for a minimal portion of the region's resources; the project's use of nonrenewable resources would not affect the availability of these resources for other needs within the region. Construction activities would not result in inefficient use of energy or natural resources. Construction contractors selected would use best available engineering techniques, construction and design practices, and equipment operating procedures. Further, mitigation would be provided to offset any loss of habitat areas and other land uses within the proposed dam inundation areas. Long-term project operation would not result in substantial long-term consumption of energy and natural resources, and increased energy production would result from the additional storage capacity.

26.4 Growth-Inducing Impacts

CEQA requires that an EIR discuss how a project may induce growth. NEPA requires that an EIS consider indirect effects of a project, which are often the result of growth inducement. A project is considered potentially growth inducing if it is reasonably foreseeable that the project may foster economic or population growth or may result in the construction of additional housing (California Code of Regulations, Section 15126.2(d)). The increase in water supply reliability that would result from the construction of any of the project's action alternatives is considered potentially growth inducing because it would foster economic growth and potentially remove an obstacle to development.

The purpose of this section is to disclose how the action alternatives analyzed in this PDEIS could be growth inducing and to describe how the potential resulting environmental effects would be addressed. In *Napa Citizens for Honest Government v. Napa County Board of Supervisors* (2001) 91 Cal.App.4th 342, 367–371 [110 Cal.Rptr.2d 579], the California Court of Appeal, Fourth District, provided clear direction on the standards for disclosure of growth-inducing effects in an EIR that is also relevant to an EIS. The lead agency may also consider mitigation measures for the anticipated effects. Growth-inducing impacts are evaluated for the project alternatives in accordance with the California Court of Appeal finding in *Napa Citizens for Honest Government v. Napa County Board of Supervisors* (2001):

> *Neither CEQA itself, nor the cases that have interpreted it, require an EIR to anticipate and mitigate the effects of a particular project on growth on other areas. In circumstances such as these, it is sufficient that the final EIR (FEIR) warns interested persons and governing bodies of the probability that additional housing will be needed so that they can take steps to prepare for or address that probability. The FEIR need not forecast the impact that the housing will have on as yet unidentified areas and propose measures to mitigate that impact. That process is best reserved until such time as a particular housing project is proposed.*

The increase in water supply reliability resulting from the proposed action would make additional water resources available for municipal, industrial, and agricultural uses in the CVP and SWP service areas. The additional water resources could be used for actions that sustain and support growth.

Project construction is not growth inducing because new housing would not be required. Growth-inducing effects resulting from the increase in water supply reliability caused by the action alternatives would be indirect, and the ability of Reclamation to forecast the extent and location of these effects is extremely limited. More than likely, the effects would be spread throughout the CVP and SWP service areas, would change annually, and would depend on how the additional water supply stored in Shasta Lake is ultimately used. Because the potential indirect growth-inducing effects are speculative and amorphous, no feasible mitigation measures are available or proposed. Direct impacts on traffic and air quality and changes to the jobs/housing balance will be evaluated and mitigated by the local land use agency during general plan updates and project-specific application review. The following potential effects of an increase in the reliability of the water supply are discussed:

- Existing fallow agricultural land and rangeland may be converted to irrigated row crops or irrigated orchard. This land use change could increase effects of local economic growth on farmers and could result in more local employment opportunities.

- If water supply is an obstacle to expansion of industrial facilities, this obstacle may be removed. Increased industrial capacity could result in economic growth and provide more local employment opportunities.

- If water supply is an obstacle to residential development, this obstacle may be removed, and local land use authorities may be encouraged to approve residential development projects on currently zoned agricultural land:

  - Residential development would result in the construction of houses.

- Residential development may cause economic growth through the collection of development fees.

The project analysis includes a primary study area and an extended study area. The primary study area encompasses Shasta Dam and Shasta Lake; inflowing rivers and streams consisting of the Sacramento River, McCloud River, Pit River, and Squaw Creek; and the Sacramento River downstream to about Red Bluff Diversion Dam. Because of the potential influence of Shasta Dam modification on natural resources along the Sacramento River, and on programs and projects in the Central Valley, the project also evaluates an extended study area that includes the Sacramento River basin downstream from Red Bluff Diversion Dam, the American River basin, the Delta, the San Joaquin River basin, and the CVP and SWP service areas.

The extended study area includes CVP and SWP reservoirs and the portions of tributaries that are downstream from these reservoirs and that affect Sacramento River, San Joaquin River, Trinity River, and Delta flows. These reservoirs and tributaries include Lake Oroville, Folsom Lake, Millerton Lake, San Luis Reservoir, New Melones Reservoir, and Trinity Lake, and portions of the Trinity, Feather, American, and Stanislaus rivers. The CVP and SWP service areas include much of the Sacramento and San Joaquin valleys, and substantial portions of the Bay Area and Southern California.

26.4.1 Increased Construction Work

The action alternatives analyzed in this PDEIS would create new construction jobs in the primary study area, but this temporary effect would not be growth inducing. Concrete workers, workers with large-scale construction experience, general laborers, and others would be drawn from the existing local construction industry. These jobs represent a relatively small increase (i.e., less than 0.5 percent) in the total labor force in the two counties of the primary study area, but would represent a substantial increase in employment for many of the cities surrounding the project, where employment has consistently been below the state average (EDD 2010, 2011). Therefore, jobs created by the action alternatives would be serviced largely by the local workforce and would not be growth inducing (see Chapter 16, “Socioeconomics, Population, and Housing”).

26.4.2 Increased Flood Protection

The action alternatives are also anticipated to provide some flood protection benefits, but these benefits are not growth inducing. The added capacity would give Reclamation greater flexibility in using the reservoir for flood management purposes, thereby increasing the threshold at which seasonal heavy-rain events produce flood conditions downstream from Shasta Dam. The benefits of this increase in capacity and related flood management options would be most evident along the upper Sacramento River in the primary study area, and would decrease downstream as other major tributaries join the Sacramento River. Structures in and inhabitants of this floodplain experience the most direct effects from storage releases during flood events. The action alternatives would

reduce the frequency, magnitude, and duration of some potential future flood events, like those that have affected structures and residents in this part of the primary study area in the past.

As a result of the added reservoir capacity, the overall risk of flooding and its related consequences below Shasta Dam is expected to be reduced. Although heavy-rain events would continue to occur in the region, enlarging the dam is intended to provide greater flexibility in flood management in the lower Sacramento River and Delta area because of the increased capacity of the reservoir. As a result, less damage to existing structures in or near the lower Sacramento River and Delta floodplains would be expected over time. However, the flood management benefits of the dam enlargement would not be expected to change the existing floodplain or Federal Emergency Management Agency flood zone designations, so the action alternatives would not remove an obstacle to development; therefore, flood protection benefits are not considered growth inducing.

26.4.3 Increased Water Supply Reliability

Implementing any of the action alternatives would improve the reliability of the water supply in both the primary and extended study area. This improved water supply reliability would better accommodate existing water contracts by increasing the water supply in some years. The environmental consequences of these contracts have been (and in the future will be) evaluated in separate environmental review processes. The improvement in water supply reliability would not change long-term contract amounts or deliveries from within their existing historical ranges.

A variety of factors indirectly influence business, residential, and population growth in the region. Among these are city and county general plans and policies, and the availability of utility services, public schools, and transportation services. Water is one of the primary public services needed to support urban development, including businesses, industry (including agriculture), and housing; a deficiency in water service capacity could constrain future development.

Implementing any of the action alternatives would also increase water yield, which has the potential to be growth inducing. The expected increase in water yield relative to the entire CVP and SWP service areas would be small (i.e., less than 1 percent), and this new yield would likely be provided to a number of geographic areas within the CVP and SWP service areas. Also, a substantial portion of this water would substitute for groundwater pumping, allow for changes in agricultural irrigation practices, or return idle cropland to production. For this reason, implementing any of the action alternatives would result in beneficial effects on agricultural resources, which would intrinsically benefit the economies in the affected localities. An increase in the reliability of water provided to agricultural areas would not necessarily lead to a direct increase in population, because the water would service primarily existing agricultural

lands and would not be expected to foster expansion into undeveloped natural communities. However, the cumulative effect of a more reliable water source would be to increase agricultural effectiveness, a key economic sector in the region, which could indirectly result in growth-inducing impacts by bringing more money into the local economies.

Agriculture is the most important segment of the economy below Shasta Dam and throughout California's Central Valley. Beneficial effects of improved water supply reliability are predicted by an economic analysis applying the "change in net income" method as estimated by the Central Valley Production Model. The average annual benefits to agriculture from the improvement in water supply reliability for CVP irrigation deliveries, based on weighted values, range from $9 million to $14.6 million (see the Economic Valuation Appendix).

Benefits from an increase in the reliability of the municipal and industrial (M&I) water supply are estimated based on SWP deliveries. The economic benefit of average M&I deliveries is calculated using a conservative value of $500 per acre-foot for M&I supplies. The estimated average annual benefits from the increase in M&I water supply reliability range from $3.9 million to $7.6 million (see the Economic Valuation Appendix).

Total water supply benefits are the sum of weighted-average benefits to the reliability of agricultural and M&I water supplies. Total benefits from increased water supply reliability range from $13.3 million to $18.1 million (see the Economic Valuation Appendix). Therefore, the action alternatives would result in positive economic effects related to growth of the agricultural and M&I sectors by potentially increasing the available water supply. This would be a potentially growth-inducing effect.

If residential development is constrained by water supply, then increased reliability of the water supply may remove an obstacle to residential development. Therefore, the action alternatives would be potentially growth inducing. Local land use authorities are required to demonstrate sufficient water supply reliability pursuant to Senate Bill 610 (Chapter 643, Statutes of 2001), in addition to an evaluation required by CEQA. Water supply reliability may be demonstrated with surface water, water contracts, groundwater, and combinations thereof. Impacts on the physical environment would be evaluated and mitigated at a project level. Because the locations of potential residential development on existing agricultural or rangeland cannot be predicted, and because of the speculative and amorphous nature of potential impacts, no mitigation for impacts of the action alternatives is required.

Increased reliability of the water supply could reduce a limitation on growth throughout the primary and extended study areas; however, projects that could affect natural resources or otherwise accommodate growth in the study area would have to comply with existing planning documents and would be subject to project-specific public environmental analysis and review. The effects of

subsequent growth would be analyzed in general plan EIRs and in project-level CEQA compliance documents for the local jurisdictions in which the growth would occur. Mitigation of these effects would be the responsibility of these local jurisdictions, not Reclamation.

The expected increase in water yield relative to the entire CVP would be small; however, this new yield could be provided to any number of geographic areas within the CVP service area (and in part would substitute for ongoing groundwater pumping). Further, it would be speculative to identify specific areas where growth could occur or the indirect effects on specific community service facilities in a particular service area.

26.5 Identification of Environmental Preferences for Alternatives

Each alternative was ranked similarly based on evaluation criteria. The primary distinguishing factors are related to water supply reliability, anadromous fish survival, and other project objectives. CP1, CP2, and CP3 primarily address water supply reliability; however, each of these plans would also contribute to other project objectives, with the exception of ecosystem restoration. Further, the likelihood that each of these three plans would meet its intended objectives is very high because the plans would not significantly rely on any other actions. However, CP4 further emphasizes anadromous fish survival through an increase in the storage dedicated to cold-water supply each year and gravel augmentation, and CP5 specifically addresses environmental restoration and gravel augmentation. With both CP4 and CP5, overall water supply reliability would be reduced, primarily because in each case ongoing future actions would be required that are not directly related to operation and maintenance of the enlarged reservoir. With the survival of increased numbers of anadromous fish, operational considerations are required to ensure a high degree of success. For environmental restoration, success would depend on the continued effectiveness of the environmental restoration facilities/features proposed as part of the SLWRI – enhanced lake area spawning and rearing habitat, increased native vegetation, and new riparian rehabilitation areas – well past completion of construction.

26.5.1 Least Environmentally Damaging Practicable Alternative

The Least Environmentally Damaging Practicable Alternative will be determined on the basis of the entire environmental review and identified in the Record of Decision, consistent with the Federal Clean Water Act, Section 404, which requires that only the Least Environmentally Damaging Practicable Alternative may be approved and implemented by a Federal agency.

26.5.2 Environmentally Preferable Alternative/Environmentally Superior Alternative

Construction-related impacts would be similar for all of the action alternatives, and the significance determinations for each of the action alternatives are

largely the same. Varying magnitudes of impacts would be related largely to the height of the dam raise because additional construction resources would be required for the larger raise and more land would be affected within the larger inundation area. All of the action alternatives would provide additional opportunities for flood management; they also would provide greater water supply reliability during extremely dry years, which would benefit all water users. CP1 and CP2 would have less of an impact on land uses within the reservoir area than the other action alternatives because they would raise the dam by 6.5 feet and 12.5 feet, respectively, compared to an 18.5-foot increase proposed under CP3, CP4, and CP5. However, water supply reliability and anadromous fish survival would be maximized with the larger raise.

CP4 would increase water supply reliability for agricultural, M&I, and environmental purposes; provide the greatest net increase in hydropower generation; maintain recreation capacity with modernized facilities; and provide water quality benefits to the upper Sacramento River and the Delta. In addition, CP4 would dedicate 378,000 acre-feet of the additional water from increased storage to maintain cold-water volume or augment flows as part of an adaptive management plan for anadromous fish survival, would augment gravel in the upper Sacramento River, and would restore riparian, floodplain, and side channel habitat.

At this time, based on analyses to date, alternatives involving an 18.5-foot raise of Shasta Dam appear to have the greatest environmental benefits, although no environmentally preferable alternative has been selected. It is recognized that additional refinement and changes may occur to the alternatives after performing further analyses and receiving input from agencies, stakeholders, and the public. Any such changes will be addressed as appropriate into the Draft EIS and other future SLWRI documents.

26.6 Compliance with Applicable Laws, Policies, and Plans

For more detailed descriptions of the laws, policies, and plans listed below see Section 3.4, “Regulatory Framework.”

26.6.1 Federal Requirements

National Environmental Policy Act

NEPA requires that an appropriate document be prepared to ensure that Federal agencies accomplish the law’s purposes. The Council on Environmental Quality has adopted regulations and other guidance that provide detailed procedures that Federal agencies follow to implement NEPA. Once finalized, Reclamation would use this EIS to comply with Council on Environmental Quality regulations and document NEPA compliance.

Clean Water Act

Section 404 A Section 404(b)(1) alternatives information package will be prepared for the proposed action and submitted to USACE and the U.S. Environmental Protection Agency. In addition, if construction is authorized, Reclamation will obtain a Section 404 permit prior to filling any waters of the United States. USACE will issue a Record of Decision that addresses pertinent consideration and implementation requirements. Section 404 also requires that a Least Environmentally Damaging Practicable Alternative is identified and must be implemented by an implementing Federal agency.

Section 401 Water quality certification requires evaluation of potential impacts in light of water quality standards and Clean Water Act (CWA) Section 404 criteria governing discharge of dredged and fill materials into waters of the United States. The Federal government delegates water pollution control authority under Section 401 of the CWA to the states. Refer to the "Porter-Cologne Water Quality Control Act" section below.

Federal Endangered Species Act

Reclamation has coordinated with USFWS and NMFS regarding potential project effects on Federally listed species. The potential effects of the SLWRI on endangered and threatened species are described in Chapter 11, "Fisheries and Aquatic Ecosystems"; Chapter 12, "Botanical Resources and Wetlands"; and Chapter 13, "Wildlife Resources." Reclamation will prepare the appropriate biological assessments to address potential impacts on Federally listed species and will consult with USFWS and NMFS regarding impacts of the proposed action.

Magnuson-Stevens Fishery Conservation and Management Act

Chapter 11, "Fisheries and Aquatic Ecosystems," discusses impacts on fisheries and fisheries habitat. Reclamation will coordinate with NMFS to ensure that recommended measures be put into the proposed action that would minimize adverse modifications to Essential Fish Habitat. The proposed action's specific implementation plan will analyze the significance of modifications to Essential Fish Habitat and will support the habitat assessments included for restoration-specific actions during the Section 7 Endangered Species Act consultations.

Fish and Wildlife Coordination Act

Compliance with the Fish and Wildlife Coordination Act (FWCA) involves assessing the impacts of a proposed action on preservation, conservation, and enhancement of fish and wildlife habitat. Reclamation will be required to include recommendations for preserving affected habitats, mitigating their loss, and enhancing such habitats, in its documentation of compliance. Documentation of compliance with the FWCA is a separate analysis of habitats of concern to USFWS, NMFS, and DFG, and does not replace the analysis required by Section 7 of the Federal Endangered Species Act.

Bald and Golden Eagle Protection Act

USFWS has proposed new permit regulations to authorize the take of bald and golden eagles under the Bald and Golden Eagle Protection Act, generally when the take to be authorized is associated with otherwise lawful activities (72 *Federal Register* 31141–31155, June 5, 2007). With delisting of the bald eagle in 2007, the Bald and Golden Eagle Protection Act is the primary law that protects bald eagles, as well as golden eagles. As discussed in Chapter 13, "Wildlife Resources," suitable habitat is not present for golden eagle in the study area; however, the proposed action would have a significant and unavoidable impact on the bald eagle. Therefore, Reclamation will consult with USFWS to implement the reasonable and prudent alternative and conservation measures to reduce impacts on the bald eagle.

Federal Clean Air Act

As discussed in Chapter 5, "Air Quality and Climate," the SLWRI would not result in long-term effects on air quality. Because the effects of the proposed action on air quality have been evaluated and mitigated to the extent possible, the proposed action would comply with the Federal Clean Air Act.

Federal Water Project Recreation Act

Compliance with the Federal Water Project Recreation Act is achieved by documenting the consideration of recreation opportunities in USACE reports and NEPA documents. Within this PDEIS, Reclamation has taken into consideration, and addressed, outdoor recreation and fish and wildlife enhancement in the primary and extended study areas.

Safe Drinking Water Act

Water used for domestic purposes must be treated by the local or regional water supply in accordance with Federal and State standards. Reclamation is in compliance with the Safe Drinking Water Act because the proposed action would not change existing license requirements or impede enforcement of primary drinking water standards.

National Historic Preservation Act

Studies of the area of potential effect and consultation with the Winnemem Wintu and the California State Historic Preservation Officer determined that sites of cultural significance exist in and around Shasta Lake, including sites related to historic activities of Native Americans. These sites could be inundated should the proposed action be implemented. A representative of the Winnemem Wintu has been involved in reviewing previous study findings, the results of the archival and field research, and conditions for preservation designed to reduce potential impacts on cultural resources. The FEIS will be sent to the California State Historic Preservation Officer for use in consultation between Reclamation and the California State Historic Preservation Officer to confirm that adverse effects on resources that are listed in or eligible for listing in the National Register of Historic Places are avoided or mitigated. For these reasons, the

project would comply with Section 106 of the National Historic Preservation Act.

Farmland Protection Policy Act

As a Federal agency preparing environmental compliance documents, Reclamation must include in its analysis a farmland assessment designed to minimize adverse impacts on prime and unique farmlands and provide for mitigation as appropriate. Chapter 10, "Agriculture and Important Farmland," evaluates potential effects of the proposed action on Important Farmland.

Rivers and Harbors Act

In the USACE Sacramento District, navigable waters of the United States in the project area that are subject to the requirements of the Rivers and Harbors Act include the Sacramento River, and all waterways in the Sacramento–San Joaquin drainage basin affected by tidal action. Sections of the River and Harbors Act applicable to the proposed action are described below.

Section 9 All of the action alternatives for the proposed action would include construction of dikes. A Section 9 approval would be required before construction of any dikes. Reclamation would obtain approval from the Chief of Engineers and by the Secretary of the Army before construction of any dikes in navigable waters of the United States.

Section 10 A Section 10 permit would be required before any activity that would alter waters of the United States. To comply with the Rivers and Harbors Act, Reclamation would apply for a permit from USACE's Sacramento District before construction, and that application would be processed simultaneously with the CWA Section 404 permit application. This PDEIS evaluates the environmental effects that the proposed action would have on waters of the United States, including navigable waters.

Section 13 Within the primary study area, the Central Valley Regional Water Quality Control Board has jurisdiction. The Federal government delegates water pollution control authority under Section 402 of the CWA to the states. Refer to the "Porter-Cologne Water Quality Control Act" section below.

Migratory Bird Treaty Act

As discussed in Chapter 13, "Wildlife Resources," this PDEIS evaluates potential impacts on migratory bird species and identifies mitigation measures to reduce impacts on birds, nests, and eggs. In addition, Reclamation would implement all feasible measures included in the FWCA Report. Reclamation would comply with the Migratory Bird Treaty Act by implementing mitigation measures described herein and in the FWCA Report before and during implementation of the proposed action.

National Forest Management Act

As discussed in Chapter 1, "Introduction," USFS is a cooperating agency in this PDEIS. Under the National Forest Management Act, any decision emanating from a NEPA process must comply with the Land and Resource Management Plan (LRMP) in order to authorize an action on lands managed by the Shasta-Trinity National Forest (STNF). Significant impacts on lands and resources managed by the STNF are disclosed in Chapter 4, "Geology, Geomorphology, Minerals, and Soils"; Chapter 12, "Botanical Resources and Wetlands"; Chapter 13, "Wildlife Resources"; Chapter 17, "Land Use and Planning"; Chapter 18, "Recreation and Public Access"; and Chapter 19, "Aesthetics and Visual Resources," of this PDEIS. These impacts may require nonsignificant, project-specific amendments to the LRMP.

The National Forest Management Act also requires that USFS maintain viable populations of existing native and desired nonnative species in the planning area. This requirement will be met by preparing a biological evaluation and associated management indicator species assessment. Those documents will be used by USFS to make a finding that the actions disclosed in the record of decision issued by Reclamation will be consistent with the LRMP.

Federal Land Policy and Management Act

As described in Chapter 3, "Considerations for Describing the Affected Environment and Environmental Consequences," the Federal Land Policy Management Act directs USFS and the U.S. Bureau of Land Management to manage public lands under the principles of multiple use and sustained yield. Under the Federal Land Policy and Management Act, the use and occupancy of public lands requires authorization by a land management agency, typically under the auspices of a special-use permit. As the principal land management agency for the Shasta Unit of the Whiskeytown-Shasta-Trinity National Recreation Area, USFS and, to a lesser degree, the U.S. Bureau of Land Management will need to use this EIS, when finalized, to support issuance of authorizations to various parties pursuant to the Federal Land Policy and Management Act.

Wild and Scenic Rivers Act

Section 7 of the Federal Wild and Scenic Rivers Act requires the STNF to manage the outstandingly remarkable values of the McCloud River consistent with the objectives and standards and guidelines of its LRMP. The evaluation in the STNF LRMP concluded that the lower McCloud River, from McCloud Dam downstream about 22 miles to the river's transition to Shasta Lake at about 1,070 feet mean sea level, provides outstanding cultural, fisheries, and geologic values, and its corridor has been classified as a highly sensitive visual area by USFS (USFS 1995). Based on the outstandingly remarkable values, the STNF determined that the lower McCloud River meets the eligibility requirements for designation under the Federal Wild and Scenic Rivers Act. Chapter 25, "Wild and Scenic River Considerations for McCloud River," evaluates potential effects of the SLWRI on the McCloud River.

Indian Trust Assets

When adverse impacts on Indian Trust Assets (ITA) cannot be avoided, appropriate mitigation or compensation will be provided. ITAs consist of lands that have been deeded to tribes or upon which tribes have a historical legal claim. However, there are no such lands within the primary study area; for this reason, it was determined that the SLWRI would have no impact on ITAs. Because ITAs have been evaluated and the SLWRI would have no impact on these resources, the SLWRI would comply with ITAs.

Executive Order 11988 (Flood Hazard Policy)

As discussed in Chapter 6, "Hydrology, Hydraulics, and Water Management," all of the action alternatives would have an effect on floodplains in the study area. However, the proposed action would not increase flood flows, and feasible mitigation would be implemented to compensate for the impact of altered flow on riparian and wetland communities.

Executive Order 11990 (Protection of Wetlands)

As discussed in Chapter 12, "Botanical Resources and Wetlands," a wetland delineation will be prepared for the proposed action and a USACE Section 404 permit will be obtained before construction. The project would identify the location of sensitive habitats by conducting a wetland delineation, avoid and minimize impacts to the extent feasible, and compensate for any losses. However, implementation of any of the action alternatives would result in significant and unavoidable impacts on wetlands.

Executive Order 12898 (Environmental Justice Policy)

As discussed in Chapter 24, "Environmental Justice," the disturbance or loss of resources associated with locations considered by the Winnemem Wintu and Pit River Madesi Band members to have religious and cultural significance would result in a disproportionately high and adverse effect on Native American populations in the vicinity of Shasta Lake. Therefore, the project would contribute to disproportionate placement of environmental impacts on Native American populations and would result in a cumulatively considerable incremental contribution to a significant and unavoidable cumulative impact. No feasible mitigation is available to reduce this high and adverse effect. Compliance with Executive Order 12898 occurs through the identification of this effect and the lack of feasible mitigation measures available to reduce it.

Executive Order 13007 (Indian Sacred Sites) and April 29, 1994, Executive Memorandum

The Native American Heritage Commission was contacted to identify whether any recorded sacred sites were situated within the primary study area and to obtain a recommended list of Native Americans to contact regarding the proposed action. Potential impacts of the proposed action on Indian sacred sites are addressed in Chapter 14, "Cultural Resources." Reclamation will continue to coordinate with the Native American Heritage Commission and Native American contacts to address potential impacts on sacred sites.

Executive Order 13112 (National Invasive Species Management Plan)

A weed management plan is within the scope of the proposed action and would include methods for managing the spread of invasive plant species. Because the details of the weed management plan have not been finalized at the time of this writing, this PDEIS identifies preparation and implementation of a weed management plan as a mitigation measure. Developing and implementing the weed management plan as a mitigation measure demonstrates compliance with Executive Order 13112. Reclamation would demonstrate continued compliance with this executive order by implementing the methods described in the weed management plan.

Federal Transit Administration

This PDEIS evaluates potential groundborne-vibration impacts on sensitive receptors, including the maximum sensitivity of 65 vibration decibels for hospitals, high-technology manufacturing, and laboratory facilities. Some construction activities associated with the action alternatives could result in groundborne vibrations exceeding 65 vibration decibels. However, sensitive receptors would need to be within 250 feet of the activities to be affected and there are no sensitive receptors within this distance. Reclamation has demonstrated consistency with this policy by evaluating the construction activities that would generate the maximum possible groundborne vibration at the highest sensitive uses.

Federal Energy Regulatory Commission

Changes to hydroelectric facilities on the Pit River, including instream flow releases or modifications to downstream structures, may necessitate a license amendment from the Federal Energy Regulatory Commission. Reclamation will support Pacific Gas and Electric Company in any application to the Federal Energy Regulatory Commission for necessary license amendments before implementing any proposed actions that would affect Pit River flows.

U.S. Coast Guard

The SLWRI has the potential to affect several bridges over inflows to Shasta Lake. Coordination with the U.S. Coast Guard will be maintained in respect to these potential impacts.

26.6.2 State Requirements

California Environmental Quality Act

This document has been prepared in accordance with CEQA and may be used by State permitting agencies that would be involved in review and approval of the project.

California Endangered Species Act

Evaluations have been conducted for State-listed endangered and threatened species, and have determined that the proposed action would affect several State-listed species. Effects on those species are discussed in Chapter 11,

"Fisheries and Aquatic Ecosystems"; Chapter 12, "Botanical Resources and Wetlands"; and Chapter 13, "Wildlife Resources." Reclamation will prepare appropriate biological assessments to address potential impacts on Federally listed species, and will consult with DFG regarding impacts of the proposed action on State-listed species.

California Fish and Game Code—Fully Protected Species

This PDEIS identifies potential actions that could result in take of fully protected species, and Reclamation will work closely with DFG to evaluate methods to avoid impacts on fully protected species.

California Fish and Game Code Section 1602—Streambed Alteration

A DFG streambed alteration agreement must be obtained for any project that would result in an impact on a river, stream, or lake. This PDEIS identifies potential actions within the proposed action that would require the alteration of stream features subject to Section 1602 of the California Fish and Game Code. This document requires Reclamation to secure an approved streambed alteration agreement before performing any actions subject to Section 1602.

California Fish and Game Code Sections 5900–5904, 5930–5948, 7261, and 7370 —Fish Passage

This PDEIS identifies potential actions that could result affect fish passage, and Reclamation will work closely with DFG to evaluate methods to avoid impacts on sturgeon, fish passage, and designated "Heritage Trout Waters." Potential impacts on fisheries are described in Chapter 11, "Fisheries and Aquatic Ecosystems."

Central Valley Flood Control Act of 2008

Reclamation has developed the proposed action in a manner that is consistent with the Central Valley Flood Control Act, and that would not inhibit development of the *Central Valley Flood Protection Plan*.

Central Valley Flood Protection Board Encroachment Permit

Certain proposed actions will require work along the Sacramento River in areas that may be subject to Title 23 because the river is managed for flood control and thus contains features subject to the jurisdiction of the Central Valley Flood Protection Board. Reclamation will secure encroachment permits, as needed, to satisfy Title 23 before performing any work along relevant reaches of the Sacramento River that contain flood control features subject to Central Valley Flood Protection Board jurisdiction.

Water Rights

The proposed action would not include any actions that would require acquisition, use, or modification of water rights. Therefore, the proposed action would comply with all existing water rights in the study areas.

California Public Resources Code

The Legislature has declared that the McCloud River, which is within the study area, possessed "extraordinary resources" in the context of the California Public Resources Code, Section 5093.542, established through enactment of the Wild and Scenic Rivers Act, as amended (Sections 5093.50 – 5093.70); however, the Legislature's action stopped short of formally designating the river as wild and scenic. Chapter 25, "Wild and Scenic River Considerations for McCloud River," evaluates potential effects of the proposed action on the McCloud River. New legislation may be required for State support and/or participation in the proposed action.

The California Public Resources Code also contains several other sections relevant to the project. Compliance with provisions of the California Public Resources Code is achieved in this PDEIS by analyzing the impact of proposed actions on recreation opportunities. Chapter 18, "Recreation and Public Access," of this PDEIS discusses effects on Shasta Lake and the surrounding recreation areas under the alternatives.

California Harbors and Navigation Code

Significant modifications to the facilities of Shasta Lake may necessitate coordination with the California Department of Boating and Waterways and/or the U.S. Coast Guard. Reclamation will conduct such coordination as necessary.

Porter-Cologne Water Quality Control Act

Proposed actions that have the potential to adversely affect water quality are identified in this PDEIS. Measures necessary for compliance with the act would need to achieve consistency with implementation programs under the water quality control plan for the Sacramento River basin, and with the Central Valley Regional Water Quality Control Board's waste discharge requirements. Other necessary actions would likely include application for and finalization of National Pollutant Discharge Elimination System permits and Section 401 water quality certifications.

California Land Conservation Act of 1965 (Williamson Act)

Approximately 51 percent of Shasta County's farmland is under Williamson Act contracts (Shasta County 2004). Williamson Act lands affected by the proposed action are discussed in Chapter 10, "Agriculture and Important Farmland."

California Clean Air Act

This PDEIS evaluates the contribution of the proposed action to any violation of air quality standards and identifies mitigation measures to help achieve consistency with the State implementation plan's attainment goal before implementation of any proposed actions.

California Native Plant Protection Act

All proposed actions are evaluated in this PDEIS for consistency with this act. Mitigation measures are provided, as necessary, to minimize potential take of listed and special-status plants under the California Native Plant Protection Act.

California Native Plant Society Species Designations

This PDEIS identifies plants of concern on California Native Plant Society lists that may be affected by proposed actions, using these lists as a method of identifying species of concern. Mitigation and minimization measures will be implemented, as necessary, to reduce the significance of potential impacts on these species of concern.

California Scenic Highway Program

On the south side of Shasta Lake, portions of State Route 151 are an officially designated State Scenic Highway. County Road A18 is an officially designated County Scenic Highway, and is also located on the southern banks of Shasta Lake. Portions of Interstate 5, as it approaches Shasta Lake and crosses the Pit River Bridge, are considered eligible for designation as a State Scenic Highway. Impacts on scenic highways are discussed in Chapter 19, "Aesthetics and Visual Resources."

State Lands Commission Land Use Lease

In the primary study area, the lands under the jurisdiction of the California State Lands Commission include areas along the Sacramento River, north of Red Bluff. Work on the Sacramento River would require a lease from the CLSC. Reclamation will coordinate with the California State Lands Commission and obtain a State Lands Lease before starting work in areas under California State Lands Commission jurisdiction.

California Surface Mining and Reclamation Act

In general, the Surface Mining and Reclamation Act of 1975 (SMARA) requires that the lead agency approve a permit and a reclamation plan and that an approved financial assurance be posted for the reclamation of the mined land. If borrow is required from borrow site(s), not previously permitted under SMARA, Reclamation will either obtain a SMARA permit or an exemption from SMARA for all borrow sites before beginning borrow activities.

State of California General Plan Guidelines

Chapter 8, "Noise and Vibration," evaluates long-term effects on noise levels in the study area. Long-term changes in noise levels associated with any proposed actions would be less than significant. Because Reclamation has evaluated long-term compatibility of noise levels, the proposed action would comply with these guidelines.

California Department of Transportation

Highway improvements or modifications such as may be required under this project may require an encroachment permit as issued through the California

Department of Transportation (Caltrans). The project may involve modifications to roadways that Caltrans considers "complex" and require extensive communication with the Caltrans Department of Engineering Services and/or structure-specific encroachment permits. These are detailed in the *Caltrans Encroachment Permits Manual*, which is available at the Caltrans Web site.

26.6.3 Local Plans and Policies

Shasta County Air Quality Management District's Authority to Construct and Permit to Operate

Reclamation would obtain an Authority to Construct permit before building or installing any new emissions unit or modifying any existing emissions unit that requires a permit, if necessary. Reclamation would also obtain a Permit to Operate after all construction is completed and the emission unit is ready for operation, if needed.

Other Local Permits and Requirements

Several other local permits and requirements may apply to the proposed action. Shasta and Tehama counties and their public works departments will require compliance with local plans and ordinances, such as the county general plan, zoning ordinances, grading plan, and various use permits. Utility easements and various encroachments also may be required.

Chapter 27
Public Involvement, Consultation, and Coordination

This chapter summarizes completed, ongoing, and anticipated public outreach and agency involvement efforts related to development of the SLWRI, including activities that satisfy NEPA requirements for public scoping and agency consultation and coordination. Chapter 29, "EIS Distribution List," lists the entities receiving a copy of the PDEIS. Reclamation encourages review of this PDEIS and will continue to solicit public and agency input on the proposed action.

27.1 Public Involvement Through Project Scoping

Public scoping activities are conducted as part of compliance with both NEPA and CEQA, but are more formalized under NEPA. Scoping allows agencies, stakeholders, organizations, and other interested parties to identify resources to be evaluated, issues that may require environmental review, reasonable alternatives to consider, and potential mitigation if significant adverse effects are identified. The scoping process helps with early identification of problems to be studied, and also helps to eliminate from detailed study issues that are not critical to the decision at hand. Scoping also provides decision makers with insight on the issues and concerns that the public believes should be considered as part of the feasibility study. Public scoping activities performed for the SLWRI environmental documentation process are described below.

27.1.1 Notice of Intent to Propose an Environmental Impact Statement

Reclamation initiated the scoping process by publishing a notice of intent to prepare an Environmental Impact Statement (EIS) and a notice of public scoping meetings pursuant to NEPA on October 7, 2005, in the *Federal Register* (Volume 70, pages 58744–58746). The opportunity for submitting written comments on the notice of intent extended through December 6, 2005.

On the same day that the notice of intent and notice of meetings were published in the *Federal Register*, Reclamation announced the scoping meetings to be held in a news release posted on the project Web site and distributed via e-mail to media in the extended study area. The release was also distributed to agencies, stakeholders, organizations, and other interested parties. A second news release on October 20, 2005, announced an additional scoping meeting to be held in Red Bluff, and was published in display advertisements that

Reclamation purchased in newspapers within the immediate study area in Redding, Red Bluff, and Dunsmuir.

27.1.2 Public Scoping Meetings

In 2005, seven public scoping meetings were conducted in an "open house" format throughout California to update the public on the status of the proposed action and to solicit and receive input on alternatives, project related concerns, and issues to be addressed in the environmental review process (see Table 27-1 for meeting locations and dates). Project team members from Reclamation and its consultants staffed informational workstations and interacted with meeting participants to provide information and answer questions. Attendance ranged from very light at the Fresno and Concord meetings to strong participation at the Dunsmuir, Redding, and Red Bluff meetings (Table 27-1). The proximity to the projects, and advertisements in three local newspapers, likely contributed to a stronger attendance in the northern cities.

Table 27-1. Scoping Meeting Locations and Attendance

Meeting Location	Date	Attendees Signed In
Sacramento	October 24, 2005	10
Concord	October 24, 2005	2
Los Angeles	October 26, 2005	4
Fresno	November 1, 2005	2
Dunsmuir	November 2, 2005	11
Redding	November 3, 2005	39
Red Bluff	November 3, 2005	20
Total		**88**

Source: Reclamation 2006

The meetings were attended by private citizens, Federal and State agency personnel, local government representatives, political representatives, members of the media, Native American groups, and business owners, and representatives of private industry, utilities, environmental interest groups, and nongovernmental organizations.

Displays of information were presented at each meeting on large-scale panels at a series of four workstations. Information included on these panels is summarized as follows:

Background

This workstation described Shasta Dam and Shasta Lake, authorization of the Federal feasibility study and other pertinent guidance, the CALFED Bay-Delta Program Record of Decision (ROD) relating to enlarging Shasta Dam and Shasta Lake, and the primary and extended study areas.

Environmental Overview

This workstation summarized the major resource areas to be evaluated, defined the biological, socioeconomic, physical, and cultural environments, and identified potential impacts on those environments. The workstation also included information on the Federal environmental review process and Federal and State regulatory requirements and processes.

Study Process

This workstation presented information on water resources problems and needs being addressed in the SLWRI environmental documents. The primary and secondary study objectives were identified along with the overall study mission. The workstation also included information about the Federal plan formulation process, including the development of the SLWRI initial alternatives and the formulation of comprehensive alternatives.

Initial Alternatives

This workstation described the initial alternatives formulated, potential major features associated with potential enlargement of Shasta Dam and Shasta Lake that are likely to be considered in future studies, and potential environmental restoration features to be included in the alternatives.

The *Environmental Scoping Report* (Reclamation 2006) describes the scoping process, comments received during scoping, and how these comments would be addressed as part of the SLWRI and in support documentation (e.g. Feasibility Report and EIS).

27.2 Other Public Outreach

In addition to scoping activities, other public outreach activities have included the following:

- Presentations to the Water Education Foundation (multiple years)
- Project update meetings with marina owners in the Shasta Lake area (multiple years)
- Bay-Delta Public Advisory Committee presentations (multiple years)
- Briefings to resource management groups and stakeholders (multiple years)
- Briefing to the Association of California Water Agencies
- Project Web site for the SLWRI (www.usbr.gov/mp/slwri/index.html)

Future meetings will focus primarily on public outreach related to the release of this PDEIS and the subsequent Draft EIS.

27.3 Consultation and Coordination

Reclamation has consulted various public agencies and organizations during the public outreach process and throughout development of the SLWRI PDEIS to obtain feedback on the investigation. Consultations have assisted Reclamation in determining the scope of the PDEIS, developing project components and objectives, identifying the range of alternatives, and defining potential environmental impacts, impact significance, and mitigation measures.

27.3.1 Consultation and Coordination with Agencies

Reclamation conducts ongoing consultation and coordination efforts with agencies. The SLWRI study management structure includes the active participation of numerous cooperating agencies and other stakeholders on a Project Coordination Team (PCT) and Study Management Team and in Technical Working Groups. Cooperating agencies for the SLWRI, pursuant to NEPA, include USFS, Colusa Indian Community Council of the Cachil Dehe Band of Wintun Indians, USACE, and U.S. Department of the Interior, Bureau of Indian Affairs. Other participants in the PCT include USFWS, NMFS, U.S. Department of the Interior, Bureau of Land Management, DWR, DFG, and other Federal and State agencies. These groups were active contributors to the ongoing development and/or review of the alternative plans that are addressed herein and in supporting documentation.

The PCT is among the most effective means of communication between agencies, continuing to provide for regular participation by numerous cooperating agencies. Regularly scheduled bimonthly meetings have been held and continue to be held, for the purpose of project coordination and decision making, with invitations extended to all cooperating agencies and other CALFED Bay-Delta Program agencies and the Central Valley Regional Water Quality Control Board.

Key elements of these coordination activities are the *Planning Aid Memorandum* and *Coordination Act Report*, documents to be issued by USFWS. A draft *Planning Aid Memorandum* outlining areas of potential concern was circulated among the resource agencies in the first quarter of 2007. Development of the *Coordination Act Report* began in summer 2007, with circulation of a draft in 2008.

27.3.2 Consultation and Coordination with Tribal Governments

Consistent with a memorandum from the President on April 29, 1994, Reclamation and the cooperating agencies will continue to actively engage Federally recognized tribal governments in planning and developing the investigation, and will consult with each tribe on a government-to-government basis before taking actions that could affect such tribal governments. Under Federal Trust responsibility, Reclamation will provide full disclosure (benefits and negative impacts) of the project, allow time for tribal review/consultation, and receive comments and/or suggestions for alternatives.

The PCT held several coordination meetings with Federally recognized tribes during 2007 and 2008. Tribes were invited to an informal meeting held on April 4, 2007, in Redding, California, to provide general information about the SLWRI and determine tribal participation interests. Additionally, from August 2007 to November 2008, members of the PCT held six separate meetings with four Federally recognized tribes whose traditional territories overlap with the SLWRI project area. The purposes of the meetings were to solicit, clarify, and document major concerns and issues regarding the SLWRI, and to establish a preferred method or approach for maintaining effective communication with each tribe during the remainder of the feasibility study and in future endeavors.

27.3.3 Coordination with Native American Tribal Groups

In accordance with Executive Order 12898, Native Americans – including Federally-recognized and non-Federally recognized tribes – are considered minority populations, and are encouraged as stakeholder groups to participate in the ongoing investigation. Several groups, such as the Winnemem Wintu and Shasta Nation, have expressed significant interest in the SLWRI. In response, the PCT conducted 10 meetings and dialogues in 2007 and 2008 with Native American groups whose traditional homelands overlap with the SLWRI study area; four of these meetings engaged non-Federally recognized tribes. Groups were invited to an April 4, 2007, informal meeting to receive general information about the SLWRI and to identify their interests for project participation. As with Federally recognized tribes, meetings were held with Native American groups to solicit, clarify, and document major concerns and issues regarding the SLWRI, and to establish each group's preferred method or approach for receiving communications about the SLWRI during the remainder of the study.

27.4 Major Topics of Interest

The focus of interest varied among the outreach activities, but a common theme centered on potential impacts on the Shasta Lake area that could result from enlargement of the reservoir.

The public, stakeholders, and other Federal agencies, and State and local agencies identified several areas of concern during SLWRI meetings and workshops. Key topics included potential adverse effects on cultural resources in the Shasta Lake area; recreation and recreation providers in the Whiskeytown-Shasta-Trinity National Recreation Area; terrestrial special-status species around Shasta Lake, including State-designated fully protected species, aquatic special-status species in the Sacramento River and Sacramento-San Joaquin Delta (including delta smelt); the lower McCloud River and its special designation under California Public Resources Code 5093.542(c); Delta water quality; south Delta water levels; Central Valley hydrology below CVP and SWP facilities and resulting effects on water supplies for water contractors and other water users; and consistency with the CALFED Bay-Delta Program ROD.

These topics are described in more detail in Section 1.6, "Areas of Controversy/Issues to Be Resolved."

27.5 Additional Steps in the Environmental Review Process

This PDEIS will be published for public, stakeholder, and agency review. During this period, stakeholder workshops will be held to present key findings and solicit input.

A Draft EIS will be prepared considering input from stakeholders and the public and results of updated modeling studies. In accordance with NEPA review requirements, the Draft EIS will be circulated for public and agency review and comment for at least 60 days following the date when the U.S. Environmental Protection Agency publishes the notice of availability of weekly receipt of environmental impact statements in the *Federal Register*. Similar to the approach to public scoping, public meetings will be held at that time at various locations statewide to solicit and receive public input on the DEIS. These meetings will be held during the public comment period so that any comments received at the meetings can be addressed in the FEIS. In addition, written comments from the public, reviewing agencies, and stakeholders will be accepted during the public comment period.

An FEIS will be prepared and circulated in accordance with NEPA requirements and will include responses to all comments. When the FEIS is complete, Reclamation will publish the document, and the notice of availability will be printed in the *Federal Register*, which will mark the start of a 60-day waiting period before Reclamation issues its ROD on the investigation. In the ROD, which is the final step in the EIS process, Reclamation will document its decision on which actions, if any, to take to address the primary objectives. It will also describe other risk reduction plans it considered, identify any mitigation plans, and describe factors and comments taken into consideration when making its decision.

To date, CEQA scoping has not been initiated. This process will commence after a State lead agency is identified.

Chapter 28
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Chapter 29
PDEIS Distribution List

This chapter provides an overview of the locations where this PDEIS is available for review and lists the agencies and organizations that received copies of this PDEIS. This list includes agencies and organizations that were involved in the scoping process for the proposed action, requested a copy of the PDEIS, or that may use the PDEIS for discretionary or informational purposes.

29.1 Document Availability

The public distribution of this PDEIS emphasizes the use of electronic media to ensure cost-effective, broad availability to the public and interested parties. This PDEIS is available on the Internet at Reclamation's Web site, <http://www.usbr.gov/mp/slwri/>. The PDEIS is also available for review at the following location:

U.S. Department of the Interior,
Bureau of Reclamation
2800 Cottage Way
Sacramento, CA 95825

29.2 Agencies and Organizations Receiving Copies of the PDEIS

All persons, agencies, and organizations listed in this chapter have been informed of the availability of and locations to obtain the PDEIS. Parties listed below have received an electronic copy of the entire PDEIS and appendices.

29.2.1 Federal and State Agencies

- U.S. Army Corps of Engineers
- U.S. Environmental Protection Agency
- U.S. Fish and Wildlife Service
- U.S. Forest Service
- National Marine Fisheries Service
- California Water Commission

- California Department of Boating and Waterways
- California Department of Conservation
- California Department of Fish and Game
- California Department of Public Health
- California Department of Parks and Recreation
- California Department of Toxic Substances Control
- California Department of Transportation
- California Department of Water Resources
- California Department of Food and Agriculture
- California Department of Forestry and Fire Protection
- California Environmental Protection Agency
- California Highway Patrol
- California Air Resources Board
- California Central Valley Flood Protection Board
- Central Valley Regional Water Quality Control Board
- State Water Resources Control Board
- California Energy Commission
- Delta Protection Commission
- Delta Stewardship Council
- Native American Heritage Commission
- State Lands Commission
- Office of Historic Preservation

29.2.2 Regional and Local Entities

- Shasta County
- Tehama County
- Shasta County Air Quality Management District
- Tehama County Air Quality Management District
- City of Redding
- City of Red Bluff

29.2.3 Other Interested Parties

- California Trout
- Environmental Defense
- Friends of the River
- Natural Heritage Institute
- Natural Resources Defense Council
- Pacific Coast Federation of Fishermen's Association
- Planning and Conservation League
- Sierra Club
- The Bay Institute
- The Nature Conservancy
- Winnemem Wintu
- Association of California Water Agencies
- California Urban Water Agencies
- Central Valley Project Water Association
- Friant Water Authority
- Kern County Water Agency
- Metropolitan Water District of Southern California

- San Luis-Delta Mendota Water Authority
- State Water Contractors
- Westlands Water District

Chapter 30
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Following is a list of persons who contributed to preparation of this PDEIS.

This list is consistent with the requirements set forth in NEPA and CEQA (40 CFR 1502.17 and Section 15129 of the State CEQA Guidelines).

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