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Shasta Lake Water Resources Investigation

Environmental Impact Statement

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

June 2013

Draft Environmental Impact Statement
Shasta Lake Water Resources Investigation

United States Department of the Interior
Bureau of Reclamation, Mid-Pacific Region
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This Draft Environmental Impact Statement (DEIS) 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.

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.

This DEIS 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 Pumping Plant, (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 DEIS 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.

In accordance with NEPA review requirements, this DEIS will be circulated for public and agency review and comment for a 90-day period after the date when the U.S. Environmental Protection Agency publishes the notice of availability in the Federal Register. Written comments from the public, reviewing agencies, and stakeholders will be accepted during the public comment period. Similar to the approach to public scoping, public hearings will be held in various locations statewide to solicit and receive public input on the DEIS. These hearings will be held during the public comment period so that any comments received at the hearings can be addressed in the Final EIS.

For further information, please contact Katrina Chow, Project Manager, at the address above, by telephone at (916) 978-5067, or by e-mail at KChow@usbr.gov.

Shasta Lake Water Resources Investigation, California

Draft
Environmental Impact Statement

Prepared by:

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

U.S. Department of the Interior
Bureau of Reclamation

June 2013

Executive Summary

S.1 Introduction and Background

This Draft Environmental Impact Statement (DEIS) has been prepared as part of the Shasta Lake Water Resources Investigation (SLWRI) to evaluate the potential physical, biological, cultural, and socioeconomic effects of implementing alternatives to modify the existing Shasta Dam and Reservoir, including taking no action. The SLWRI is a feasibility study being conducted by the U.S. Department of the Interior, Bureau of Reclamation (Reclamation), Mid-Pacific Region.

The SLWRI is being conducted consistent with the National Environmental Policy Act (NEPA), the 1983 U.S. Water Resources Council *Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies* (P&G), and other pertinent Federal, State of California (State), and local laws and policies. Reclamation is serving as the Federal lead agency for compliance with NEPA. Cooperating agencies, pursuant to NEPA, include the U.S. Department of Agriculture, 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 Interior, Bureau of Indian Affairs. This document has also been prepared in accordance with the California Environmental Quality Act (CEQA).

Reclamation completed the Draft *SLWRI Feasibility Report* (Draft Feasibility Report), Preliminary DEIS, and related appendices in November 2011. These documents were released to the public in February 2012 to present potential impacts, costs, and benefits of alternatives being evaluated to-date; share information generated since the completion of the *SLWRI Plan Formulation Report* in 2007; and provide an additional opportunity for public and stakeholder input.

Since the release of the Draft Feasibility Report and Preliminary DEIS, SLWRI alternatives were refined based on several factors, including updates to Central Valley Project (CVP) and State Water Project (SWP) water operations and stakeholder input. Water operations modeling and related evaluations for this DEIS were updated to reflect the following:

- The Reclamation 2008 *Biological Assessment on the Continued Long-Term Operations of the CVP and SWP* (2008 OCAP BA)

- The U.S. Department of Interior, Fish and Wildlife Service (USFWS) 2008 *Formal Endangered Species Act Consultation on the Proposed Coordinated Operations of the CVP and SWP* (2008 USFWS Biological Opinion (BO))

- The National Marine Fisheries Service (NMFS) 2009 *BO and Conference Opinion on the Long-Term Operations of the CVP and SWP* (2009 NMFS BO)

- Additional changes in CVP and SWP facilities and operations, such as implementation of the San Joaquin River Restoration Program

Due to shifts in the distribution of project benefits demonstrated in preliminary studies, SLWRI action alternatives were refined to improve the balance of water supply benefits and to provide a greater range in alternative focus and operations. Alternatives refinement is discussed in detail in Chapter 2 and in the Plan Formulation Appendix. This DEIS reflects revised action alternatives and updates to modeling and related analyses and impact evaluations.

S.1.1 Background

Reclamation completed constructing Shasta Dam and Reservoir in 1945. Reclamation operates Shasta Dam and Reservoir, in conjunction with other facilities, to provide flood damage reduction and irrigation and municipal and industrial (M&I) water supply, maintain navigation flows, protect fish in the Sacramento River and the Sacramento-San Joaquin Delta (Delta), and generate hydropower. The Central Valley Project Improvement Act (CVPIA), enacted in 1992, 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. Major modifications to Shasta Dam include construction of a temperature control device (TCD) in 1997 for improved management of water temperatures in the upper Sacramento River.

Shasta Dam Under Construction

Shasta Dam and Reservoir were constructed as an integral element of the CVP, with Shasta Reservoir representing about 41 percent of the total reservoir

storage capacity of the CVP. The 602-foot-tall Shasta Dam (533 feet above the streambed) and 4.55 million-acre-foot (MAF) Shasta Reservoir are located on the upper Sacramento River in Northern California, north of the City of Redding (see Figure S-1) within the Whiskeytown-Shasta-Trinity National Recreation Area (NRA). Shasta Lake supports extensive water-oriented recreation. Recreation within these lands is managed by USFS.

In 2000, as a result of increasing demands for water supplies and growing concerns over declines in ecosystem resources in the Central Valley of California, Reclamation reinitiated a feasibility investigation to evaluate the potential for enlarging Shasta Dam and Reservoir.

Figure S-1. Location of Shasta Dam and Reservoir

S.2 Study Authorization

The SLWRI is being conducted under the authority of Public Law 96-375, which was reaffirmed under Public Law 108-361, also known as the CALFED Bay-Delta Authorization Act. Public Law 96-375 (October 3, 1980) provides feasibility study authority for the SLWRI and allows the Secretary of the Interior to:

> *…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:

> *…(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 conduct feasibility studies of expanding CVP storage in Shasta Lake to:

> *…increase the pool of cold water available to maintain lower Sacramento River temperatures needed by certain fish and provide other water management benefits, such as water supply reliability.*

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 NRA, which includes Shasta Dam and Reservoir. Public Law 102-575, the CVPIA, directed numerous changes to the 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.

S.3 Intended Use of Environmental Impact Statement

The purpose of an Environmental Impact Statement (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. An EIS identifies and evaluates proposed action alternatives that meet the project objectives, analyzes the potential environmental effects, and identifies measures to reduce or avoid potential environmental effects resulting from the action alternatives (i.e., mitigation measures). An EIS also must disclose adverse environmental impacts that cannot be avoided, cumulative impacts, the relationship of short-term uses and long-term productivity, and irreversible and irretrievable commitments of resources. In addition, NEPA requires that an EIS consider indirect effects of a project, which are often the result of growth inducement.

The Draft EIS is being circulated for review and comment by agencies, stakeholders, and the public to inform and engage interested persons in the planning and NEPA processes. Comments received during the public review period will be considered, and responses to comments will be included in the Final EIS. Continued public outreach, including public hearings, will be conducted before completion of the Final EIS.

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 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.4 Purpose and Need/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 2010 Association of Environmental Professionals *CEQA Statute and Guidelines* require a clearly written statement of objectives, including the underlying purpose of a proposed project (Section 15124(b)), also described below.

S.4.1 Project Purpose and Objectives

Project Purpose

The purpose of the proposed action is to improve operational flexibility of the Delta watershed system through modifying the existing Shasta Dam and Reservoir to meet specified primary and secondary project objectives.

Project Objectives

Two primary project objectives (also referred to as planning objectives) and five secondary project objectives were developed for the SLWRI.

Primary Project Objectives

- Increase the survival of anadromous fish populations in the Sacramento River, primarily upstream from Red Bluff Pumping Plant (RBPP)
- 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

Secondary Project 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

Primary project objectives are those which specific alternatives are formulated to address. The two 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 are considered to the extent possible through pursuit of the primary project objectives.

S.4.2 Project Need

The need for the proposed action is described below and summarized from the 2004 Reclamation *SLWRI Initial Alternatives Information Report*, the 2007 Reclamation *SLWRI Plan Formulation Report*, the 2011 Draft Feasibility Report (released in 2012), and the Plan Formulation Appendix.

Anadromous Fish Survival

The Sacramento River system 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 critical years,[1] is a critical factor affecting the abundance of Chinook salmon and steelhead in the river. Water temperatures that are too high or, less commonly, too low, can be detrimental to the various life stages of Chinook salmon. Elevated water temperatures can negatively impact holding and spawning adults, egg viability and incubation, preemergent fry, and rearing juveniles and smolts, significantly diminishing the next generation of returning spawners. Stress caused by high water temperatures also may reduce the resistance of fish to parasites, disease, and pollutants. Releases of cold water from Shasta Reservoir can improve seasonal water temperatures in the Sacramento River downstream from Shasta Dam for anadromous fish during critical periods.

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 structural changes at Shasta Dam. Despite these steps, additional actions are needed to address anadromous fish survival in the upper Sacramento River.

Water Supply Reliability

Demands for water in 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 that have resulted in unmet water demands and subsequent increases in competition for water supplies among urban, agricultural, and environmental uses. The California Department of Water Resources (DWR) 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 critical 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

[1] Throughout this document, water year types are defined according to the Sacramento Valley Index Water Year Hydrologic Classification unless specified otherwise.

was established to evaluate the potential to improve water supply reliability, primarily by modifying Shasta Dam and enlarging Shasta Lake.

Ecosystem Resources

The quantity, quality, diversity, and connectivity of riparian, wetland, floodplain, and shaded riverine habitat in the Sacramento River ecosystem have been severely limited through confinement of the river system by levees, reclamation of adjacent lands for farming, bank protection, construction of dams and reservoirs, channel stabilization, and land development. This has contributed to a decline in habitat and native species populations. Ecosystem restoration along the Sacramento River has been the focus of several ongoing programs, including the Senate Bill 1086 Program, CVPIA, CALFED, Central Valley Habitat Joint Venture, and numerous local programs within the Central Valley. Despite these efforts, a significant need remains to conserve and restore ecosystem resources along the Sacramento River.

Flood Management

Communities and agricultural lands in the Central Valley are subject to flooding along the Sacramento River that poses risks to human life, health, safety, and property. Physical impacts from flooding include damage to buildings, contents, automobiles, agricultural crops, and equipment. Threats from flooding are caused by many factors, including overtopping or sudden failures of levees, which can result in deep and rapid flooding with little warning. In addition, urban development in flood-prone areas has exposed the public to the risk of flooding.

Hydropower

Although California is the most energy-efficient state per capita in the Nation, demands for electricity are growing at a rapid pace. Over the next 10 years, California's peak demand for electricity is expected to increase 30 percent, from about 50,000 megawatts (MW) to about 65,000 MW. In addition, Executive Orders S-14-08 and S-21-09, issued in 2008 and 2009, respectively, established a goal of using renewable energy sources, including hydropower, for 33 percent of the State's energy consumption by 2020. This has created even greater needs for new electrical energy supplies, particularly clean energy sources, such as hydropower.

Recreation

As California's population continues to grow, demands will increase substantially for water-oriented recreation at and near the lakes, reservoirs, streams, and rivers of the Central Valley. Further increases in demand, accompanied by relatively static recreation resources, will cause issues at existing recreation areas. These challenges will be especially pronounced at Shasta Lake, which is one of the most visited recreation destinations in the state and in the region. Even under current levels of demand, USFS, which manages recreation at Shasta Lake, has expressed concern about seasonal capacity problems at existing marinas and USFS facilities. A substantial and increasing

need exists to improve recreation-related facilities and conditions at Shasta Lake.

Water Quality

The Sacramento River and the Delta support fish and wildlife while providing water supplies for urban, agricultural, and environmental uses across the state. Saltwater intrusion, municipal discharges, agricultural drainage, and water project flows and diversions have led to water quality issues within the Delta, particularly related to salinity. In the Sacramento River, urban and agricultural runoff, and runoff and seepage from abandoned mining operations, have resulted in elevated levels of pesticides, phosphorous, mercury, and other metals. Additional operational flexibility could provide opportunities to improve Sacramento River and Delta water quality conditions.

S.5 Study Area

Present Shasta Dam

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. As shown in Figure S-2, 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 RBPP, including tributaries at their confluence. The extended study area includes the Sacramento River downstream from the RBPP, including portions of the American and Feather river basins downstream from CVP/SWP facilities; the 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 CVP and SWP facilities and water service areas (shown in Figure S-3).

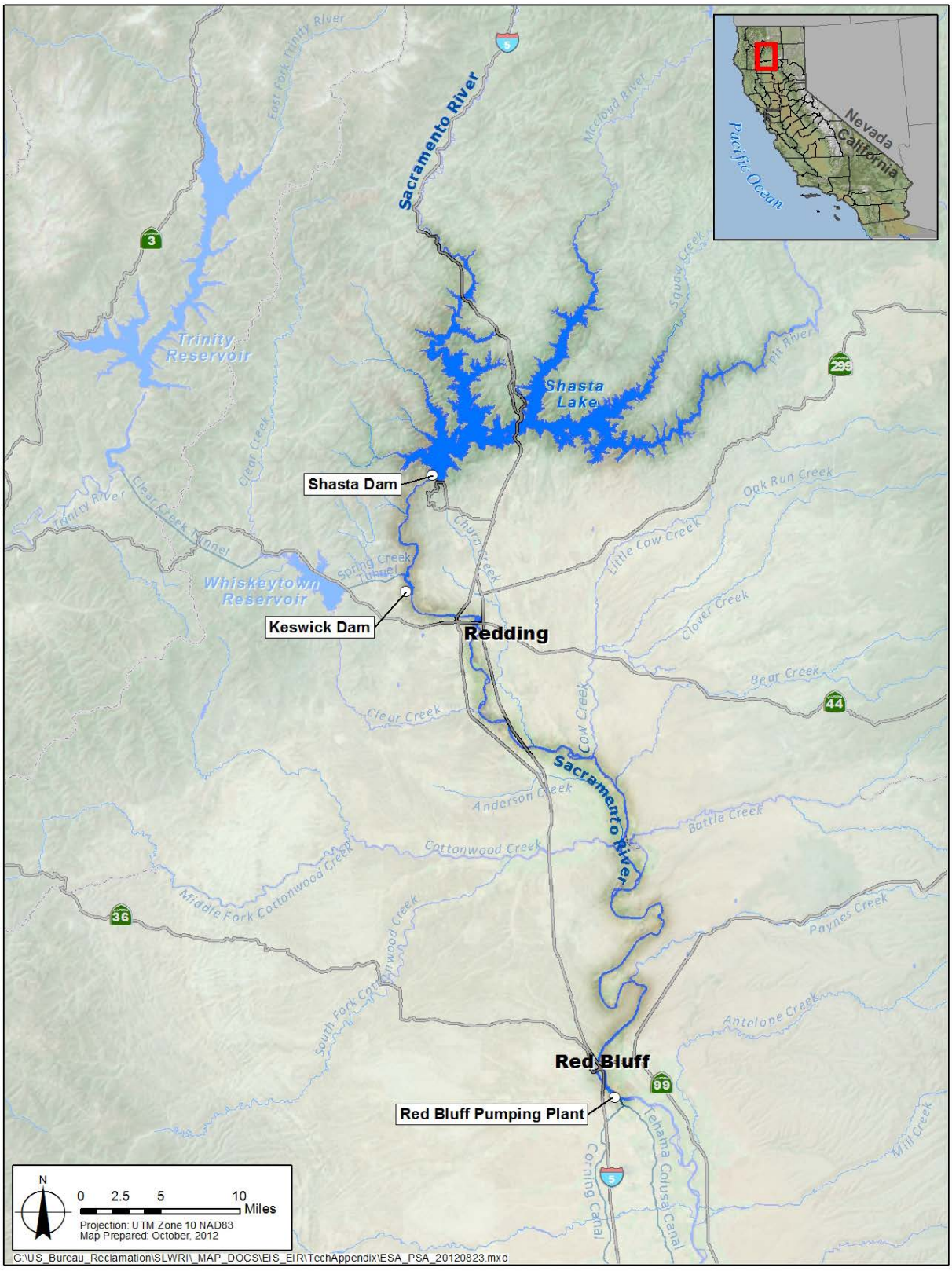

Figure S-2. Primary Study Area – Shasta Lake Area and Sacramento River from Shasta Dam to Red Bluff Pumping Plant

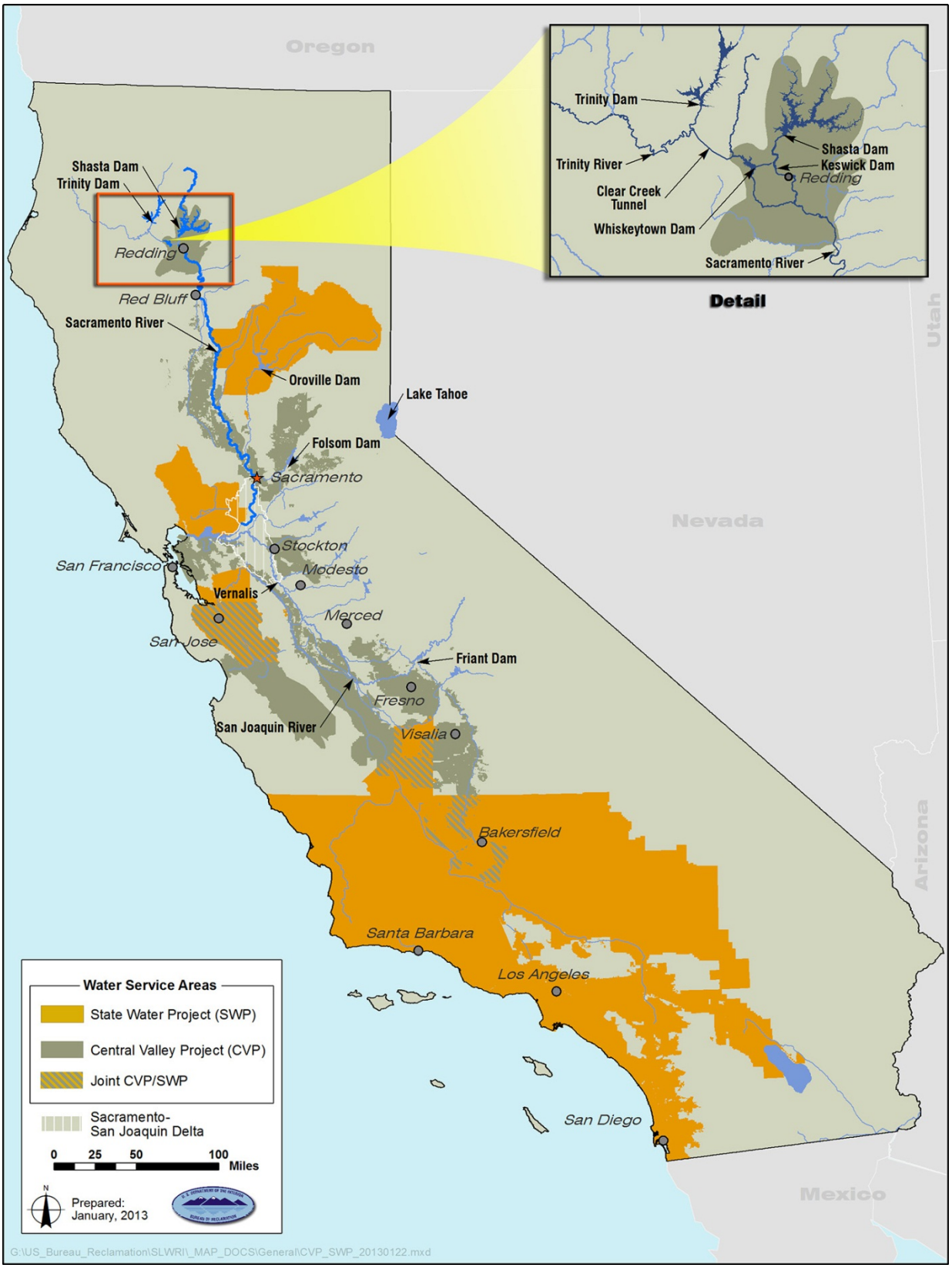

Figure S-3. Central Valley Project and State Water Project Facilities and Water Service Areas

S.6 Summary Description of Alternatives

Consistent with NEPA and the P&Gs, the plan formulation process for the SLWRI was divided into multiple phases, as shown in Figure S-4. Through this process, five comprehensive plans (i.e., action alternatives) were formulated in addition to a No-Action Alternative. Each of the five comprehensive plans includes enlarging Shasta Dam and Reservoir and a variety of management measures to address, in varying degrees, all of the project objectives. All of the comprehensive plans include eight common management measures:

- **Enlarge Shasta Lake cold-water pool** – All action alternatives would involve enlarging the cold-water pool by raising Shasta Dam to enlarge Shasta Reservoir.

- **Modify the TCD** – Minimum modifications to the TCD under all action alternatives would include raising the existing structure and modifying the shutter control.

- **Increase conservation storage** – All action alternatives would increase the conservation storage in Shasta Reservoir by raising Shasta Dam.

- **Reduce water demand** – All action alternatives would include an additional water conservation program for new water supplies created by the project to augment current water use efficiency practices.

- **Modify flood operations** – 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.

- **Modify hydropower facilities** – Enlarging Shasta Dam would require various modifications to the dam's existing hydropower facilities to enable their continued efficient use.

- **Maintain and increase recreation opportunities** – Recreation is important to the Shasta Lake region; therefore, existing recreation opportunities would be maintained and/or increased under all action alternatives.

- **Maintain or improve water quality** – 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 additional operational flexibility for responses to Delta emergencies.

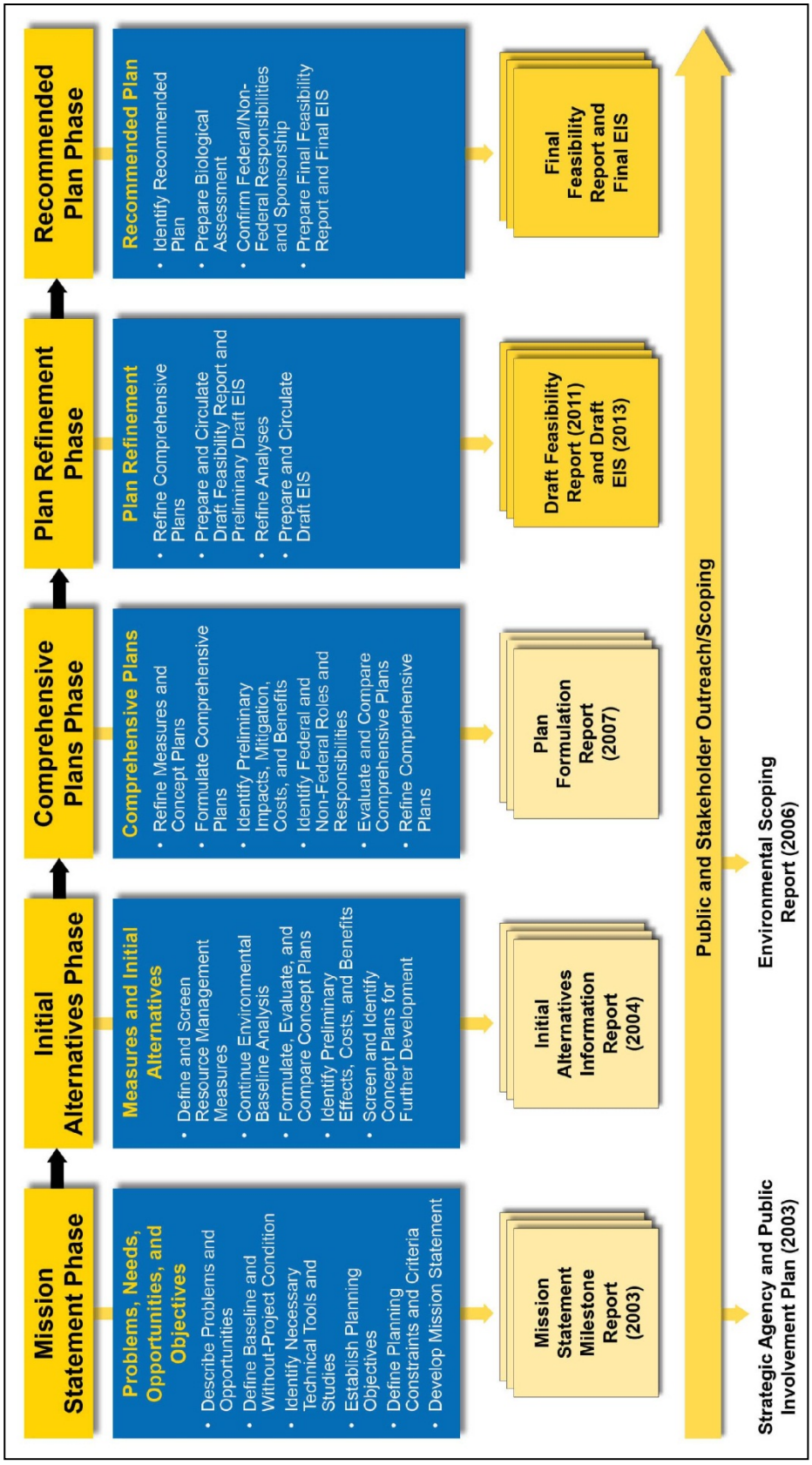

Figure S-4. Plan Formulation Phases

The No-Action Alternative and five comprehensive plans are summarized below.

S.6.1 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. However, the Federal Government 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 project objectives.

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 in 2000. According to the 2009 NMFS *Public Draft Recovery Plan,* prolonged drought that depletes the cold-water pool in Shasta Reservoir could place populations of anadromous fish at risk of severe population decline or extirpation in the long-term. Under the No-Action Alternative, it is assumed that actions to protect fisheries and benefit aquatic environments would continue, including maintaining the TCD, ongoing spawning gravel augmentation programs, 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

Under the No-Action Alternative, the Federal Government would continue to implement reasonably foreseeable actions, but would not take additional actions to help restore ecosystem resources, develop additional hydropower generation,

reduce flood damage, increase recreation opportunities at Shasta Lake, or improve water quality in the Sacramento River and the Delta. This would result in the following conditions:

- As opportunities arise, some 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 threat of flooding would continue, and may increase as population growth continues.
- California's demand for electricity is expected to increase substantially in the future. No actions would be taken to help meet this growing demand.
- As California's population continues to grow, demands would grow substantially 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, several environmental flow goals have been established through legal mandates. Despite these efforts, these resources would continue to decline and ecosystems would continue to be impacted.

S.6.2 Comprehensive Plan 1 (CP1) – 6.5-Foot Dam Raise, Anadromous Fish Survival and Water Supply Reliability

CP1 focuses on both anadromous fish survival and water supply reliability. This alternative primarily 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 (based on the National Geodetic Vertical Datum 1929

CP1	
Dam Raise	*6.5 feet*
Increased Storage	*256,000 acre-feet*
Focus	*Anadromous Fish Survival & Water Supply Reliability*
Major Components	*Dam Modifications & Reservoir Area Relocations*
	Mitigation Measures

(NGVD29)),[2] in combination with spillway modifications, this alternative would increase the height of the reservoir's full pool by 8.5 feet. 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.

Under CP1, the additional storage in Shasta Reservoir would be used to increase water supply reliability and to expand the cold-water pool for downstream anadromous fisheries. Enlarging Shasta Reservoir would increase the depth and volume of the cold-water pool, increasing the ability of Reclamation to release cold water from Shasta Dam and regulate seasonal water temperatures for fish in the upper Sacramento River during critical periods. This alternative (and all action alternatives) includes extending the existing TCD for efficient use of the expanded cold-water pool. CP1 would increase water supply reliability for agricultural, M&I, and environmental purposes. CP1 would also help reduce future water shortages through increasing irrigation and M&I deliveries, primarily during drought periods.

CP1 also addresses secondary planning objectives related to hydropower generation, recreation, flood damage reduction, ecosystem restoration, and water quality. Higher water surface elevations in the reservoir would result in an increase in power generation. CP1 includes features to at least maintain the existing recreation capacity at Shasta Lake, and water-oriented recreation experiences would be enhanced due to an increase in average lake surface area, reduced drawdown during the recreation season, and modernization of recreation facilities. 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, and increased flexibility to meet flow and temperature requirements, could also enhance overall ecosystem resources in the Sacramento River. Additional storage in Shasta Reservoir would also provide improved operational flexibility for meeting Delta water quality objectives through increased and/or high-flow releases to improve Delta water quality.

Operations for water supply, hydropower, and environmental and other regulatory requirements would be similar to existing operations, except during dry and critical years when a portion of the increased storage in Shasta Reservoir would be reserved to specifically focus on increasing M&I deliveries. In dry years, 70,000 acre-feet of the 256,000 acre-feet increased storage capacity in Shasta Reservoir would be reserved for increasing M&I deliveries. In critical years, 35,000 acre-feet of the increased storage capacity would be reserved for increasing M&I deliveries.

[2] Dam crest elevations are based on NGVD29. All current feasibility-level designs and figures for Shasta Dam and appurtenant structures are based on NGVD29.

S.6.3 Comprehensive Plan 2 (CP2) – 12.5-Foot Dam Raise, Anadromous Fish Survival and Water Supply Reliability

CP2	
Dam Raise	*12.5 feet*
Increased Storage	*443,000 acre-feet*
Focus	*Anadromous Fish Survival & Water Supply Reliability*
Major Components	*Dam Modifications & Reservoir Area Relocations*
	Mitigation Measures

CP2 focuses on both anadromous fish survival and water supply reliability. This alternative primarily 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 (NGVD29), in combination with spillway modifications, 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, the additional storage in Shasta Reservoir would be used to increase water supply reliability and to expand the cold-water pool for downstream anadromous fisheries. CP2 would increase the ability of Shasta Dam to regulate seasonal water temperatures for fish, primarily during critical periods, and would increase water supply reliability for agricultural, M&I, and environmental purposes. CP2 would also help reduce future water shortages through increasing irrigation and M&I deliveries, primarily during drought periods.

CP2 also addresses secondary planning objectives related to hydropower generation, recreation, flood damage reduction, ecosystem restoration, and water quality. Higher water surface elevations in the reservoir would result in an increase in power generation. CP2 includes features to at least maintain the existing recreation capacity at Shasta Lake, and water-oriented recreation experiences would be enhanced due to an increase in average lake surface area, reduced drawdown during the recreation season, and modernization of recreation facilities. 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 CP2, and increased flexibility to meet flow and temperature requirements, could also enhance overall ecosystem resources in the Sacramento River. Additional storage in Shasta Reservoir would also provide improved operational flexibility for meeting Delta water quality objectives through increased and/or high-flow releases to improve Delta water quality.

Operations for water supply, hydropower, and environmental and other regulatory requirements would be similar to existing operations, except during dry and critical years when a portion of the increased storage in Shasta Reservoir would be reserved to specifically focus on increasing M&I deliveries. In dry years, 120,000 acre-feet of the 443,000 acre-feet increased storage capacity in Shasta Reservoir would be reserved for increasing M&I deliveries. In critical years, 60,000 acre-feet of the increased storage capacity would be reserved for increasing M&I deliveries.

S.6.4 Comprehensive Plan (CP3) – 18.5-Foot Dam Raise, Agricultural Water Supply Reliability and Anadromous Fish Survival

CP3 focuses on both agricultural water supply reliability and anadromous fish survival. This alternative primarily 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.

CP3	
Dam Raise	*18.5 feet*
Increased Storage	*634,000 acre-feet*
Focus	*Agricultural Water Supply Reliability & Anadromous Fish Survival*
Major Components	*Dam Modifications & Reservoir Area Relocations*
	Mitigation Measures

By raising Shasta Dam from a crest at elevation 1,077.5 to elevation 1,096.0 (NGVD29), in combination with spillway modifications, 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 tunnels.

Because CP3 focuses on increasing agricultural water supply reliability and anadromous fish survival, none of the increased storage capacity in Shasta Reservoir would be reserved for increasing M&I deliveries. Operations for water supply, hydropower, and environmental and other regulatory requirements would be similar to existing operations. The additional storage would be retained for water supply reliability and to expand the cold-water pool for downstream anadromous fisheries. CP3 would increase the ability of Shasta Dam to regulate seasonal water temperatures for fish, primarily during critical periods, and would increase water supply reliability for agricultural, M&I, and environmental purposes. CP3 would also help reduce future water shortages through increasing irrigation deliveries.

CP3 also addresses secondary planning objectives related to hydropower generation, recreation, flood damage reduction, ecosystem restoration, and water quality. Higher water surface elevations in the reservoir would result in an increase in power generation. CP3 includes features to at least maintain the existing recreation capacity at Shasta Lake, and water-oriented recreation experiences would be enhanced due to an increase in average lake surface area, reduced drawdown during the recreation season, and modernization of recreation facilities. 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 CP3, and increased flexibility to meet flow and temperature requirements, could also enhance overall ecosystem resources in the Sacramento River. Additional storage in Shasta Reservoir would also provide improved operational flexibility for meeting Delta water quality objectives through increased and/or high-flow releases to improve Delta water quality.

S.6.5 Comprehensive Plan 4 (CP4) – 18.5-Foot Dam Raise, Anadromous Fish Survival Focus with Water Supply Reliability

CP4 focuses on increasing anadromous fish survival, while also increasing water supply reliability. This alternative primarily 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. In addition, CP4 would dedicate a portion of the increased storage in Shasta Reservoir for maintaining cold-water volumes to benefit anadromous fish in the upper Sacramento River. CP4 also includes two additional ecosystem restoration features: (1) augmenting spawning gravel in the upper Sacramento River at targeted locations to provide either immediate spawning habitat or long-term recruitment, and (2) restoring riparian, floodplain, and side channel habitat in the upper Sacramento River to provide rearing habitat for juvenile salmonids.

CP4	
Dam Raise	*18.5 feet*
Increased Storage	*634,000 acre-feet*
Focus	*Anadromous Fish Survival with Water Supply Reliability*
Major Components	*Dam Modifications & Reservoir Area Relocations*
	Adaptive Management (Reserving 378,000 acre-feet of Storage for Cold-Water Pool)
	Augment Spawning Gravel
	Restore Riparian, Floodplain, & Side Channel Habitat
	Mitigation Measures

The additional storage created by the 18.5-foot dam raise would be used to improve the ability to meet water temperature objectives and habitat requirements for anadromous fish during drought years and increase water

supply reliability. By raising Shasta Dam from a crest at elevation 1,077.5 to elevation 1,096.0 (NGVD29), in combination with spillway modifications, CP4 would increase the overall full pool storage from 4.55 MAF to 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 of 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. Operations for the remaining portion of increased storage (approximately 256,000 acre-feet) would be the same as for CP1, with 70,000 acre-feet reserved in dry years and 35,000 acre-feet reserved in critical years to specifically focus on increasing M&I deliveries.

CP4 also addresses secondary planning objectives related to hydropower generation, recreation, flood damage reduction, ecosystem restoration, and water quality. Higher water surface elevations in the reservoir would result in an increase in power generation. CP4 includes features to at least maintain the existing recreation capacity at Shasta Lake, and water-oriented recreation experiences would be enhanced due to an increase in average lake surface area, reduced drawdown during the recreation season, and modernization of recreation facilities. 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 CP4, and increased flexibility to meet flow and temperature requirements, could also enhance overall ecosystem resources in the Sacramento River. Additional storage in Shasta Reservoir would also provide improved operational flexibility for meeting Delta water quality objectives through increased and/or high-flow releases to improve Delta water quality.

S.6.6 Comprehensive Plan 5 (CP5) – 18.5-Foot Dam Raise, Combination Plan

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 RBPP, and increased recreation opportunities around Shasta Lake. This alternative primarily consists of raising

CP5	
Dam Raise	*18.5 feet*
Increased Storage	*634,000 acre-feet*
Focus	*Water Supply Reliability, Anadromous Fish Survival, Ecosystem Restoration, and Recreation*
Major Components	*Dam Modifications & Reservoir Area Relocations*
	Construct Resident Fish Habitat at Shasta Lake & along Tributaries
	Augment Spawning Gravel
	Restore Riparian, Floodplain, & Side Channel Habitat
	Increase Recreation Opportunities
	Mitigation Measures

Shasta Dam 18.5 feet; implementing the set of eight common management measures described above; 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; and increasing recreation opportunities at Shasta Lake. By raising Shasta Dam from a crest at elevation 1,077.5 to elevation 1,096.0 (NGVD29), in combination with spillway modifications, CP5 would increase the height of the reservoir's full pool by 20.5 feet, increasing the overall full pool storage from 4.55 MAF to 5.19 MAF.

Under CP5, the additional storage in Shasta Reservoir would be used to increase water supply reliability and to expand the cold-water pool for downstream anadromous fisheries. Enlarging Shasta Reservoir would increase the depth and volume of the cold-water pool, increasing the ability of Reclamation to release cold water from Shasta Dam and regulate seasonal water temperatures for fish in the upper Sacramento River during critical periods. This alternative (and all action alternatives) includes extending the existing TCD for efficient use of the expanded cold-water pool. CP5 would increase water supply reliability for agricultural, M&I, and environmental purposes. CP5 would also help reduce future water shortages through increasing irrigation and M&I deliveries, primarily during drought periods.

CP5 also addresses secondary planning objectives related to hydropower generation, recreation, flood damage reduction, ecosystem restoration, and water quality. Higher water surface elevations in the reservoir would result in an increase in power generation. CP5 includes features to at least maintain the existing recreation capacity at Shasta Lake, and water-oriented recreation experiences would be enhanced due to an increase in average lake surface area, reduced drawdown during the recreation season, and modernization of recreation facilities. 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 CP5, and increased flexibility to meet flow and temperature requirements, could also enhance overall ecosystem resources in the Sacramento River. Additional storage in Shasta Reservoir would also provide improved operational flexibility for meeting Delta water quality objectives through increased and/or high-flow releases to improve Delta water quality.

Operations for water supply, hydropower, and environmental and other regulatory requirements would be similar to existing operations, except during dry and critical years when a portion of the increased storage in Shasta Reservoir would be reserved to specifically focus on increasing M&I deliveries. In dry years, 150,000 acre-feet of the 634,000 acre-feet increased storage capacity in Shasta Reservoir would be reserved for increasing M&I deliveries.

In critical years, 75,000 acre-feet of the increased storage capacity would be reserved for increasing M&I deliveries.

S.6.7 Summary of Comprehensive Plan Physical Features and Benefits

The following sections describe the physical features and potential benefits of comprehensive plans (action alternatives) evaluated in this DEIS.

Physical Features

Each of the comprehensive plans (action alternatives) involves raising Shasta Dam by 6.5 feet to 18.5 feet, increasing the storage capacity in Shasta Reservoir by 256,000 acre-feet to 634,000 acre-feet, and constructing a common set of features, as shown in Table S-1. Features and related construction activities under all comprehensive plans would include the following:

- Clearing vegetation 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

CP4 and CP5 would also include features and related construction activities associated with gravel augmentation and restoring riparian, floodplain, and side channel habitat along the upper Sacramento River. Additional features and related construction activities associated with Shasta Lake and tributary shoreline enhancements and features to increase Shasta Lake recreation opportunities are included under CP5. Figure S-5 illustrates major features in the Shasta Lake area common to all comprehensive plans.

Benefits

For all of the comprehensive plans, the additional storage would be used to increase the ability of Reclamation to regulate water temperatures for anadromous fish and increase water supply reliability, primarily in drought periods. Table S-2 summarizes the potential benefits for each project objective for each comprehensive plan. As shown in Table S-2, each of the comprehensive plans would contribute in varying degrees to all of the primary and secondary planning objectives.

Table S-1. Summary of Physical Features of Action Alternatives

	Action Alternatives				
Main Features	**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 Dam Crest (feet)[1]	1084.0	1090.0	1096.0	1096.0	1096.0
Elevation of Full Pool (feet)[2]	1,078.2	1,084.2	1,090.2	1,090.2	1,090.2
Capacity Increase (acre-feet)	256,000	443,000	634,000	634,000	634,000
Main Dam	Raise dam crest. Construct new parapets and utility gallery. Raise existing elevator tower and hoist tower.	Raise dam crest. Construct new parapets and utility gallery. Raise existing elevator tower and hoist tower.	Raise dam crest. Construct new parapets and utility gallery. Raise existing elevator tower and hoist tower.	Raise dam crest. Construct new parapets and utility gallery. Raise existing elevator tower and hoist tower.	Raise dam crest. Construct new parapets and utility gallery. Raise existing elevator tower and hoist tower.
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.
River Outlets	Replace 4 lower-tier tube valves with jet flow gates.	Replace 4 lower-tier tube valves with jet flow gates.	Replace 4 lower-tier tube valves with jet flow gates.	Replace 4 lower-tier tube valves with jet flow gates.	Replace 4 lower-tier tube valves with jet flow gates.
Temperature Control Device	Raise/modify controls.	Raise/modify controls.	Raise/modify controls.	Raise/modify controls.	Raise/modify controls.
Shasta Powerplant/Penstocks	Raise penstock hoists.	Raise penstock hoists.	Raise penstock hoists.	Raise penstock hoists.	Raise penstock hoists.
Pit 7 Dam/Powerhouse	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 Clearing	Clear 150 acres completely and 220 acres with overstory removal.	Clear 240 acres completely and 350 acres with overstory removal.	Clear 340 acres completely and 500 acres with overstory removal.	Clear 340 acres completely and 500 acres with overstory removal.	Clear 340 acres completely and 500 acres with overstory removal.
Reservoir Area Dikes and Railroad Embankments	Construct 3 railroad embankments and 2 new dikes.	Construct 3 railroad embankments and 3 new dikes.	Construct 3 railroad embankments and 4 new dikes.	Construct 3 railroad embankments and 4 new dikes.	Construct 3 railroad embankments and 4 new dikes.

Table S-1. Summary of Physical Features of Action Alternatives (contd.)

	Action Alternatives				
Main Features	**CP1**	**CP2**	**CP3**	**CP4**	**CP5**
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
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	Relocate 2 bridges and realign track in-between, modify 1 bridge	Relocate 2 bridges and realign track in-between, modify 1 bridge	Relocate 2 bridges and realign track in-between, modify 1 bridge	Relocate 2 bridges and realign track in-between, modify 1 bridge	Relocate 2 bridges and realign track in-between, modify 1 bridge
Recreation Facilities	Modify or replace 9 marinas, 6 public boat ramps, 6 resorts, 202 campsites/day-use sites/RV sites, 2 USFS facilities, 8.1 miles of trail, and 2 trailheads.	Modify or replace 9 marinas, 6 public boat ramps, 6 resorts, 261 campsites/ day-use sites/RV sites, 2 USFS facilities, 9.9 miles of trail, and 2 trailheads.	Modify or replace 9 marinas, 6 public 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 public 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 public 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 and 18 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 riparian, floodplain, and side channel habitat along the upper Sacramento River.	Construct shoreline fish habitat around Shasta Lake. Enhance aquatic habitat in tributaries to Shasta Lake to improve fish passage. Augment spawning gravel in the upper Sacramento River at the rate of up to 10,000 tons per year. Restore riparian, floodplain, and side channel habitat along the upper Sacramento River.

Notes:
[1] Dam crest elevations are based on the National Geodetic Vertical Datum of 1929 (NGVD29). All current feasibility-level designs and figures for Shasta Dam and appurtenant structures are based on NGVD29.
[2] Full pool elevations are based on the North American Vertical Datum of 1988 (NAVD88), which is 2.66 feet higher than NGVD29. All current feasibility-level designs and figures for reservoir area infrastructure modifications and relocations to accommodate increased water levels are based on a 2001 aerial survey of the reservoir using NAVD88.

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

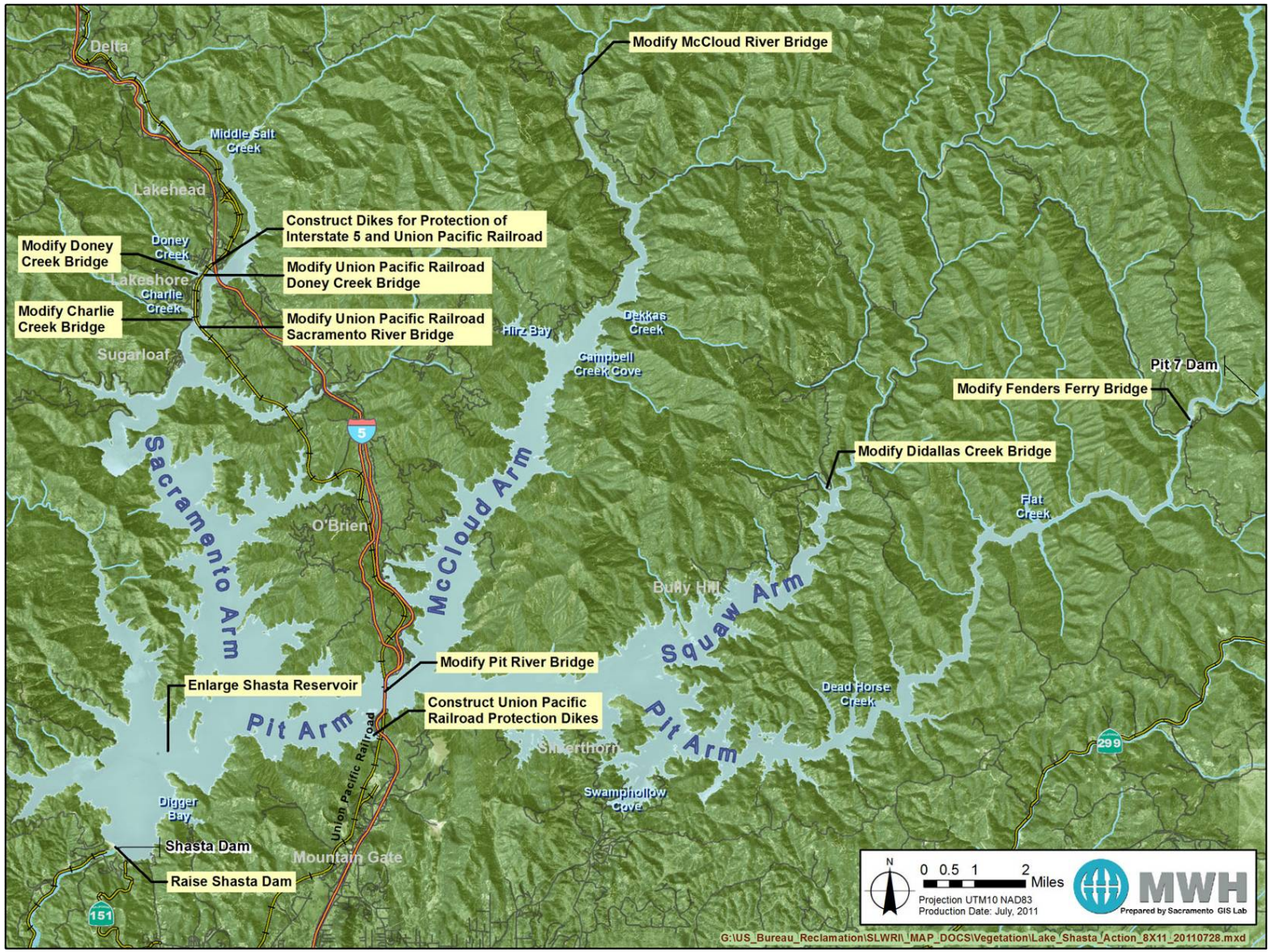

Figure S-5. Major Features Common to All Action Alternatives

Table S-2. Summary of Major Potential Benefits of Action 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 Related to Project Objectives					
Increase Anadromous Fish Survival					
Dedicated Storage (TAF)	-	-	-	378	-
Production Increase (thousand fish)[1]	61	379	207	813	378
Spawning Gravel Augmentation (tons)[2]				10,000	10,000
Side Channel Rearing Habitat Restoration				Yes	Yes
Increase Water Supply Reliability					
Total Increased Firm Water Supplies (TAF/year)[3]	47.3	77.8	63.1	47.3	113.5
Increased Firm Water Supplies NOD (TAF/year)[3]	4.5	10.7	35.2	4.5	25.2
Increased Firm Water Supplies SOD (TAF/year)[3]	42.7	67.1	28.0	42.7	88.3
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)	54	90	90	133	117
Conserve, Restore, and Enhance Ecosystem Resources					
Shoreline Enhancement (acres)	-	-	-	-	130
Tributary Aquatic Habitat Enhancement (miles)[4]	-	-	-	-	6
Riparian, Floodplain, and Side Channel Restoration Habitat	-	-	-	Yes	Yes
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]	89	134	205	370	175
Modernization of Relocated Recreation Facilities	Yes	Yes	Yes	Yes	Yes

Notes:

[1] Average annual increase in juvenile Chinook salmon surviving to migrate downstream from Red Bluff Pumping Plant. Numbers were derived from SALMOD.

[2] Average amount per year for 10-year period.

[3] Total drought period reliability for Central Valley Project and State Water Project deliveries. 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] Annual recreation visitor user days were estimated using two methodologies. The maximum value is reported to capture the largest potential effects from increased visitation. These values do not account for increased visitation due to modernization of recreation facilities associated with all comprehensive plans. Annual visitation for National Economic Development analysis may be refined for the Final Feasibility Report.

Key:

- = not applicable
CP = comprehensive plan
Delta = Sacramento-San Joaquin Delta
GWh/year = gigawatt-hours per year
NOD = north of Delta
SOD = south of Delta
TAF = thousand acre feet

S.7 Alternatives Considered and Eliminated

Formulation of a range of alternatives for evaluation in this feasibility study began with a review of problems, needs, and opportunities identified and defined previously, study authorities, and other pertinent direction, followed by development of primary and secondary planning objectives, and, finally, development of comprehensive plans (action alternatives) to meet the project purpose and need. Some project alternatives suggested during this process (e.g., raising Shasta Dam by up to 200 feet) 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, had extremely high costs, or had high social or environmental impacts.

S.8 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.8.1 Methods and Assumptions

This DEIS 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.

CVP and SWP Operational Assumptions

Reclamation and DWR use CalSim-II, a specific application of the Water Resources Integrated Modeling System (WRIMS) to Central Valley water

operations, to study operations, benefits, and effects of new facilities and operational parameters for the CVP and SWP. In this DEIS, the quantitative assessment of actions related to water resources relied primarily on two CalSim-II baselines for CEQA and NEPA:

- "Existing Conditions," based on a 2005 level of demand and current facilities (a 2005 baseline)
- "Future Conditions (No-Action Alternative)," expected future conditions without the project based on forecasted 2030 demands and reasonably foreseeable future projects and facilities (a 2030 baseline)

For this DEIS, CVP and SWP operational assumptions in CalSim-II were based on operations described in Reclamation's 2008 OCAP BA, the 2008 USFWS BO, the 2009 NMFS BO, and Coordinated Operations Agreement between Reclamation and DWR, as ratified by Congress. These operational assumptions were used to guide refinement, modeling, and evaluation of potential effects of the No-Action Alternative and action alternatives included in this DEIS. Ongoing reconsultation processes for the 2008 USFWS and 2009 NMFS BOs have resulted in some uncertainty in future CVP and SWP operational constraints. In response to lawsuits challenging the 2008 and 2009 BOs, the District Court for the Eastern District of California (District Court) remanded the BOs to USFWS and NMFS in 2010 and 2011, respectively, and subsequently ordered reconsultation and preparation of new BOs. These legal challenges may result in changes to CVP and SWP operational constraints if the revised USFWS and NMFS BOs contain new or amended reasonable and prudent alternatives (RPA).

Despite this uncertainty, the 2008 and 2009 BOs issued by the fishery agencies contain the most recent estimate of potential changes in water operations that could occur in the near future. Furthermore, it is anticipated that the final BOs issued by the resource agencies will contain similar RPAs. However, if ongoing reconsultation results in operational conditions that deviate substantially from the 2008 OCAP BA and the 2008 and 2009 BOs, these changes may be considered in future SLWRI documents.

Climate Change

Council on Environmental Quality (CEQ) 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 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

The 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.

Each resource area analyzed in the DEIS evaluates the effects of comprehensive plans combined with predicted effects of climate change. The ways comprehensive plans could affect GHG production are also addressed. The Climate Change Projection Appendix provides a summary of global climate forecasts and a discussion of the implications of climate change for California water resources. This appendix also includes quantitative analyses of climate change for selected comprehensive plans on resource areas. The discussion of climate change implications provided in the Climate Change Projection Appendix provides context for consideration of cumulative conditions.

S.8.2 Summary of Impacts

The action alternatives would affect environmental resources in the primary and extended study areas. 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. Under CEQA, potentially significant impacts are treated as significant impacts. Therefore, consistent with CEQA, unless feasible mitigation measures have been identified to reduce the magnitude of a significant or potentially significant impact to less than significant, the level of significance after mitigation is considered significant and unavoidable.

Table S-3, 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.8.3 Significant and Unavoidable Impacts

As shown in Table S-3, after consideration of actions, operations, and features to avoid, mitigate, and/or compensate for adverse effects, the action alternatives would likely result in the following significant and unavoidable direct and indirect impacts:

- **Geology, Geomorphology, Minerals, and Soils** – Loss or diminished availability of known mineral resources that would be of future value to the region; lost or diminished soil biomass productivity; and substantial 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 at Shasta Lake and vicinity 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).

- **Botanical Resource** – Loss of Multi-Species Conservation Strategy covered species; loss of USFS sensitive, U.S. Department of Interior, Bureau of Land Management, sensitive, or California Rare Plant Rank 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).

- **Cultural Resources** – Inundation of Traditional Cultural Properties (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).

- **Aesthetics and Visual Resources** – 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 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):

- **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).

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

- **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).

- **Cultural Resources** – Inundation of places of Native American cultural significance (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).

S.8.4 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 and potentially affected public and private landowners, communities, and individuals.

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 (e.g., procedures for stockpiling and staging, public access routes, and construction notification).

- Comply with applicable laws, policies, and plans for this project, including all terms and conditions of all project permits, approvals, and conditions attached thereto.

- Provide relocation assistance services for displaced individuals, families, businesses, and private property owners in accordance with the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, as amended.

- Develop and implement a comprehensive mitigation strategy to minimize potential effects on physical, biological, and socioeconomic resources.

- Implement measures to ensure compliance with the National Historic Preservation Act (NHPA) Section 106 consultation process to avoid, minimize, or mitigate any significant, adverse impacts to cultural resources and historic properties, to the extent possible.

- 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) and when instream flows are managed outside the flood season (e.g., June 15 to September 15).

- Monitor potential impacts to important fishery resources throughout all phases of project construction.

- Implement best management practices to avoid and/or minimize potential impacts to water quality associated with dam construction and the 10-year-long spawning gravel augmentation program.

- 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 Fish and Game Code 5650 Section (a).

S.9 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.9.1 Areas of Controversy

Federal, State, and local stakeholders have identified several areas of controversy during SLWRI public outreach activities, including public scoping activities, agency meetings and workshops, and related ongoing stakeholder outreach activities. Key topics include potential adverse effects on cultural resources in the Shasta Lake area; recreation and recreation providers in the Whiskeytown-Shasta-Trinity NRA; the lower McCloud River and its special designation under California Public Resources Code 5093.542(c); impacts on reservoir area property owners; terrestrial special-status species around Shasta Lake, including State-designated fully protected species; fishery and riparian habitat resources along the upper Sacramento River; aquatic special-status species in the Sacramento River and Delta (including delta smelt); 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; and assumptions on CVP and SWP regulatory constraints based on the 2008 USFWS BO and 2009 NMFS BO (discussed above).

S.9.2 Issues to Be Resolved

Efforts are underway to resolve the following issues described below.

Native American Concerns and Cultural Resources

This DEIS is consistent with the NHPA Section 106, and describes 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 NHPA Section 106 process. No Federally recognized tribes reside in the immediate Shasta Lake area. However, the Winnemem Wintu have raised concerns about potential impacts of enlarging Shasta Dam on sites they value for historic and cultural significance. 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. The scale of these surveys has been limited, and because of a variety of external factors, has 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 action alternatives have been identified near the study area. A comprehensive mitigation strategy is currently under development. 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 project objective. 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, must be in place before the project can operate. Evaluation of water rights for potential enlargement of Shasta Reservoir will remain a focus of Reclamation.

Identification of Preferred Alternative

Consistent with CEQ guidance and NEPA guidelines, the preferred alternative for implementation will be identified in the Final EIS. The following guidance is provided in the 2009 CEQ Draft *Proposed National Objectives, Principles, and Standards for Water and Related Resources Implementation Studies*:

> *Opportunities shall be provided for public reaction and input prior to key study decisions, particularly the tentative and final selection of recommended plans.*

Accordingly, the preferred alternative will be identified in the Final EIS in consideration of public, stakeholder, and agency comments on this DEIS. Ultimately, the alternative that best meets the stated objectives and maximizes net public benefits will be identified with supporting rationale and documentation. The alternative recommended for implementation may or may not be identified as the "Environmentally Preferable Alternative" consistent with NEPA, the "National Economic Development Plan" consistent with the P&Gs, the "Least Environmentally Damaging Practicable Alternative" consistent with the Clean Water Act, and the "Environmentally Superior Alternative" consistent with CEQA.

S.10 Public Involvement and Next Steps

In accordance with NEPA review requirements, this DEIS will be circulated for public and agency review and comment for a 90-day period after 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*. Written comments from the public, reviewing agencies, and stakeholders will be accepted during the public comment period. Similar to the approach to public scoping, public hearings will be held in various locations statewide to solicit and receive public input on the DEIS. These hearings will be held during the public comment period so that any comments received at the hearings can be addressed in the Final EIS.

A Final EIS will be prepared and circulated in accordance with NEPA requirements and will include responses to all comments. Concurrent with the Final EIS, Reclamation will prepare and process a Final Feasibility Report. The Final EIS and Final Feasibility Report will be used together to support the Federal decision, which will be documented in the ROD(s). Reclamation will circulate the Final EIS for a minimum of 30 days before issuing its ROD. In the ROD, which is the final step in the NEPA 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.

The ROD, Final EIS, Final Feasibility Report, and supporting documents will be submitted by the Commissioner of Reclamation to the Secretary of the Interior. After review by the Office of Management and Budget, in accordance with Executive Order 12322, the Secretary will transmit a ROD, Final EIS, and Final Feasibility Report to the U.S. Congress to determine the type and extent of Federal interest in enlarging Shasta Dam and Reservoir if a plan is recommended for implementation. The proposed project would be considered for authorization by Congress and, if authorized, a separate appropriation authorization would be required. The project would be considered for inclusion in the President's budget based on (1) national priorities, (2) magnitude of the Federal commitment, (3) level of local support, (4) willingness of the non-Federal sponsor to fund its share of the project costs, and (5) budgetary constraints that may exist at the time of construction.

While this DEIS has been prepared in consideration of CEQA requirements, to-date, formal CEQA scoping has not been initiated. This process may commence if and when a State lead agency is identified.

Table S-3. 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[5]	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	NA	–
	CP1–CP5	Long-term	Pool level increase would inundate 78 acres (CP1), 110 acres (CP2), or 173 acres (CP3, CP4, and CP5) of mapped slope instability hazard	LTS	No mitigation needed; thus, none proposed.	LTS
Impact Geo-2: Alteration of Fluvial Geomorphology and Hydrology of Aquatic Habitats	N-A	NA	–	NI	NA	–
	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	NA	–
	CP1–CP5	Long-term	–	S	No feasible mitigation is available to reduce impact.	SU

Notes:

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Table S-3. 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[5]	LOS After Mitigation[4]
Impact Geo-4: Lost or Diminished Soil Biomass Productivity	N-A	NA	–	NI	NA	–
	CP1	Long-term	Loss of 1,954.6 acres of moderate productivity land; 1604.5 acres of low productivity land; 565 acres of nonproductive land	S	No feasible mitigation is 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	S	No feasible mitigation is 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	S	No feasible mitigation is available to reduce impact.	SU
Impact Geo-5: Substantial Soil Erosion or Loss of Topsoil Due to Shoreline Processes	N-A	NA	–	NI	NA	–
	CP1	Short-term and long-term	Soil erosion of approximately 421,000 cubic yards per year for the first 15 years	S	No feasible mitigation is available to reduce impact.	SU
	CP2	Short-term and long-term	Soil erosion of approximately 549,000 cubic yards per year for the first 15 years	S	No feasible mitigation is available to reduce impact.	SU
	CP3-CP5	Short-term and long-term	Soil erosion of approximately 767,000 cubic yards per year for the first 15 years	S	No feasible mitigation is available to reduce impact.	SU
Impact Geo-6: Substantial Soil Erosion or Loss of Topsoil Due to Upland Processes	N-A	NA	–	NI	NA	–
	CP1–CP5	Long-term	Up to approximately 3,340 acres in the upland portion of the Shasta Lake and vicinity area could be disturbed	LTS	No mitigation needed; thus, none proposed.	LTS

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Table S-3. Summary of Impacts and Mitigation Measures (contd.)

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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	NA	–
	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	NA	–
	CP1–CP5	Long-term	–	LTS	No mitigation needed; thus, none proposed.	LTS
Impact Geo-9: Substantial Increase in Channel Erosion and Meander Migration	N-A	Long-term	–	NI	NA	–
	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	NA	–
	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	NA	–
	CP1–CP3	Long-term	–	NI	No mitigation needed; thus, none proposed.	NI
	CP4–CP5	Long-term	–	LTS	No mitigation needed; thus, none proposed.	LTS

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Table S-3. 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[5]	LOS After Mitigation[4]
Impact Geo-12: Alteration of Downstream Tributary Fluvial Geomorphology Due to Shasta Dam Operations	N-A	NA	–	NI	NA	–
	CP1–CP5	Long-term	–	LTS	No mitigation needed; thus, none proposed.	LTS
Impact Geo-13: Substantial Increase in Channel Erosion and Meander Migration (Lower Sacramento River and Delta)	N-A	NA	–	NI	NA	–
	CP1–CP5	Long-term	–	LTS	No mitigation needed; thus, none proposed.	LTS
Impact Geo-14: Substantial Increase in Channel Erosion and Meander Migration (CVP/SWP Service Areas)	N-A	NA	–	NI	NA	–
	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	–	NI	NA	–
	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

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Table S-3. 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[5]	LOS After Mitigation[4]
Impact AQ-2: Long-Term Emissions of Criteria Air Pollutants and Precursors During Project Operation	N-A,	Long-term	–	LTS	NA	–
	CP1,	Long-term	Increase of an average of 158 one-way daily trips	LTS	No mitigation needed, thus none proposed.	LTS
	CP2	Long-term	Increase of an average of 238 one-way daily trips	LTS	No mitigation needed; thus, none proposed.	LTS
	CP3	Long-term	Increase of an average of 364 one-way daily trips	LTS	No mitigation needed; thus, none proposed.	LTS
	CP4	Long-term	Increase of an average of 658 one-way daily trips	LTS	No mitigation needed; thus, none proposed.	LTS
	CP5	Long-term	Increase of an average of 311 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	–	NI	NA	–
	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	–	NI	NA	–
	CP1–CP5	Short-term and long-term	–	LTS	No mitigation needed; thus, none proposed.	LTS

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Table S-3. 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[5]	LOS After Mitigation[4]
Impact AQ-5: Short-Term Emissions of Criteria Air Pollutants and Precursors Below Shasta Dam During Project Construction	N-A,	NA	–	NI	NA	–
	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
Impact AQ-6: Generation of Greenhouse Gases	N-A	NA	–	LTS	NA	–
	CP1–CP5	Short-term	Emission of 15,100 to 83,400 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	–	NI	NA	–
	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	–	NI	NA	–
	CP1–CP5	NA	–	NI	No mitigation needed; thus, none proposed.	NI

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Table S-3. 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[5]	LOS After Mitigation[4]
Impact H&H-3: Place Within a 100-Year Flood Hazard Area Structures That Would Impede or Redirect Flood Flows	N-A	NA	–	NI	NA	–
	CP1–CP5	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	LTS	NA	–
	CP1–CP5	Long-term	–	LTS	No mitigation needed; thus, none proposed.	LTS
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	LTS	NA	–
	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	LTS	NA	–
	CP1–CP5	Long-term	–	LTS	No mitigation needed; thus, none proposed.	LTS
Impact H&H-7: Change in X2 Position	N-A	NA	–	NI	NA	–
	CP1 & CP4	NA	–	NI	No mitigation needed; thus, none proposed.	NI
	CP2, CP3, 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	LTS	NA	–
	CP1–CP5	Long-term	–	LTS	No mitigation needed; thus, none proposed.	LTS

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Impact H&H-9: Change in Deliveries to North-of-Delta CVP Water Service Contractors and Refuges	N-A	Long-term	Reduced frequency	LTS	NA	–
	CP1–CP5	Long-term	–	LTS	No mitigation needed; thus, none proposed.	LTS
Impact H&H-10: Change in Deliveries to South-of-Delta CVP Water Service Contractors and Refuges	N-A	Long-term	Reduced frequency	PS	NA	–
	CP1, CP3–CP5	Long-term	–	B	No mitigation needed; thus, none proposed.	B
	CP2	Long-term	–	LTS	No mitigation needed; thus, none proposed.	LTS
Impact H&H-11: Change in Deliveries to SWP Table A, Contractors	N-A	Long-term	Reduced frequency	B	NA	–
	CP1–CP5	Long-term	–	LTS	No mitigation needed; thus, none proposed.	LTS
Impact H&H-12: Change in Groundwater	N-A	NA	–	LTS	NA	–
	CP1–CP5	Short-term and long-term	Increased groundwater levels	B	No mitigation needed; thus, none proposed.	B
Impact H&H-13: Change in Groundwater Quality	N-A	Short-term and long-term	–	LTS	NA	–
	CP1–CP5	Short-term and long-term	–	LTS	No mitigation needed; thus, none proposed.	LTS

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Table S-3. 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[5]	LOS After Mitigation[4]
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	–	NI	NA	–
	CP1	Short-term	Short-term changes in the amount of exposed area that would be subject to erosion	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
	CP2	Short-term	Similar to CP1, but greater area and longer duration	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
	CP3-CP5	Short-term	Similar to CP1 and CP2, but greater area and longer duration	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

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Table S-3. 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[5]	LOS After Mitigation[4]
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	–	NI	NA	–
	CP1	Short-term	Some areas potentially subject to surface disturbance, including jurisdictional waters	LTS	No mitigation needed; thus, none proposed.	LTS
	CP2	Short-term	Similar to CP1, but greater area and longer duration	LTS	No mitigation needed; thus, none proposed.	LTS
	CP3–CP5	Short-term	Similar to CP1 and CP2, but greater area and longer duration	LTS	No mitigation needed; thus, none proposed.	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	N-A	NA	–	NI	NA	–
	CP1–CP5	Short-term	–	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	–	NI	NA	–
	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

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Table S-3. 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[5]	LOS After Mitigation[4]
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	–	NI	NA	–
	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	10 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	14 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
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	–	LTS	NA	–
	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

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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	–	NI	NA	–
	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

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Resource Topic/Impact	Alt[1]	Impact Duration[2]	Quantification/ Relative Magnitude of Impact[3]	LOS Before Mitigation[4]	Mitigation Measure[5]	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	–	NI	NA	–
	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	–	NI	NA	–
	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	–	LTS	NA	–
	CP1–CP5	Long-term	–	LTS	No mitigation needed; thus, none proposed.	LTS

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Resource Topic/Impact	Alt[1]	Impact Duration[2]	Quantification/ Relative Magnitude of Impact[3]	LOS Before Mitigation[4]	Mitigation Measure[5]	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	–	LTS	NA	–
	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 7 percent under existing conditions and future conditions	B	No mitigation needed; thus, none proposed.	B
	CP3	Long-term	Reduce temperature exceedences at Bend Bridge by 11 percent under existing conditions and 10 percent under future conditions	B	No mitigation needed; thus, none proposed.	B
	CP4	Long-term	Reduce temperature exceedences at Bend Bridge by 12 percent under existing conditions and future conditions	B	No mitigation needed; thus, none proposed.	B
	CP5	Long-term	Reduce temperature exceedences at Bend Bridge by 10 percent under existing conditions and 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	–	LTS	NA	–
	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

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Resource Topic/Impact	Alt[1]	Impact Duration[2]	Quantification/ Relative Magnitude of Impact[3]	LOS Before Mitigation[4]	Mitigation Measure[5]	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	–	NI	NA	–
	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	–	NI	NA	–
	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	–	NI	NA	–
	CP1–CP5	Temporary	–	LTS	No mitigation needed; thus, none proposed.	LTS
Impact WQ-16: Long-Term Sediment Effects that Would Cause Violations of Water Quality Standards or Adversely Affect Beneficial Uses in the Extended Study Area	N-A	NA	–	LTS	NA	–
	CP1–CP5	Long-term	–	LTS	No mitigation needed; thus, none proposed.	LTS

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Table S-3. 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[5]	LOS After Mitigation[4]
Impact WQ-17: Long-Term Temperature Effects that Would Cause Violations of Water Quality Standards or Adversely Affect Beneficial Uses in the Extended Study Area	N-A	NA	–	LTS	NA	–
	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	–	LTS	NA	–
	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	–	LTS	NA	–
	CP1–CP5	Long-term	No additional violations of water quality standards	LTS	No mitigation needed; thus, none proposed.	LTS
Impact WQ-19b: Delta Salinity on the San Joaquin River at Jersey Point	N-A	NA	–	LTS	NA	–
	CP1–CP5	Long-term	No additional violations of water quality standards	LTS	No mitigation needed; thus, none proposed.	LTS
Impact WQ-19c: Delta Salinity on the Sacramento River at Emmaton	N-A	NA	–	LTS	NA	–
	CP1–CP5	Long-term	No additional violations of water quality standards	LTS	No mitigation needed; thus, none proposed.	LTS

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Table S-3. 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[5]	LOS After Mitigation[4]
Impact WQ-19d: Delta Salinity on the Old River at Rock Slough	N-A	NA	–	LTS	NA	–
	CP1–CP5	Long-term	No additional violations of water quality standards	LTS	No mitigation needed; thus, none proposed.	LTS
Impact WQ-19e: Delta Water Quality on the Delta-Mendota Canal at Jones Pumping Plant	N-A	NA	–	LTS	NA	–
	CP1–CP5	Long-term	No additional violations of water quality standards	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	–	LTS	NA	–
	CP1–CP5	Long-term	No additional violations of water quality standards	LTS	No mitigation needed; thus, none proposed.	LTS
Impact WQ-19g: Delta Salinity on the San Joaquin River at Vernalis	N-A	NA	–	LTS	NA	–
	CP1–CP5	Long-term	No additional violations of water quality standards	LTS	No mitigation needed; thus, none proposed.	LTS
Impact WQ-19h: Delta Salinity on the San Joaquin River at Brandt Bridge	N-A	NA	–	LTS	NA	–
	CP1–CP5	Long-term	No additional violations of water quality standards	LTS	No mitigation needed; thus, none proposed.	LTS
Impact WQ-19i: Delta Salinity on the Old River near the Middle River	N-A	NA	–	LTS	NA	–
	CP1–CP5	Long-term	No additional violations of water quality standards	LTS	No mitigation needed; thus, none proposed.	LTS
Impact WQ-19j: Delta Salinity on the Old River at Tracy Road Bridge	N-A	NA	–	LTS	NA	–
	CP1–CP5	Long-term	No additional violations of water quality standards	LTS	No mitigation needed; thus, none proposed.	LTS

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Resource Topic/Impact	Alt[1]	Impact Duration[2]	Quantification/ Relative Magnitude of Impact[3]	LOS Before Mitigation[4]	Mitigation Measure[5]	LOS After Mitigation[4]
Impact WQ-20: X2 Position	N-A	NA	–	PS	NA	–
	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
Noise and Vibration						
Impact Noise-1: Exposure of Sensitive Receptors in the Primary Study Area to Project-Generated Construction Noise	N-A	Long-term	–	LTS	NA	–
	CP1–CP3	Short-term	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	S	Mitigation Measure Noise-1: Implement Measures to Prevent Exposure of Sensitive Receptors to Temporary Construction Noise at Project Construction Sites.	LTS
	CP4-CP5	Short-term	Similar to CP1–CP3, but greater noise related to gravel augmentation and habitat restoration along the upper Sacramento River	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	Long-term	–	LTS	NA	–
	CP1–CP5	Short-term	–	LTS	No mitigation needed; thus, none proposed.	LTS
Impact Noise-3: Exposure of Sensitive Receptors in the Primary Study Area to Project-Generated Mobile Source Noise During Operations	N-A	Long-term	–	LTS	NA	–
	CP1–CP5	Short-term and long-term	–	LTS	No mitigation needed; thus, none proposed.	LTS

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Resource Topic/Impact	Alt[1]	Impact Duration[2]	Quantification/ Relative Magnitude of Impact[3]	LOS Before Mitigation[4]	Mitigation Measure[5]	LOS After Mitigation[4]
Hazards and Hazardous Materials and Waste						
Impact Haz-1: Wildland Fire Risk (Shasta Lake and Vicinity and Upper Sacramento River)	N-A	NA	–	NI	NA	–
	CP1	Short-term	Increased risk of ignition during construction	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 construction duration	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 construction duration	PS	Mitigation Measure Haz-1: Coordinate and Assist Public Services Agencies to Reduce Fire Hazards.	LTS
Impact Haz-2: Release of Potentially Hazardous Materials or Hazardous Waste (Shasta Lake and Vicinity and Upper Sacramento River)	N-A	NA	–	NI	NA	–
	CP1	Short-term	Risk of release of hazardous materials during construction	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 construction duration	PS	Mitigation Measure Haz-2: Reduce Potential for Release of Hazardous Materials and Waste.	LTS
	CP3	Short-term	Similar to CP1 & CP2, but greater and longer construction duration	PS	Mitigation Measure Haz-2: Reduce Potential for Release of Hazardous Materials and Waste.	LTS
	CP4-CP5	Short-term	Similar to CP3, but greater construction	PS	Mitigation Measure Haz-2: Reduce Potential for Release of Hazardous Materials and Waste.	LTS

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Impact Haz-3: Exposure of Workers to Hazardous Materials (Shasta Lake and Vicinity and Upper Sacramento River)	N-A	NA	–	NI	NA	–
	CP1	Short-term	Risk of exposure to hazardous materials during construction	LTS	No mitigation needed; thus, none proposed.	LTS
	CP2	Short-term	Similar to CP1, but greater and longer duration	LTS	No mitigation needed; thus, none proposed.	LTS
	CP3	Short-term	Similar to CP1 & CP2, but greater and longer duration construction	LTS	No mitigation needed; thus, none proposed.	LTS
	CP4-CP5	Short-term	Similar to CP3, but greater construction	LTS	No mitigation needed; thus, none proposed.	LTS
Impact Haz-4: Exposure of Sensitive Receptors to Hazardous Materials (Shasta Lake and Vicinity and Upper Sacramento River)	N-A	NA	–	NI	NA	–
	CP1	Short-term	Risk of exposure to hazardous materials during construction	PS	Mitigation Measure Haz-4: Reduce Potential for Exposure of Sensitive Receptors to Hazardous Materials or Waste.	LTS
	CP2	Short-term	Similar to CP1, but greater and longer construction duration	PS	Mitigation Measure Haz-4: Reduce Potential for Exposure of Sensitive Receptors to Hazardous Materials or Waste.	LTS
	CP3	Short-term	Similar to CP1 & CP2, but greater and longer construction duration	PS	Mitigation Measure Haz-4: Reduce Potential for Exposure of Sensitive Receptors to Hazardous Materials or Waste.	LTS
	CP4-CP5	Short-term	Similar to CP3, but greater construction	PS	Mitigation Measure Haz-4: Reduce Potential for Exposure of Sensitive Receptors to Hazardous Materials or Waste.	LTS

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Impact Haz-5: Wildland Fire Risk (Lower Sacramento River, Delta, CVP/SWP Service Areas)	N-A	NA	–	NI	NA	–
	CP1–CP5	Short-term	–	LTS	No mitigation needed; thus, none proposed.	LTS
Impact Haz-6: Release of Potentially Hazardous Materials or Hazardous Waste (Lower Sacramento River, Delta, CVP/SWP Service Areas)	N-A	NA	–	NI	NA	–
	CP1–CP5	Short-term	–	LTS	No mitigation needed; thus, none proposed.	LTS
Impact Haz-7: Exposure of Workers to Hazardous Materials (Lower Sacramento River, Delta, CVP/SWP Service Areas)	N-A	NA	–	NI	NA	–
	CP1–CP5	Short-term	–	LTS	No mitigation needed; thus, none proposed.	LTS
Impact Haz-8: Exposure of Sensitive Receptors to Hazardous Materials (Lower Sacramento River, Delta, CVP/SWP Service Areas)	N-A	NA	–	NI	NA	–
	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	–	PS	NA	–
	CP1–CP5	Permanent	–	NI	No mitigation needed; thus, none proposed.	NI

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Impact Ag-2: Direct and Indirect Conversion of Forest Land to Nonforest Uses in the Vicinity of Shasta Lake	N-A	NA	NA	NI	NA	–
	CP1	Permanent	Permanent conversion of forest land by inundation and infrastructure relocation	S	No feasible mitigation is available to reduce impact.	SU
	CP2	Permanent	Similar to CP1, but greater.	S	No feasible mitigation is available to reduce impact.	SU
	CP3–CP5	Permanent	Similar to CP1 and CP2, but greater.	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	–	PS	NA	–
	CP1	Permanent	Inundation of lands or soil saturation due to increased flows.	LTS	No mitigation needed; thus, none proposed.	LTS
	CP2	Permanent	Similar to CP1, but greater	LTS	No mitigation needed; thus, none proposed.	LTS
	CP3–CP5	Permanent	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	–	LTS	NA	–
	CP1	Permanent	Altered dynamics and structure of forests in the riparian corridor along the upper Sacramento River due to increased flows	LTS	No mitigation needed; thus, none proposed.	LTS
	CP2	Permanent	Similar to CP1, but greater	LTS	No mitigation needed; thus, none proposed.	LTS
	CP3–CP5	Permanent	Similar to CP1 & CP2, but greater	LTS	No mitigation needed; thus, none proposed.	LTS

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Table S-3. 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[5]	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	–	PS	NA	–
	CP1–CP5	Permanent	Inundation of lands or soil saturation due to increased flows.	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	–	LTS	NA	–
	CP1–CP5	Permanent	Altered dynamics and structure of forests in the riparian corridor in the extended study area due to increased flows	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	–	LTS	NA	–
	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	NA	–	NI	NA	–
	CP1–CP5	Short-term	–	LTS	No mitigation needed; thus, none proposed.	LTS
Impact Aqua-3: Effects on Cold-Water Habitat in Shasta Lake	N-A	Long-term	–	PS	NA	–
	CP1–CP5	Long-term	–	B	No mitigation needed; thus, none proposed.	B

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Impact Aqua-4: Effects on Special-Status Aquatic Mollusks	N-A	Long-term	–	LTS	NA	–
	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	NA	–
	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	–	NI	NA	–
	CP1–CP5	Permanent	–	LTS	No mitigation needed; thus, none proposed.	LTS

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Impact Aqua-7: Effects on Spawning and Rearing Habitat of Adfluvial Salmonids in Low-Gradient Tributaries to Shasta Lake	N-A	NA	–	NI	NA	–
	CP1	Permanent	5.4 miles of low-gradient reaches	S	Mitigation Measure Aqua-7: 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
	CP2	Permanent	7.4 miles of low-gradient reaches	S	Mitigation Measure Aqua-7: 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
	CP3–CP5	Permanent	11 miles of low-gradient reaches	S	Mitigation Measure Aqua-7: 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-8: Effects on Aquatic Connectivity in Non-Fish-Bearing Tributaries to Shasta Lake	N-A	NA	–	NI	NA	–
	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

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Impact Aqua-9: Effects on Water Quality at Livingston Stone Hatchery	N-A	NA	–	NI	NA	–
	CP1–CP5	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	–	NI	NA	–
	CP1–CP5	Short-term and long-term	–	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	–	NI	NA	–
	CP1–CP5	Short-term and long-term	–	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	–	PS	NA	–
	CP1	Long-term	Improved flow and water temperature conditions in the upper Sacramento River	LTS	No mitigation needed; thus, none proposed.	LTS
	CP2	Long-term	Similar to CP1, but greater benefits	B	No mitigation needed; thus, none proposed.	B
	CP3 & CP5	Long-term	Similar to CP1 and CP2, but greater benefits	B	No mitigation needed; thus, none proposed.	B
	CP4	Long-term	Similar to CP1- CP3 & CP5, but greater benefits	B	No mitigation needed; thus, none proposed.	B

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Table S-3. 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[5]	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	NA	–
	CP1	Long-term	Slightly improved flow and water temperature conditions in the upper Sacramento River	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	–	NI	NA	–
	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

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Table S-3. Summary of Impacts and Mitigation Measures (contd.)

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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	–	NI	NA	–
	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
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	–	NI	NA	–
	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	–	NI	NA	–
	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	–	NI	NA	–
	CP1-CP5	Long-term	–	LTS	No mitigation needed; thus, none proposed.	LTS

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Table S-3. 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[5]	LOS After Mitigation[4]
Impact Aqua-19: Effects to Delta Fisheries Resulting from Changes in Sacramento River Inflow	N-A	NA	–	NI	NA	–
	CP1-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	–	NI	NA	–
	CP1 - CP5	NA	–	NI	No mitigation needed; thus, none proposed.	NI
Impact Aqua-21: Reduction in Low Salinity Habitat Conditions Resulting from an Upstream Shift in X2 Location	N-A	NA	–	NI	NA	–
	CP1-CP5	Long-term	–	LTS	No mitigation needed; thus, none proposed.	LTS
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	NA	–
	CP1-CP5	Long-term	–	LTS	No mitigation needed; thus, none proposed.	LTS
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	–	NI	NA	–
	CP1-CP5	Long-term	–	PS	None proposed because operations will be guided by RPAs established by NMFS and USFWS BOs to reduce any impacts to listed fish species	LTS

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Table S-3. 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[5]	LOS After Mitigation[4]
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	–	NI	NA	–
	CP1–CP5	Long-term	–	LTS	No mitigation needed; thus, none proposed.	LTS
Botanical Resources and Wetlands						
Impact Bot-1: Loss of Federally or State Listed Plant Species	N-A	NA	–	NI	NA	–
	CP1–CP5	NA	–	NI	No mitigation needed; thus, none proposed.	NI
Impact Bot-2: Loss of MSCS Covered Species	N-A	Permanent	–	NI	NA	–
	CP1	Permanent	All or portions of MSCS plant populations could be inundated	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

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Resource Topic/Impact	Alt[1]	Impact Duration[2]	Quantification/ Relative Magnitude of Impact[3]	LOS Before Mitigation[4]	Mitigation Measure[5]	LOS After Mitigation[4]
Impact Bot-3: Loss of USFS Sensitive, BLM Sensitive, or CRPR Species	N-A	Permanent	–	NI	NA	–
	CP1	Permanent	All or portions of USFS sensitive, BLM sensitive, and CRPR species plant populations could be inundated	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	–	NI	NA	–
	CP1	Permanent	Loss of jurisdictional waters caused by flooding the impoundment area and discharge of fill associated with the relocation of facilities and dam construction	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

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Impact Bot-5: Loss of General Vegetation Habitats	N-A	Permanent	–	NI	NA	–
	CP1	Permanent	Loss of general vegetation habitats because of inundation, vegetation removal, or construction activities	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	–	NI	NA	–
	CP1	Long-term and/or permanent	Spread of noxious and invasive weeds as a result of ground-disturbing activities during construction and an increased number of vectors	PS	Mitigation Measure Bot-6: Develop and Implement a Weed Management Plan In Conjunction with Stakeholders.	LTS
	CP2	Long-term and/or permanent	Greater than CP1	PS	Mitigation Measure Bot-6: Develop and Implement a Weed Management Plan In Conjunction with Stakeholders.	LTS
	CP3–CP5	Long-term and/or permanent	Greater than CP1 & CP2	PS	Mitigation Measure Bot-6: Develop and Implement a Weed Management Plan In Conjunction with Stakeholders.	LTS

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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	–	LTS	NA	–
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	Altered flow regimes on the upper Sacramento River could alter the structure and species composition or cause the loss of special-status species and habitat	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

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Impact Bot-8: Conflict with Approved Local or Regional Plans with Objectives of Riparian Habitat Protection or Watershed Management	N-A	Long-term	–	LTS	NA	–
	CP1 & CP4	Long-term	Adverse effects on riparian communities along the upper Sacramento River in conflict with local or regional plans	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

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Table S-3. 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[5]	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	NA	–
	CP1 & CP4	Long-term and/or permanent	Small reduction in the frequency and magnitude of overbank flows could affect vernal pool habitats, if present	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	NA	–
	CP1 & CP4	Permanent	Increased water yield for water districts in the primary study area	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
Impact Bot-11: Loss of Sensitive Natural Communities or Habitats Resulting from Implementing the Gravel Augmentation Program or Restoring Riparian, Floodplain, and Side Channel Habitats	N-A	NA	–	NI	NA	–
	CP1–CP3	Long-term	–	NI	No mitigation needed; thus, none proposed.	NI
	CP4–CP5	Long-term	Potential removal of riparian and wetland vegetation or the degradation of riparian and wetland habitats	PS	Mitigation Measure Bot-11: Revegetate Disturbed Areas, Consult with CDFW.	LTS

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Table S-3. 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[5]	LOS After Mitigation[4]
Impact Bot-12: Loss of Special-Status Plants Resulting from Implementing the Gravel Augmentation Program, or Restoring Riparian, Floodplain, and Side Channel Habitats	N-A	NA	–	NI	NA	–
	CP1–CP3	Long-term	–	NI	No mitigation needed; thus, none proposed.	NI
	CP4–CP5	Long-term	Vegetation removal and gravel placement could result in the loss of special-status plants if present	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 Riparian, Floodplain, and Side Channel Habitats	N-A	NA	–	NI	NA	–
	CP1–CP3	Long-term	–	NI	No mitigation needed; thus, none proposed.	NI
	CP4–CP5	Long-term	Potential spread of noxious and invasive weeds as a result of vegetation clearing and grubbing and an increased number of vectors	PS	Mitigation Measure Bot-13: Implement Weed Management Measures and Revegetation.	LTS

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Table S-3. 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[5]	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	NA	–
	CP1 & CP4	Long-term	Altered flow regimes on the lower Sacramento River could alter the structure and species composition or cause the loss of special-status species and habitat	S	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	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	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

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Table S-3. 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[5]	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	NA	–
	CP1 & CP4	Long-term	Adverse effects on riparian communities along the lower Sacramento River in conflict with local or regional plans	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

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Table S-3. 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[5]	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	NA	–
	CP1 & CP4	Long-term	Increased water yield for water districts in the extended study area along the lower Sacramento River	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	NA	–
	CP1 & CP4	Long-term	Altered flow regimes in the CVP/SWP service areas could alter the structure and species composition or cause the loss of special-status species and habitat	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

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Table S-3. 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[5]	LOS After Mitigation[4]
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	NA	–
	CP1 & CP4	Long-term	Adverse effects on riparian communities in the CVP/SWP service areas in conflict with local or regional plans	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-19: Loss of Sensitive Plant Communities and Special-Status Plant Species Resulting from Induced Growth in the CVP/SWP Service Areas	N-A	Long-term	–	LTS	NA	–
	CP1 & CP4	Long-term	Increased water yield for water districts in the CVP/SWP service areas	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

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Table S-3. 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[5]	LOS After Mitigation[4]
Wildlife Resources						
Impact Wild-1: Take and Loss of Habitat for the Shasta Salamander	N-A	NA	–	NI	NA	–
	CP1	Short-term and long-term	Loss of approximately 42 acres of limestone habitat and 4,056 acres of non-limestone habitat	S	Mitigation Measure Wild-1: Avoid, Relocate, and Acquire Mitigation Lands for Shasta Salamander.	SU
	CP2	Short-term and long-term	Loss of approximately 45 acres of limestone habitat and 4,536 acres of non-limestone habitat	S	Mitigation Measure Wild-1: Avoid, Relocate, and Acquire Mitigation Lands for Shasta Salamander.	SU
	CP3–CP5	Short-term and permanent	Loss of approximately 51 acres of limestone habitat and 5,266 acres of non-limestone habitat	S	Mitigation Measure Wild-1: Avoid, Relocate, and Acquire Mitigation Lands for Shasta Salamander.	SU
Impact Wild-2: Impact on the Foothill Yellow-Legged Frog and Tailed Frog and Their Habitat	N-A	NA	–	NI	NA	–
	CP1	Short-term and permanent	Loss of approximately habitat	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	Similar to CP1, but greater (larger area of inundation)	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	Similar to CP1 & CP2, but greater (larger area of inundation)	PS	Mitigation Measure Wild-2: Avoid, Relocate, and Acquire Mitigation Lands for Foothill Yellow-Legged Frog and Tailed Frog.	SU

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Impact Wild-3: Impact on the Northwestern Pond Turtle and Its Habitat	N-A	NA	–	NI	NA	–
	CP1	Short-term and permanent	Loss of habitat	PS	Mitigation Measure Wild-3: Avoid, Relocate, and Acquire Mitigation Lands for Northwestern Pond Turtle.	SU
	CP2	Short-term and permanent	Similar to CP1, but greater (larger area of inundation)	PS	Mitigation Measure Wild-3: Avoid, Relocate, and Acquire Mitigation Lands for Northwestern Pond Turtle.	SU
	CP3–CP5	Short-term and permanent	Similar to CP1 & CP2, but greater (larger area of inundation)	PS	Mitigation Measure Wild-3: Avoid, Relocate, and Acquire Mitigation Lands for Northwestern Pond Turtle.	SU
Impact Wild-4: Impact on the American Peregrine Falcon	N-A	NA	–	NI	NA	–
	CP1–CP5	Short-term	Loss of nests	PS	Mitigation Measure Wild-4: Conduct Preconstruction Surveys for the American Peregrine Falcon and Establish Buffers.	LTS

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Resource Topic/Impact	Alt[1]	Impact Duration[2]	Quantification/ Relative Magnitude of Impact[3]	LOS Before Mitigation[4]	Mitigation Measure[5]	LOS After Mitigation[4]
Impact Wild-5: Take and Loss of Habitat for the Bald Eagle	N-A	NA	–	NI	NA	–
	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
Impact Wild-6: Take and Loss of Nesting and Foraging Habitat for the Northern Spotted Owl	N-A	NA	–	NI	NA	–
	CP1	Short-term and permanent	Loss of nests and habitat	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	Similar to CP1, but greater (larger area of inundation)	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	Similar to CP1 & CP2, but greater (larger area of inundation)	PS	Mitigation Measure Wild-6: Acquire and Preserve Mitigation Lands; Conduct Protocol-Level Surveys for the Northern Spotted Owl and Establish Buffers.	SU

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Resource Topic/Impact	Alt[1]	Impact Duration[2]	Quantification/ Relative Magnitude of Impact[3]	LOS Before Mitigation[4]	Mitigation Measure[5]	LOS After Mitigation[4]
Impact Wild-7: Impact on the Purple Martin and Its Habitat	N-A	NA	–	NI	NA	–
	CP1	Short-term and long-term	Loss of potential nest sites 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 sites	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 sites	S	Mitigation Measure Wild-7: Conduct a Preconstruction Survey for Purple Martin and Establish Buffers.	SU
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	NA	–	NI	NA	–
	CP1	Short-term and permanent	Loss of nests and habitat	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	Similar to CP1, but greater (larger area of inundation)	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

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Impact Wild-8: Impacts on the Willow Flycatcher, Vaux's Swift, Yellow Warbler, and Yellow-Breasted Chat and Their Foraging and Nesting Habitat (contd.)	CP3–CP5	Short-term and permanent	Similar to CP1 & CP2, but greater (larger area of inundation)	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
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	NA	–	NI	NA	–
	CP1	Short-term and permanent	Loss of nests and 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, Great Blue Heron, and Osprey and Establish Buffers.	SU
	CP2	Short-term and permanent	Similar to CP1, but greater (larger area of inundation)	PS	Mitigation Measure Wild-9: Acquire and Preserve Mitigation Lands; Conduct a Preconstruction Survey for the Long-Eared Owl, Northern Goshawk, Cooper's Hawk, Great Blue Heron, and Osprey and Establish Buffers.	SU
	CP3–CP5	Short-term and permanent	Similar to CP1 & CP2, but greater (larger area of inundation)	PS	Mitigation Measure Wild-9: Acquire and Preserve Mitigation Lands; Conduct a Preconstruction Survey for the Long-Eared Owl, Northern Goshawk, Cooper's Hawk, Great Blue Heron, and Osprey and Establish Buffers.	SU

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Impact Wild-10: Take and Loss of Habitat for the Pacific Fisher	N-A	NA	–	NI	NA	–
	CP1	Short-term and permanent	Construction-related mortality and loss of habitat	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	Similar to CP1, but greater (larger area of inundation)	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	Similar to CP1 & CP2, but greater (larger area of inundation)	PS	Mitigation Measure Wild-10: Acquire and Preserve Mitigation Lands; Conduct Preconstruction Surveys for the Pacific Fisher and Establish Buffers.	SU

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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	NA	–	NI	NA	–
	CP1	Short-term and permanent	Construction-related mortality and loss of habitat 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	Similar to CP1, but greater (larger area of inundation)	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	Similar to CP1 & CP2, but greater (larger area of inundation)	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

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Table S-3. 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[5]	LOS After Mitigation[4]
Impact Wild-12: Impacts on Special-Status Terrestrial Mollusks (Shasta Sideband, Wintu Sideband, Shasta Chaparral, and Shasta Hesperian) and Their Habitat	N-A	NA	–	NI	NA	–
	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
Impact Wild-13: Permanent Loss of General Wildlife Habitat	N-A	NA	–	NI	NA	–
	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

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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	NA	–	NI	NA	–
	CP1	Short-term and long-term	Loss of nests and habitat	PS	Mitigation Measure Wild-14: Acquire and Preserve Mitigation Lands and 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: Acquire and Preserve Mitigation Lands and 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: Acquire and Preserve Mitigation Lands and Conduct Preconstruction Surveys for Other Nesting Raptors and Migratory Birds and Establish Buffers.	SU

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Impact Wild-15: Loss of Critical Deer Winter and Fawning Range	N-A	NA	–	NI	NA	–
	CP1	Short-term and long-term	Loss of wintering and fawning range	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	NA	–	NI	NA	–
	CP1–CP5	Long-term	[TBD]	[TBD]	[TBD]	[TBD]

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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	NA	–
	CP1, CP4	Long-term	Adverse effects on habitat for a variety of riparian-dependent special-status species	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 and CP4 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, and CP4, 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

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Table S-3. Summary of Impacts and Mitigation Measures (contd.)

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Impact Wild-18: Impacts on Bank Swallow in the Primary Study Area Resulting from Modifications of Geomorphic Processes	N-A	Long-term	Reduction in rate of bank erosion	LTS	NA	–
	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	NA	–	NI	NA	–
	CP1-CP5	NA	–	NI	No mitigation needed; thus, none proposed.	NI
Impact Wild-20: Consistency with Local and Regional Plans with Goals of Promoting Riparian Habitat in the Primary Study Area	N-A	NA	–	NI	NA	–
	CP1, CP4	Long-term	Goals of local and regional plans could be more difficult to attain	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

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Table S-3. 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[5]	LOS After Mitigation[4]
Impact Wild-20: Consistency with Local and Regional Plans with Goals of Promoting Riparian Habitat in the Primary Study Area (contd.)	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
Impact Wild-21: Impacts on Riparian-Associated Special-Status Wildlife Resulting from the Gravel Augmentation Program	N-A	NA	–	NI	NA	–
	CP1–CP3	NA	–	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

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Resource Topic/Impact	Alt[1]	Impact Duration[2]	Quantification/ Relative Magnitude of Impact[3]	LOS Before Mitigation[4]	Mitigation Measure[5]	LOS After Mitigation[4]
Impact Wild-22: Impacts on Riparian-Associated Special-Status Wildlife Species Resulting from Restoration Projects	N-A	NA	–	NI	NA	–
	CP1–CP3	NA	–	NI	No mitigation needed; thus, none proposed.	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
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	NA	–
	CP1–CP5	Long-term	Adverse effects on habitat for a variety of riparian-dependent special-status species	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

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Resource Topic/Impact	Alt[1]	Impact Duration[2]	Quantification/ Relative Magnitude of Impact[3]	LOS Before Mitigation[4]	Mitigation Measure[5]	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	NA	–
	CP1–CP5	Long-term	Reduction in rate of bank erosion	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	NA	–	NI	NA	–
	CP1–CP5	NA	–	NI	No mitigation needed; thus, none proposed.	NI
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	NA	–	NI	NA	–
	CP1-CP5	Long-term	Goals of local and regional plans could be more difficult to attain	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

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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	NA	–	NI	NA	–
	CP1-CP5	Long-term	–	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	NA	–	NI	NA	–
	CP1	Permanent	355 localities potentially containing historic-era remains and 212±54 prehistoric resources within inundation area	S	Mitigation Measure Culture-1: Develop and Implement measures identified in an NHPA Section 106 MOA or PA.	LTS
	CP2	Permanent	371 localities potentially containing historic-era remains and 224±57 prehistoric resources within inundation area	S	Mitigation Measure Culture-1: Develop and Implement measures identified in an NHPA Section 106 MOA or PA.	LTS
	CP3–CP5	Permanent	391 localities potentially containing historic-era remains and 243±63 prehistoric resources within inundation area	S	Mitigation Measure Culture-1: Develop and Implement measures identified in an NHPA Section 106 MOA or PA.	LTS
Impact Culture-2: Inundation of Traditional Cultural Properties	N-A	NA	–	NI	NA	–
	CP1–CP5	Permanent	–	S	Adverse effects will be avoided, minimized, or mitigated through project redesign, when warranted, or through the development and implementation of an MOA or PA.	SU

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Impact Culture-3: Disturbance or Destruction of Archaeological and Historical Resources near the Upper Sacramento River Due to Construction	N-A	NA	–	NI	NA	–
	CP1-CP3	Permanent		NI	No mitigation needed; thus, none proposed.	NI
	CP4–CP5	Permanent	–	S	Mitigation Measure Culture-3: Implement Mitigation Measure Culture-1: Develop and Implement measures identified in an NHPA Section 106 MOA or PA.	LTS
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	Short-term	Potential periodic water and power supply disruptions	PS	NA	–
	CP1–CP5	Short-term	Construction labor is expected to come from the local population	LTS	No mitigation needed; thus, none proposed.	LTS

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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	NA	–
	CP1	Temporary	300 new construction jobs, 390 new indirect jobs, and 600 induced jobs	B	No mitigation needed; thus, none proposed.	B
	CP2	Temporary	300 new direct construction jobs, 600 new indirect jobs, and 600 induced jobs	B	No mitigation needed; thus, none proposed.	B
	CP3–CP4	Short-term	350 new direct construction jobs, 450 new indirect jobs, and 700 induced jobs	B	No mitigation needed; thus, none proposed.	B
	CP5	Short-term	360 new direct construction jobs, 470 new indirect jobs, and 710 induced jobs	B	No mitigation needed; thus, none proposed.	B
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	Short-term	Potential water or power supply disruptions	PS	NA	–
	CP1–CP5	Short-term	–	LTS	No mitigation needed; thus, none proposed.	LTS

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Resource Topic/Impact	Alt[1]	Impact Duration[2]	Quantification/ Relative Magnitude of Impact[3]	LOS Before Mitigation[4]	Mitigation Measure[5]	LOS After Mitigation[4]
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	NA	–
	CP1	Short-term	$126.2 million in personal annual incomes in the local economic study area	B	No mitigation needed; thus, none proposed.	B
	CP2	Short-term	$126.2 million in personal annual incomes	B	No mitigation needed; thus, none proposed.	B
	CP3	Short-term	$146.2 million in personal annual incomes	B	No mitigation needed; thus, none proposed.	B
	CP4	Short-term	$147.1 million in personal annual incomes	B	No mitigation needed; thus, none proposed.	B
	CP5	Short-term	$149.7 million in personal annual incomes	B	No mitigation needed; thus, none proposed.	B
Impact Socio-5: Short-Term Increases in Sales and Profits for Businesses in the Primary Study Area that Support the Construction Industry	N-A	NA	–	NI	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

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Resource Topic/Impact	Alt[1]	Impact Duration[2]	Quantification/ Relative Magnitude of Impact[3]	LOS Before Mitigation[4]	Mitigation Measure[5]	LOS After Mitigation[4]
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	NA	–	NI	NA	–
	CP1	Short-term	Increased personal income, direct income and 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	Short-term	Similar to, but more beneficial than CP2	B	No mitigation needed; thus, none proposed.	B
	CP4-CP5	Short-term	Similar to, but more beneficial than CP3	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	NA	–	NI	NA	–
	CP1	Long-term	Reduced risk of flooding below Shasta Dam	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	NA	–	NI	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

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Table S-3. 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[5]	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	NA	–	NI	NA	–
	CP1	Short-term	Temporary increase in short-term, construction-related, State sales and income tax revenues	B	No mitigation needed; thus, none proposed.	B
	CP2	Short-term	Similar to CP1, 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-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	NA	–	NI	NA	–
	CP1	Short-term	Some local purchase of construction materials	B	No mitigation needed; thus, none proposed.	B
	CP2	Short-term	Similar to CP1, but more beneficial	B	No mitigation needed; thus, none proposed.	B
	CP3–CP5	Short-term	Similar to CP1 & CP2, but more beneficial	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	NA	–	NI	NA	–
	CP1	Short-term	Short-term increase in State sales and income tax revenues	B	No mitigation needed; thus, none proposed.	B
	CP2	Short-term	Similar to CP1, but more beneficial	B	No mitigation needed; thus, none proposed.	B
	CP3–CP5	Short-term	Similar to CP1 & CP2, but more beneficial	B	No mitigation needed; thus, none proposed.	B

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Resource Topic/Impact	Alt[1]	Impact Duration[2]	Quantification/ Relative Magnitude of Impact[3]	LOS Before Mitigation[4]	Mitigation Measure[5]	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	NA	–	NI	NA	–
	CP1	Long-term	Reduced risk of flooding below Shasta Dam	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	NA	–	NI	NA	–
	CP1	Short-term	Some purchase of construction materials within the extended study area	B	No mitigation needed; thus, none proposed.	B
	CP2	Short-term	Similar to CP1, but more beneficial	B	No mitigation needed; thus, none proposed.	B
	CP3–CP5	Short-term	Similar to CP1 & CP2, but more beneficial	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	NA	–	NI	NA	–
	CP1	Short-term	Temporary shortages in water or hydropower caused by lowered reservoir levels during construction	PS	Mitigation Measure Socio-14: Secure Replacement Water or Hydropower During Project Construction.	LTS
	CP2	Short-term	Similar to CP1, but greater construction period duration	PS	Mitigation Measure Socio-14: Secure Replacement Water or Hydropower During Project Construction.	LTS
	CP3–CP5	Short-term	Similar to CP1 & CP2, but greater construction period duration	PS	Mitigation Measure Socio-14: Secure Replacement Water or Hydropower During Project Construction.	LTS

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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	NA	–	NI	NA	–
	CP1	Short-term	Temporary increase in short-term, construction-related, State sales and income tax revenues	B	No mitigation needed; thus, none proposed.	B
	CP2	Short-term	Similar to CP1, 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-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	NA	–	NI	NA	–
	CP1	Long-term	Increased agricultural net income due to improved water reliability	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-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	NA	–	NI	NA	–
	CP1	Long-term	Reduced risk of urban water and power shortages due to improved water reliability	B	No mitigation needed, thus none proposed.	B
	CP2	Long-term	Similar to CP1, but more beneficial			
	CP3–CP5	Long-term	Similar to CP1 & CP2, but more beneficial	B	No mitigation needed; thus, none proposed.	B

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Table S-3. 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[5]	LOS After Mitigation[4]
Land Use and Planning						
Impact LU-1: Disruption of Existing Land Uses (Shasta Lake and Vicinity and Upper Sacramento River)	N-A	NA	–	NI	NA	–
	CP1	Short-term and long-term	Short-term disruption 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.	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	–	NI	NA	–
	CP1	Short-term and long-term	Inundation and relocation that could conflict with land use goals and policies	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

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Impact LU-3: Disruption of Existing Land Uses (Lower Sacramento River, Delta, CVP/SWP Service Areas)	N-A	NA	–	NI	NA	–
	CP1–CP5	NA	–	NI	No mitigation needed; thus, none proposed.	NI
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	–	NI	NA	–
	CP1–CP5	NA	–	NI	No mitigation needed; thus, none proposed.	NI
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	Short-term	–	LTS	NA	–
	CP1	Short-term	99 affected facilities and infrastructure elements	LTS	No mitigation needed; thus, none proposed.	LTS
	CP2	Short-term	122 affected facilities and infrastructure elements	LTS	No mitigation needed; thus, none proposed.	LTS
	CP3–CP5	Short-term	163 affected facilities and infrastructure elements	LTS	No mitigation needed; thus, none proposed.	LTS

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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	NA	–
	CP1	Short-term	Affect access to local recreation activities during 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 longer 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 longer 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

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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	NA	–
	CP1-CP5	Long-term	–	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	NA	–
	CP1	Long-term	Approximately 730 acres of newly inundated area would receive no vegetation treatment, 220 acres would have overstory removal, and 150 acres would have complete removal	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	Approximately 1,167 acres of newly inundated area would receive no vegetation treatment, 350 acres would have overstory removal, and 240 acres would have complete removal	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	Approximately 1,738 acres of newly inundated area would receive no vegetation treatment, 500 acres would have overstory removal, and 340 acres would have complete removal	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

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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	–	NI	NA	–
	CP1 & CP4	Long-term	Flow increases of <8 percent; inundation of small additional area	LTS	No mitigation needed; thus, none proposed.	LTS
	CP2	Long-term	Similar to CP1 and CP4, but greater	LTS	No mitigation needed; thus, none proposed.	LTS
	CP3	Long-term	Similar to CP1, CP2, and CP4, but greater	LTS	No mitigation needed; thus, none proposed.	LTS
	CP5	Long-term	Similar to CP1-CP4, 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	–	NI	NA	–
	CP1 & CP4	Long-term	Flow increases of <8 percent; inundation of small additional area	LTS	No mitigation needed; thus, none proposed.	LTS
	CP2	Long-term	Similar to CP1 and CP4, but greater	LTS	No mitigation needed; thus, none proposed.	LTS
	CP3 & CP5	Long-term	Similar to CP1, CP2, and CP4, 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	–	NI	NA	–
	CP1 & CP4	Long-term	Flow increases of <8 percent; inundation of small additional area	LTS	No mitigation needed; thus, none proposed.	LTS
	CP2	Long-term	Similar to CP1 and CP4, but greater	LTS	No mitigation needed; thus, none proposed.	LTS
	CP3 & CP5	Long-term	Similar to CP1, CP2, and CP4, but greater	LTS	No mitigation needed; thus, none proposed.	LTS

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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	–	NI	NA	–
	CP1 & CP4	Long-term	Flow decreases of <7 percent; inundation of small additional area	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	NA	–
	CP1	Long-term	Provide enhanced sport angling opportunities for all four runs of Chinook salmon	B	No mitigation needed; thus, none proposed.	B
	CP2 & CP5	Long-term	Similar to CP1, but greater	B	No mitigation needed; thus, none proposed.	B
	CP4	Long-term	Similar to CP1, CP2, & CP 5,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	–	NI	NA	–
	CP1–CP3	Short-term	–	NI	No mitigation needed; thus, none proposed.	NI
	CP4–CP5	Short-term	Potential disruption during a 1-month period	LTS	No mitigation needed; thus, none proposed.	LTS

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Impact Rec-11 (CP1–CP5): Changes in Usability of Reading Island Fishing Access Boat Ramp and Enhanced Recreation at Upper Sacramento River Restoration Sites	N-A	NA	–	NI	NA	–
	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	–	NI	NA	–
	CP1 & CP4	Long-term	Flows would increase but would remain below winter and spring high flows experienced in most years –	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	–	NI	NA	–
	CP1 & CP4	Long-term	Increased mean monthly flows within the extended study area	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

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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	–	NI	NA	–
	CP1 & CP4	Long-term	Increased mean monthly flows within the extended study area	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	–	NI	NA	–
	CP1 & CP4	Long-term	Increased mean monthly flows within the extended study area	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

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Table S-3. 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[5]	LOS After Mitigation[4]
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 (contd.)	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
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	NA	–	NI	NA	–
	CP1–CP5	Short-term and long-term	Degraded visual character and quality of primary study area	S	Mitigation Measure Vis-1: Amend the STNF LRMP to Include Revised VQOs for Developments at Turntable Bay marina.	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	NA	–	NI	NA	–
	CP1	Short-term	Scenic views obstructed or degraded in primary study area	S	Mitigation Measure Vis-2: Minimize Construction-Related Visual Impacts on Scenic Views From Key Observation Points.	SU
	CP2	Short-term	Similar to CP1, but greater (acres, miles, duration)	S	Mitigation Measure Vis-2: Minimize Construction-Related Visual Impacts on Scenic Views From Key Observation Points.	SU
	CP3–CP5	Short-term	Similar to CP1& CP2, but greater (acres, miles, duration)	S	Mitigation Measure Vis-2: Minimize Construction-Related Visual Impacts on Scenic Views From Key Observation Points.	SU

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Impact Vis-3: Generation of Increased Daytime Glare and/or Nighttime Lighting (Shasta Lake and Vicinity and Upper Sacramento River)	N-A	NA	–	NI	NA	–
	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
Impact Vis-4: Consistency with Federal and State Scenic Highway Requirements (Shasta Lake and Vicinity and Upper Sacramento River)	N-A	NA	–	NI	NA	–
	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

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Resource Topic/Impact	Alt[1]	Impact Duration[2]	Quantification/ Relative Magnitude of Impact[3]	LOS Before Mitigation[4]	Mitigation Measure[5]	LOS After Mitigation[4]
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	Long-term	–	LTS	NA	–
	CP1	Long-term	Increase in 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	Increase in round trips per day	PS	Mitigation Measure Trans-1: Prepare and Implement a Traffic Control and Safety Assurance Plan.	LTS
	CP2	Long-term	Similar to CP1, but greater	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	PS	Mitigation Measure Trans-1: Prepare and Implement a Traffic Control and Safety Assurance Plan.	LTS
	CP3–CP5	Long-term	Similar to CP1 and CP2, but greater	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	PS	Mitigation Measure Trans-1: Prepare and Implement a Traffic Control and Safety Assurance Plan.	LTS

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Table S-3. Summary of Impacts and Mitigation Measures (contd.)

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Impact Trans-2: Adverse Effects on Access to Local Streets or Adjacent Uses in the Primary Study Area	N-A	NA	–	LTS	NA	–
	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: To Reduce Effects on Local Access, 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: To Reduce Effects on Local Access, 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: To Reduce Effects on Local Access, 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	–	LTS	NA	–
	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

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Impact Trans-4: Adverse Effects on Emergency Access in the Primary Study Area	N-A	NA	–	LTS	NA	–
	CP1	Temporary	Road closures may result in increased response times for emergency vehicles	PS	Mitigation Measure Trans-4: To Reduce Effects on Emergency Access, 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	PS	Mitigation Measure Trans-4: To Reduce Effects on Emergency Access, 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	PS	Mitigation Measure Trans-4: To Reduce Effects on Emergency Access, 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: To Reduce Effects on Emergency Access, Implement Mitigation Measure Trans-1: Prepare and Implement a Traffic Control and Safety Assurance Plan	LTS

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Impact Trans-5: Accelerated Degradation of Surface Transportation Facilities in the Primary Study Area	N-A	NA	–	LTS	NA	–
	CP1	Permanent	Increase in round trips per day	PS	Mitigation Measure Trans-5: Identify and Repair Roadway Segments Damaged by the Project.	LTS
	CP2	Permanent	Similar to CP1, but greater	PS	Mitigation Measure Trans-5: Identify and Repair Roadway Segments Damaged by the Project.	LTS
	CP3–CP5	Permanent	Similar to CP1 & CP2, but greater	PS	Mitigation Measure Trans-5: Identify and Repair Roadway Segments Damaged by the Project.	LTS
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	NA	–
	CP1–CP5	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	NA	–
	CP1–CP5	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	NA	–
	CP1–CP5	NA	–	NA	No mitigation needed; thus, none proposed.	NA

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Impact Trans-9 (No-Action): Adverse Effects on Emergency Access in the Extended Study Area	N-A	Temporary	–	LTS	NA	–
	CP1–CP5	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	NA	–
	CP1–CP5	NA	–	NA	No mitigation needed; thus, none proposed.	NA
Utilities and Service Systems						
Impact Util-1: Damage to or Disruption of Public Utility and Service Systems Infrastructure (Shasta Lake and Vicinity and Upper Sacramento River)	N-A	NA	–	NI	NA	–
	CP1	Short-term	Abandon & relocate 31,000 feet of power lines, 33,000 feet of telecommunications lines	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, 36,000 feet of telecommunications lines	PS	Mitigation Measure Util-1: Implement Procedures to Avoid Damage to or Temporary Disruption of Service.	LTS
	CP3–CP5	Short-term	Abandon & relocate 39,000 feet of power lines, 39,000 feet of telecommunications lines	PS	Mitigation Measure Util-1: Implement Procedures to Avoid Damage to or Temporary Disruption of Service.	LTS

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Resource Topic/Impact	Alt[1]	Impact Duration[2]	Quantification/ Relative Magnitude of Impact[3]	LOS Before Mitigation[4]	Mitigation Measure[5]	LOS After Mitigation[4]
Impact Util-2: Utility Infrastructure Relocation or Modification (Shasta Lake and Vicinity and Upper Sacramento River)	N-A	NA	–	NI	NA	–
	CP1	Short-term	Abandon & relocate 31,000 feet of power lines, 33,000 feet of telecommunications lines	PS	Mitigation Measure Util-2: Adopt Measures to Minimize Infrastructure Relocation Impacts.	LTS
	CP2	Short-term	Abandon & relocate 36,000 feet of power lines, 36,000 feet of telecommunications lines	PS	Mitigation Measure Util-2: Adopt Measures to Minimize Infrastructure Relocation Impacts.	LTS
	CP3–CP5	Short-term	Abandon & relocate 39,000 feet of power lines, 39,000 feet of telecommunications lines	PS	Mitigation Measure Util-2: Adopt Measures to Minimize Infrastructure Relocation Impacts.	LTS
Impact Util-3: Short-Term Increase in Solid Waste Generation (Shasta Lake and Vicinity and Upper Sacramento River)	N-A	NA	–	NI	NA	–
	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	Short-term	219,889 cubic yards of solid waste	LTS	No mitigation needed; thus, none proposed.	LTS
	CP4	Short-term	Similar to CP3 but slight increase in solid waste generation	LTS	No mitigation needed; thus, none proposed.	LTS
	CP5	Short-term	Similar to CP4 but slight increase in solid waste generation	LTS	No mitigation needed; thus, none proposed.	LTS

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Impact Util-4: Increases in Solid Waste Generation from Increased Recreational Opportunities (Shasta Lake and Vicinity and Upper Sacramento River)	N-A	NA	–	NI	NA	–
	CP1	Long-term	Increase in solid waste generated by recreationists	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 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	–	NI	NA	–
	CP1–CP5	Long-term	–	TS	No mitigation needed; thus, none proposed.	TS
Impact Util-6: Damage to or Disruption of Public Utility and Service Systems Infrastructure (Lower Sacramento River, Delta, CVP/SWP Service Areas)	N-A	NA	–	NA	NA	–
	CP1–CP3	Short-term	–	NI	No mitigation needed; thus, none proposed.	NI
Impact Util-7: Utility Infrastructure Relocation or Modification (Lower Sacramento River, Delta, CVP/SWP Service Areas)	N-A	NA	–	NA	NA	–
	CP1–CP5	Short-term	–	NI	No mitigation needed; thus, none proposed.	NI

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Impact Util-8: Short-Term Increase in Solid Waste Generation (Lower Sacramento River, Delta, CVP/SWP Service Areas)	N-A	NA	–	NA	NA	–
	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 Util-9: Increases in Solid Waste Generation from Increased Recreational Opportunities (Lower Sacramento River, Delta, CVP/SWP Service Areas)	N-A	NA	–	NA	NA	–
	CP1–CP5	Long-term	–	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	–
	CP1–CP5	Long-term	NA	TS	No mitigation needed; thus, none proposed.	TS

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Public Services						
Impact PS-1: Disruption of Public Services (Shasta Lake and Vicinity and Upper Sacramento River)	N-A	NA	–	NI	NA	–
	CP1	Short-term	Risk of service disruption during construction	PS	Mitigation Measure PS-1: Coordinate and Assist Public Services Agencies.	LTS
	CP2	Short-term	Similar to CP1, but greater construction duration & area	PS	Mitigation Measure PS-1: Coordinate and Assist Public Services Agencies.	LTS
	CP3–CP5	Short-term	Similar to CP1 & CP2, but greater construction duration & area	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	–	NI	NA	–
	CP1	Short-term	– Risk of degraded level of public services during construction	PS	PS-2: Provide Support to Public Services Agencies.	LTS
	CP2	Short-term	Similar to CP1, but greater construction duration	PS	PS-2: Provide Support to Public Services Agencies.	LTS
	CP3–CP5	Short-term	Similar to CP1 & CP2, but greater construction duration	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	–	NI	NA	–
	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

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Impact PS-4: Short-Term Disruption of Public Services (Lower Sacramento River, Delta, CVP/SWP Service Areas)	N-A	NA	–	NI	NA	–
	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	–	NI	NA	–
	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	–	NI	NA	–
	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,	Long-term	Increase in Shasta Powerplant energy generation	B	NA	–
	CP1–CP5	Long-term	Increase in Shasta Powerplant energy generation	B	No mitigation needed; thus, none proposed.	B
Impact Hydro-2: Decrease in CVP System Energy Generation	N-A,	Long-term	Decrease in energy generation of <1%	B	NA	–
	CP1–CP5	Long-term	<5% decrease in CVP system energy generation	B	No mitigation needed; thus, none proposed.	B

Notes:

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

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

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Table S-3. 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[5]	LOS After Mitigation[4]
Impact Hydro-3: Decrease in SWP System Energy Generation	N-A,	Long-term	Increase in SWP system energy generation	B	NA	–
	CP1, CP3-CP5	Long-term	<5% decrease in SWP system energy generation	LTS	No mitigation needed; thus, none proposed.	LTS
	CP2	Long-term	Increase in SWP system energy generation	B	No mitigation needed; thus, none proposed.	B
Impact Hydro-4: Increase in CVP System Pumping Energy Use	N-A,	Long-term	<5% increase in CVP energy system pumping energy use	LTS	NA	–
	CP1–CP5	Long-term	<5% increase in CVP energy system pumping energy use	LTS	No mitigation needed; thus, none proposed.	LTS
Impact Hydro-5: Increase in SWP System Pumping Energy Use	N-A	Long-term	<5% increase in SWP energy system pumping energy use	LTS	NA	–
	CP1	Long-term	<5% increase in SWP energy system pumping energy use	LTS	No mitigation needed; thus, none proposed.	LTS
Impact Hydro-6: Decrease in Pit 7 Powerplant Energy Generation	N-A	Long-term	<5% decrease in Pit 7 Powerplant energy generation	LTS	NA	–
	CP1-CP5	Long-term	<5% decrease in Pit 7 Powerplant energy generation	LTS	No mitigation needed; thus, none proposed.	LTS

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Table S-3. 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[5]	LOS After Mitigation[4]
Environmental Justice						
Impact EJ-1: Potential Disproportionate High and Adverse Effect on Minority and Low-Income Populations in the Vicinity of Shasta Lake	N-A	NA	–	NDHA	NA	–
	CP1–CP5	Short-term	–	NDHA	No mitigation needed; thus, none proposed.	NDHA
Impact EJ-2: Potential Disproportionate High and Adverse Effect on Native American Populations from Disturbance or Loss of Sacred Locations in the Vicinity of Shasta Lake	N-A	NA	–	NDHA	NA	–
	CP1–CP5	Short-term and long-term	–	DHA	No feasible mitigation is available to reduce impact.	DHA
Impact EJ-3: Potential Disproportionate High and Adverse Effect on Minority and Low-Income Populations in the Upper Sacramento River Area	N-A	Long-term	–	NDHA	NA	–
	CP1–CP5	Long-term	–	NDHA	No mitigation needed; thus, none proposed.	NDHA
Impact EJ-4: Potential Disproportionate High and Adverse Effect on Minority and Low-Income Populations in the Lower Sacramento River and Delta Area	N-A	NA	–	NDHA	NA	–
	CP1–CP5	Long-term	–	NDHA	No mitigation needed; thus, none proposed.	NDHA
Impact EJ-5: Potential Disproportionate High and Adverse Effect on Minority and Low-Income Populations in the CVP/SWP Service Areas	N-A	NA	–	NDHA	NA	–
	CP1–CP5	Long-term	–	NDHA	No mitigation needed; thus, none proposed.	NDHA

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Table S-3. 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[5]	LOS After Mitigation[4]
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	–	NI	NA	–
	CP1	Permanent	11 percent of Segment 4 would be periodically inundated	S	No feasible mitigation available to reduce impact.	SU
	CP2	Permanent	21 percent of Segment 4 would be periodically inundated	S	No feasible mitigation available to reduce impact.	SU
	CP3–CP5	Permanent	39 percent increase over the current transition reach), inundating larger portion of the lower McCloud River and Segment 4	S	No feasible mitigation available to reduce impact.	SU
Impact WASR-2: Conflict with Shasta-Trinity National Forest, Land and Resource Management Plan	N-A	NA	–	NI	NA	–
	CP1–CP5	Permanent	–	NI	No mitigation needed; thus, none proposed.	NI
Impact WASR-3: Conflict with the California Public Resources Code, Section 5093.542 – McCloud River Fishery	N-A	NA	–	NI	NA	–
	CP1	Long-term	Increased inundation could potentially affect aquatic habitat in the McCloud River, in conflict with the State Public Resources Code.	PS	Mitigation for this impact is under development.	[TBD]
	CP2	Long-term	Similar to CP1, but greater inundation.	PS	Mitigation for this impact is under development.	[TBD]
	CP3–CP5	Long-term	Similar to CP1 and CP2, but greater inundation.	PS	Mitigation for this impact is under development.	[TBD]

Notes:

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Table S-3. 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[5]	LOS After Mitigation[4]
Impact WASR-4: Conflict with the California Public Resources Code, Section 5093.542 – Free-Flowing Conditions	N-A	NA	–	NI	NA	–
	CP1	Long-term	Increased inundation would conflict with the natural and free-flowing condition of the McCloud River, in conflict with the State Public Resources Code.	S	No feasible mitigation available to reduce impact.	SU
	CP2	Long-term	Similar to CP1, but greater inundation.	S	No feasible mitigation available to reduce impact.	SU
	CP3–CP5	Long-term	Similar to CP1 and CP2, but greater inundation.	S	No feasible mitigation available to reduce impact.	SU

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Key:

BLM = U.S. Bureau of Land Management
BMP = best management practice
CDFW = California Department of Fish and Wildlife
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
GHG = greenhouse gas
ITA = Indian Trust Assets
lb = pound
L_{eq} = equivalent noise level
LRMP = Land and Resource Management Plan
MOA = Memorandum of Understanding
MSCS = Multi-Species Conservation Strategy
NHPA = National Historic Preservation Act
NO_X = oxides of nitrogen
PA = Programmatic Agreement
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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Abbreviations and Acronyms

°F	degrees Fahrenheit
2008 OCAP BA	2008 *Biological Assessment on the Continued Long-Term Operations of the CVP and SWP*
2008 USFWS BO	USFWS 2008 *Formal ESA Consultation on the Proposed Coordinated Operations of the CVP and SWP*
2009 NMFS BO	NMFS 2009 *Biological Opinion and Conference Opinion on the Long-Term Operations of the CVP and SWP*
AB	Assembly Bill
ABA	Architectural Barriers Act
ACID	Anderson-Cottonwood Irrigation District
ADA	Americans with Disabilities Act
AFRP	Anadromous Fish Restoration Program
AFS	anadromous fish survival
APA	Administrative Procedure Act
APE	area of potential effect
AQAP	Air Quality Attainment Plan
ARB	Air Resources Board
ARPA	Archaeological Resources Protection Act of 1979
Authority	Western Power Authority
BA	Biological Assessment
BAMM	best available mitigation measure
Banks	SWP Harvey O. Banks Pumping Plant
Basin Plan	Water Quality Control Plan for the Sacramento River 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. Department of the Interior, Bureau of Land Management
BMP	best management practice
BO	Biological Opinion
BRCP	Butte Regional Conservation Plan
BST	Benchmark Study Team
BVWD	Bella Vista Water District
CAA	Federal Clean Air Act
CAAA	Federal Clean Air Act Amendments of 1990
Cal EMA	California Emergency Management Agency

Cal Fire	California Department of Forestry and Fire Protection
Cal/EPA	California Environmental Protection Agency
Cal/OSHA	California Occupational Safety and Health Administration
CalEEMod	California Emissions Estimator Model
CALFED	CALFED Bay-Delta Program
Cal-IPC	California Invasive Plant Council
CalSim-II	California Water Resources Simulation Model II
Caltrans	California Department of Transportation
CBC	California Building Standards Code
CBDA	California Bay-Delta Authority
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
CDFA	California Department of Food and Agriculture
CDFW	California Department of Fish and Wildlife (formerly known as the California Department of Fish and Game [CDFG]
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
CMS	comprehensive mitigation strategy
CNDDB	California Natural Diversity Database
CNEL	community noise equivalent level
CNPS	California Native Plant Society
CO	carbon monoxide
CO	combined objective
CO_2	carbon dioxide
CO_2e	carbon dioxide equivalent
COA	Coordinated Operations Agreement
County	Tehama County Department of Public Works
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
CVRWQCB	Central Valley Regional Water Quality Control Board
CWA	Clean Water Act
CWHR	California Wildlife Habitat Relationship
CWP	cold-water pool
D-1275	SWRCB Water Rights Decision 1275
D-1379	SWRCB Water Rights Decision 1379
D-1641	SWRCB Revised Water Rights Decision 1641
dB	decibel
dBA	A-weighted decibel
dBA/DD	dBA per doubling of distance
DCC	Delta Cross Channel
Declaration	United Nations Declaration on the Rights of Indigenous Peoples
DEIS	Draft Environmental Impact Statement
Delta	Sacramento-San Joaquin Delta
diesel PM	diesel particulate matter
District Court	District Court for the Eastern District of California
DO	dissolved oxygen
DOC	California Department of Conservation
DOSS	Delta Operations for Salmonids and Sturgeon
Draft Feasibility Report	Draft *SLWRI Feasibility Report*
DSC	Delta Stewardship Council
DSM2	Delta Simulation Model 2
DWR	California Department of Water Resources
E/I	export/inflow
EBMUD	East Bay Municipal Utility District
EC	electrical conductivity
EIR	Environmental Impact Report
EIS	environmental impact statement
EPA	U.S. Environmental Protection Agency
ERP	Ecosystem Restoration Program
ESA	Federal Endangered Species Act
FAC	facultative plants

FACU	facultative upland plants
FACW	facultative wetland plants
Federal WSRA	Federal Wild and Scenic Rivers Act
FERC	Federal Energy Regulatory Commission
FLPMA	Federal Land Policy and Management Act of 1976
FMMP	Farmland Mapping and Monitoring Program
FSSC	Forest Service Site Class
FSZ	Farmland Security Zone
FTA	Federal Transit Administration
FWCA	Fish and Wildlife Coordination Act
GAMA	Groundwater Ambient Monitoring and Assessment
General Industrial Permit	Industrial Stormwater General Permit
General Permit	State General Permit for Storm Water Discharges Associated with Construction Activity
GHG	greenhouse gas
GIS	geographic information system
GWh	gigawatt-hour
GWP	global warming potential
H&H	hydrology, hydraulics, and water management
HAP	hazardous air pollutant
HCP	Habitat Conservation Plan
HMBP	Hazardous Material Business Plan
hp	horsepower
Hz	Hertz
I-5	Interstate 5
IFPSC	Interagency Fish Passage Steering Committee
IMPLAN	IMpact analysis for PLANning
in/sec	inches per second
ITA	Indian Trust Asset
ITE	Institute of Transportation Engineers
Jones	CVP C.W. “Bill” Jones Pumping Plant
JPOD	joint points of diversion
KCSA	Keswick County Service Area
km	kilometer
KOP	key observation point
kV	kilovolts
lb/day	pounds per day
L_{dn}	day-night noise level

LEDPA	Least Environmentally Damaging Practicable Alternative
L_{eq}	equivalent noise level
L_{max}	maximum noise level
L_{min}	minimum noise level
LRMP	Land and Resource Management Plan
LSR	Late Successional Reserves
LSSRP	Local Bridge Seismic Safety Retrofit Program
LSZ	low salinity zone
LTGen	LongTermGen, Version 1.18
Lx	statistical descriptor
m	meter
M&I	municipal and industrial
MAF	million-acre feet
MBTA	Migratory Bird Treaty Act
MCV	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 ton
MOA	Memorandum of Agreement
MSCS	Multi-Species Conservation Strategy
msl	mean sea level
MT	metric ton
MW	megawatt
MWh	megawatt-hour
NAVD88	North American Vertical Datum of 1988
NDOI	Net Delta Outflow Index
NED	National Economic Development
NEHRPA	National Earthquake Hazards Reduction Program Act
NEPA	National Environmental Policy Act
NFS	National Forest System
NGVD29	National Geodetic Vertical Datum 1929
NHPA	National Historic Preservation Act
NL	Not Listed
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. Natural Resources Conservation Service
NRHP	National Register of Historic Places
NSR	North State Resources
NSVAB	Northern Sacramento Valley Air Basin
NWFP	Northwest Forest Plan
NWP	Nationwide Permit
OBL	obligate wetland plants
OCAP	Operations Criteria and Plan
OES	Governor's Office of Emergency Services
OHV	Off Highway Vehicle
OMR	Old and Middle River
OPR	Governor's Office of Planning and Research
Oroville Facilities	Edward Hyatt Pumping-Generating Plant, Thermalito Diversion Dam Powerplant, and Thermalito Pumping-Generating Plant
ORV	outstandingly remarkable values
OSHA	Occupational Safety and Health Administration
P&G	*Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies*
PA	programmatic agreement
PCB	polychlorinated biphenyl
PCT	Project Coordination Team
PG&E	Pacific Gas and Electric Company
PM_{10}	respirable particulate matter with an aerodynamic resistance diameter of 10 micrometers or less
$PM_{2.5}$	fine particulate matter with an aerodynamic resistance diameter of 2.5 micrometers or less
Porter-Cologne Act	Porter-Cologne Water Quality Control Act
PPV	peak particle velocity
PRC	Public Resources Code
PSD	New Source Review Prevention of Significant Deterioration
PUD	Public Utilities District
RABA	Redding Area Bus Authority
RBPP	Red Bluff Pumping Plant
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
Resources Agency	California Resources Agency
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
S&M	Survey and Manage
SALMOD	SALMOD, Version 3.8
SB	Senate Bill
SCAQMD	Shasta County Air Quality Management District
SCFD	Shasta County Fire Department
SCSD	Shasta Community Services District
SCSO	Shasta County Sheriff's Department
SCSO	Shasta County Sheriff's Office
SCWA	Shasta County Water Agency
SDWA	Safe Drinking Water Act
SEL	single-event (impulsive) noise level
Settlement	Stipulation of Settlement in *NRDC, et al., v. Kirk Rodgers, et al.*
SHPO	State Historic Preservation Officer
SIP	State implementation plan
SJRRP	San Joaquin River Restoration Program
SLC	State Lands Commission
SLWRI	Shasta Lake Water Resources Investigation
SMAQMD	Sacramento Metropolitan Air Quality Management District's
SMARA	Surface Mining and Reclamation Act of 1975
SMM	standard mitigation measure
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	Shasta River Water Reliability Study
SSLE	Security, Safety and Law Enforcement
State PRC	California Public Resources Code, Section 5093.542
STATSGO	State Soil Geographic Database
STNF LRMP	*Shasta-Trinity National Forest Land and Resource Management Plan*
STNF	Shasta-Trinity National Forest
SVAB	Sacramento Valley Air Basin
SVI	Sacramento Valley Index
SWAP	Statewide Agriculture Production
SWP	State Water Project
SWPPower	State Water Project Power, BST April 2010 Version
SWPPP	Stormwater 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
Thermal Plan	Water Quality Control Plan for the Control of Temperature in the Coastal and Interstate Waters and Enclosed Bays and Estuaries of California
TMDL	total maximum daily load
TNC	The Nature Conservancy
Uniform Act	Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, as amended
UPRR	Union Pacific Railroad
URBEMIS	2007 Urban Emissions model
USACE	U.S. Army Corps of Engineers
USC	U.S. Code
USFS	U.S. Department of Agriculture, Forest Service
USFWS	U.S. Department of Interior, Fish and Wildlife Service
USGS	U.S. Geological Survey

VAMP	Vernalis Adaptive Management Plan
VAU	visual assessment unit
VdB	vibration decibel
VOC	volatile organic compound
VQO	visual quality objective
VRM	Visual Resource Management
WDR	waste discharge requirements
Western	Western Area Power Administration
WOMT	Water Operations Management Team
WQCP	Water Quality Control Plan
WRIMS	Water Resources Integrated Modeling System
WSEL	water surface elevation
WSR	water supply reliability
WSRA	Wild and Scenic Rivers Act
WUI	wildland-urban interface
WWTP	Wastewater Treatment Plant
X2	2 parts per thousand isohaline
X2	estuarine habitat

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Chapter 1
Introduction

This Draft Environmental Impact Statement (DEIS) has been prepared as part of the Shasta Lake Water Resources Investigation (SLWRI) to evaluate the potential physical, biological, cultural, and socioeconomic effects of implementing alternatives to modify the existing Shasta Dam and Reservoir, including taking no action. The SLWRI is led by the U.S. Department of the Interior, Bureau of Reclamation (Reclamation), Mid-Pacific Region.

Reclamation is serving as the Federal lead agency for compliance with the National Environmental Policy Act (NEPA). Under NEPA, a cooperating agency is any 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 pursuant to NEPA, include the U.S. Department of Agriculture, 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 could be used by State of California (State) permitting agencies that would be involved in reviewing and approving the project.

Reclamation completed the Draft *SLWRI Feasibility Report* (Draft Feasibility Report), Preliminary DEIS, and related appendices in November 2011. These documents were released to the public in February 2012, to present potential impacts, costs, and benefits of alternative actions being evaluated to date; to share information generated since the completion of the SLWRI Plan Formulation Report in December 2007; and to provide an additional opportunity for public and stakeholder input.

Since the release of the Draft Feasibility Report and Preliminary DEIS, SLWRI alternatives were refined based on several factors, including updates to Central Valley Project (CVP) and State Water Project (SWP) water operations and stakeholder input. Water operations modeling and related evaluations for this DEIS were updated to reflect the following:

- The 2008 Biological Assessment on the Continued Long-Term Operations of the CVP and SWP (2008 OCAP BA) (Reclamation 2008b)

- The U.S. Department of Interior, Fish and Wildlife Service (USFWS) 2008 *Formal Endangered Species Act Consultation on the Proposed*

Coordinated Operations of the CVP and SWP (2008 USFWS Biological Opinion (BO)) (USFWS 2008)

- The National Marine Fisheries Service (NMFS) 2009 *BO and Conference Opinion on the Long-Term Operations of the CVP and SWP* (2009 NMFS BO) (NMFS 2009b)

- Additional changes in CVP and SWP facilities and operations, such as implementation of the San Joaquin River Restoration Program

Due to shifts in the distribution of project benefits demonstrated in preliminary studies, SLWRI action alternatives were refined to improve the balance of water supply benefits and provide a greater range in alternative focus and operations. These refinements are discussed in detail in Chapter 2, "Alternatives," and the Plan Formulation Appendix. This DEIS reflects revised action alternatives and updates to modeling and related analyses and impact evaluations conducted in 2012.

1.1 Background

Reclamation was established in 1902, to help meet 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 CVP, which stores and delivers about 20 percent of California's developed water—7 million acre-feet (MAF)—to more than 250 water contractors throughout California.

Shasta Dam and Reservoir were constructed between September 1938 and June 1945. Water storage in Shasta Reservoir began in December 1943, and Shasta Dam was fully operable in April 1949. Reclamation operates Shasta Dam and Reservoir in conjunction with other facilities, to provide for the management of floodwater, irrigation water supply, municipal and industrial (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 Reclamation priority equal to water supply, and added "fish and wildlife enhancement" as a priority equal to hydropower generation.

Shasta Dam and Reservoir are integral elements of the CVP, with Shasta Reservoir representing about 41 percent of the total reservoir storage capacity of the CVP. The 602-foot-tall Shasta Dam (533 feet above the streambed) and 4.55-MAF Shasta Reservoir are located on the upper Sacramento River in Northern California, north of the City of Redding (see Figure 1-1) and within the Whiskeytown-Shasta-Trinity National Recreation Area (NRA). Shasta Lake supports extensive water-oriented recreation. Recreation in this area is managed

by the USFS. Shasta Reservoir and Shasta Lake are used interchangeably within this DEIS. Generally, however, Shasta Reservoir is used in references related to water operations for water supply, flood control, and environmental and related regulatory requirements (e.g., operations of the reservoir). In addition, Shasta Reservoir is often used in discussion related to broader CVP and SWP operations or facilities. Shasta Lake is a common name for the reservoir used by the public, and is often associated with describing the locality.

Figure 1-1. Location of Shasta Dam and Reservoir

In 2000, as a result of increasing demands for water supplies and growing concerns over declines in ecosystem resources in California's Central Valley, Reclamation reinitiated a feasibility investigation to evaluate the potential for enlarging Shasta Dam and Reservoir. In conducting the SLWRI and associated development of multiple SLWRI planning documents, Reclamation determined that expanding the capacity of Shasta Reservoir by modifying Shasta Dam could (1) increase survival of anadromous fish in the Sacramento River, and (2) improve water supply reliability for agricultural, 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.

1.1.1 Study Authorization

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

> *…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 U.S. Secretary of the Interior to carry out the activities described in paragraphs (1) through (10) of Subsection (d), which include:

> *...(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 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 conduct feasibility studies of expanding CVP storage in Shasta Lake to:

> *…increase the pool of cold water available to maintain lower Sacramento River temperatures needed by certain fish and provide other water management benefits, such as water supply reliability.*

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 NRA which includes Shasta Dam and Reservoir. Public Law 102-575, the CVPIA, directed numerous changes to CVP operations. Among these changes was adding "fish and wildlife protection, restoration, and enhancement" as a project purpose, which would result in substantial changes to water supply deliveries, river flows, and related environmental conditions in the primary and extended study areas. To minimize impacts to CVP water contractors, the CVPIA also directed

the U.S. 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: *Enlarged Shasta Lake Investigation Preliminary Findings Report* (1983), *Shasta Dam and Reservoir Enlargement, Appraisal Assessment of the Potential for Enlarging Shasta Dam and Reservoir* (1999a), *SLWRI Strategic Agency and Public Involvement Plan* (2003b), *SLWRI Mission Statement Milestone Report* (2003a), *SLWRI Initial Alternatives Information Report* (2004), *SLWRI Environmental Scoping Report* (2006), and *SLWRI Plan Formulation Report* (2007).

As described above, Reclamation also completed the Preliminary DEIS, Draft Feasibility Report, and supporting technical appendices for the SLWRI in November 2011. These documents were released to the public in February 2012.

1.2 Purpose and Need/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, Section 1502.13). In California, the State CEQA Guidelines require a clearly written statement of objectives, including the underlying purpose of a proposed project (Section 15124(b)).

1.2.1 Project Purpose and Objectives

Project Purpose

The purpose of the proposed action is to improve operational flexibility of the Sacramento-San Joaquin Delta (Delta) watershed system by modifying the existing Shasta Dam and Reservoir to meet specified primary and secondary project objectives.

Project Objectives

Two primary project objectives (also referred to as planning objectives) and five secondary project objectives were developed for the SLWRI:

Primary Project Objectives

- Increase the survival of anadromous fish populations in the Sacramento River, primarily upstream from the Red Bluff Pumping Plant (RBPP)

- 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

Secondary Project Objectives

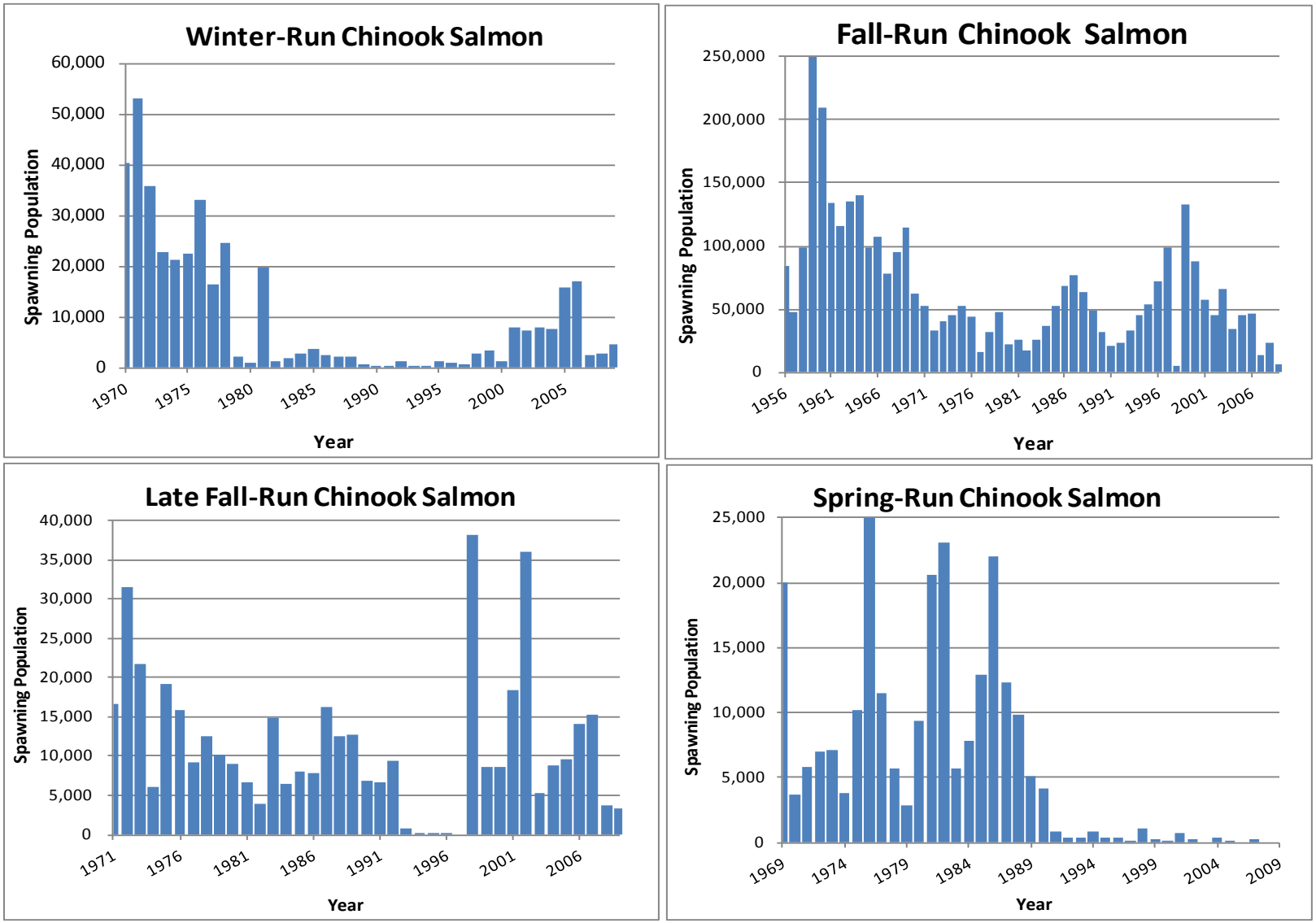
- Conserve, restore, and enhance ecosystem resources in the Shasta Lake area and along the upper Sacramento River
- Reduce flood damage along the Sacramento River
- Develop additional hydropower generation capabilities at Shasta Dam
- Maintain and increase recreation opportunities at Shasta Lake
- Maintain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

Primary project objectives are those which specific alternatives are formulated to address. The two 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 are considered to the extent possible through pursuit of the primary project objectives.

1.2.2 Project Need

Anadromous Fish Survival

The Sacramento River system 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 declined considerably over the last 40 years (Figure 1-2) (CDFG 2010).



Source: CDFG 2010

Figure 1-2. Chinook Salmon Historic Spawning Populations in the Sacramento River

Several fish species in the upper Sacramento River have been listed as endangered or threatened, as defined by the Federal Endangered Species Act (ESA): 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 also are listed as endangered or threatened, as defined by the California Endangered Species Act (CESA): Sacramento River winter-run Chinook salmon (endangered) and Central Valley spring-run Chinook salmon (threatened).

Numerous factors have contributed to these declines. One of the most significant environmental factors affecting the number of Chinook salmon in the upper Sacramento River is unsuitable water temperature (NMFS 2009a). Water temperatures that are too high or, less commonly, too low, can be detrimental to the various life stages of Chinook salmon. Elevated water temperatures can negatively affect holding and spawning adults, egg viability and incubation, preemergent fry, and rearing juveniles and smolts, substantially diminishing the next generation of returning spawners. Stress caused by high water temperatures also may reduce the resistance of fish to parasites, disease, and pollutants.

Releases of cold water from Shasta Reservoir can considerably improve seasonal water temperatures during critical periods for anadromous fish in the Sacramento River downstream from Shasta Dam. The 2009 NMFS Public Draft Recovery Plan states that prolonged droughts depleting the cold-water stored in Shasta Reservoir, or some related failure to manage cold-water storage, could put populations of anadromous fish at risk of severe population decline or extirpation in the long-term (NMFS 2009a). The risk associated with a prolonged drought is especially high in the Sacramento River, as Shasta Reservoir is intended to maintain only one year of carryover storage. The recovery plan emphasizes that, under current conditions, even two consecutive years of drought could reduce Shasta Reservoir storage to levels insufficient to support the Sacramento River winter-run Chinook salmon spawning and incubation season.

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. Three NMFS BO documents (NMFS 1993, 2004, 2009b) 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 minimum flows in the river downstream from Keswick Dam and minimum Shasta Reservoir carryover storage targets primarily to affect water temperatures during key periods.

In addition to flow requirements, structural changes were made at Shasta Dam to change the temperature of released water, such as construction of a temperature control device (TCD), completed in 1997. The TCD can be used to

selectively draw water from different depths within the lake, including the deepest, to help maintain river water temperatures beneficial to salmon. The TCD is effective in helping to reduce winter-run Chinook salmon mortality in some critical water years[1] and for fall- and spring-run Chinook salmon in below-normal water years.

The overall trend for the past 10 years has shown increases in Sacramento River Chinook salmon populations (CDFG 2010). This increasing trend in salmon populations is likely due primarily to minimum release requirements at Shasta Dam, the TCD, and changes in operating the Red Bluff Diversion Dam. In addition, the RBPP is expected to benefit Chinook salmon populations in the Sacramento River. However, there is a residual need for generally cooler water in the Sacramento River, especially in dry and critical water years.

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* (DWR 2009) 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.

Estimated Water Supply Shortages Table 1-1 displays estimated water demands, available supplies, and shortages for the Central Valley and the State under existing conditions (Reclamation 2008a). Current water supply shortages for the State are estimated at 2.3 and 4.2 MAF for average and dry years, respectively. As shown in Table 1-2, without further investment in water management and infrastructure, future shortages are expected to increase to approximately 4.9 and 6.1 MAF in average and dry years, respectively, by 2030. 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. Shortages were determined on a regional basis, assuming that limitations on conveyance and storage would prevent surpluses from one region or use category from filling shortages in another.

[1] Throughout this document, water year types are defined according to the Sacramento Valley Index Water Year Hydrologic Classification unless specified otherwise.

Table 1-1. Estimated Water Demands, Supplies, and Shortages Under Existing Conditions[1]

Item	Hydrologic Basin						State of California	
	Sacramento		San Joaquin		Two-Basin Total			
	Average Year[2]	Dry Year[2]	Average Year[2]	Dry Year[2]	Average Year[2]	Dry Year[2]	Average Year[2]	Dry Year[2]
Population (million)[3]	2.9		2.0		4.9		36.9	
Water Demand (MAF)								
Urban	0.9	0.9	0.6	0.6	1.5	1.5	8.9	9.0
Agricultural	8.7	8.7	7.0	7.0	15.7	15.7	34.2	34.2
Environmental	11.9	9.4	3.1	2.3	15.0	11.7	17.5	13.9
Total	***21.5***	***19.0***	***10.7***	***9.9***	***32.2***	***28.9***	***60.6***	***57.1***
Water Supply (MAF)								
Urban	0.9	0.9	0.6	0.6	1.5	1.5	8.8	8.4
Agricultural	8.7	8.6	6.9	7.0	15.6	15.6	33.2	32.0
Environmental	11.5	8.7	2.5	1.8	14.0	10.5	16.3	12.6
Total	***21.1***	***18.2***	***10.0***	***9.4***	***31.1***	***27.6***	***58.3***	***53.0***
Total Shortage (MAF)[4]	**0.4**	**0.8**	**0.7**	**0.5**	**1.1**	**1.3**	**2.3**	**4.1**

Notes:

[1] Water demands, supplies, and shortages are from the 2008 Reclamation Water Supply and Yield Study

[2] Representative dry and average year supplies and demands were based on adjusted water use and supply data from the 2005 California Water Plan Update (DWR 2005).

[3] Population estimates are from the California Department of Finance (2010)

[4] Total shortages are calculated as the sum of shortages for each category by region and, therefore, may not equal the difference between total demands and supplies. For categories where supply is greater than demand, the shortage is equal to zero.

Key:

MAF = million acre-feet

Table 1-2. Estimated Water Demands, Supplies, and Shortages for 2030[1]

Item	Sacramento and San Joaquin Hydrologic Basins		State of California	
	Two-Basin Total			
	Average Year[2]	Dry Year[2]	Average Year[2]	Dry Year[2]
Population (million)[3]	10.5		49.2	
Water Demand (MAF)				
Urban	2.4	2.5	11.9	12.0
Agricultural	15.0	15.0	31.4	31.4
Environmental	14.9	11.7	17.5	14.0
Total	***32.3***	***29.2***	***60.8***	***57.4***
Water Supply (MAF)				
Urban	1.5	1.5	8.4	8.0
Agricultural	15.6	15.6	32.8	31.5
Environmental	14.0	10.5	16.3	12.6
Total	***31.1***	***27.6***	***57.5***	***52.1***
Total Shortage (MAF)[4]	**1.8**	**2.2**	**4.9**	**6.1**

Notes:

[1] Water demands, supplies, and shortages are from the 2008 Reclamation Water Supply and Yield Study

[2] Representative dry and average year supplies and demands were based on water use and supply data from the 2005 California Water Plan Update (DWR 2005) adjusted for population growth, increasing urban water use, and reductions in irrigated acreage and environmental flow due to insufficient water supplies.

[3] Population estimates are from the California Department of Finance (2010)

[4] Total shortages are calculated as the sum of shortages for each category by region and, therefore, may not equal the difference between demands and supplies. For categories where supply is greater than demand, the shortage is equal to zero.

Key:

MAF = million acre-feet

Potential Effects of Population Growth on Water Demands 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. Some portion of increased population 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 serve replaced 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.

The 2009 *California Water Plan Update* (DWR) estimates changes in future water demands by 2050 considering three different population growth scenarios as well as climate change. Table 1-3 shows results of this study for an average water year (DWR 2009) for the Current Trends scenario assuming that recent population growth trends will continue until 2050.

Table 1-3. Estimated Annual Change in Water Demand in California for 2050

Item	Current Trends
Population (million)	59.5
Irrigated Crop Acreage (million)	8.6
Urban	7
Agricultural	-4.5
Environmental	1
Total	***3***

Potential Effects of Climate Change Another potentially significant factor affecting water supply reliability is climate change. Potential effects of climate change are many and complex (DWR 2006), varying through time and geographic location across the State (Reclamation 2011a). Changes in geographic distribution, timing, and intensity of precipitation are projected for the Central Valley (Reclamation 2011a), which could broadly impact rainfall runoff relationships important for flood management as well as water supply. Additionally, when climate change is considered in projections of future water demand, annual water demand is higher than under a repeat of historical climate (DWR 2009). Other possible impacts range from potential sea level rise, which could impact coastal areas and water quality, to impacts to overall system storage for water supply.

A reduction in total system storage is widely predicted with climate change. Less water held in snowpacks and demand for more flood control space in reservoirs is expected with future climate change. During drought periods, supplies could be further reduced, and expected shortages would be substantially greater.

System Flexibility The CVP and SWP were designed and constructed to accommodate the variability of precipitation in California, seasonally, temporally, and spatially. However, the projects' flexibility has been fully utilized by population growth and increased environmental and ecosystem commitments and requirements since the projects were constructed (Reclamation 2008a).

Chronic water shortages since the early 1900s have led to groundwater overdraft in many regions across the State. Portions of the CVP and SWP were constructed to reduce groundwater overdraft, however increasing water supply demands that cannot be met by the CVP or SWP are causing modern day overdraft conditions.

Increasing CVP and SWP operational constraints have led to growing competition for limited system resources between various users and uses. Urban

and required environmental water uses have each increased, resulting in increased competition and conflicting demands for limited water supplies. For example, the CVPIA, implemented in 1993, dedicated project yield to environmental purposes Table 1-4 illustrates the impacts of the CVPIA on CVP deliveries Current BOs by NMFS and USFWS, resulting in increased Delta pumping constraints and other operational restrictions, coupled with drought conditions, have even further decreased CVP deliveries.

Table 1-4. Impact of CVPIA on CVP Deliveries

CVP Contract Deliveries	All Years			Driest Years		
	Pre-CVPIA Implementation (TAF)	Post-CVPIA Implementation (TAF)	Percent Change	Pre-CVPIA Implementation (TAF)	Post-CVPIA Implementation (TAF)	Percent Change
NOD Urban	176	167	-5%	166	145	-13%
NOD Agriculture	279	234	-16%	169	84	-50%
SOD Urban	134	122	-9%	114	96	-16%
SOD Agriculture	1,588	1,137	-28%	931	471	-49%
Total	**2,176**	**1,660**	**-24%**	**1,381**	**796**	**-42%**

Source: Reclamation 2008a

Notes:

[1] Deliveries were modeled using CalSim-II.

Key:

CVP = Central Valley Project
CVPIA = Central Valley Project Improvement Act
NOD = north of Delta
SOD = south of Delta
TAF= thousand acre-feet

Potential Approaches to Address Water Supply Needs As noted by Reclamation's *Water Supply and Yield Study* (Reclamation 2008a), the *California Water Plan Update* (DWR 2009), and CALFED ROD (2000a), an integrated portfolio of solutions, regional and statewide, is needed to meet future water supply needs. The *Water Supply and Yield Study* 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* 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.

Ecosystem Resources

The health of the Sacramento River ecosystem, as elsewhere in the Central Valley, has been impacted in the last century by conflicts over the use of limited natural resources, particularly water resources. Many of California's rivers and streams have been harnessed for beneficial uses such as hydropower, flood damage reduction, and water supply, contributing to a decline in habitat and native species populations, and a resulting increase in endangered or threatened species listings under the ESA and CESA.

Constructing Shasta Dam has had both negative and positive effects on environmental resources in the region. While the dam displaced valuable riverine and upland habitat, it also created shoreline and shallow water habitat for aquatic, terrestrial, and avian species in the reservoir area. For example, Shasta Lake is home to the largest concentration of nesting bald eagles in California, with 18 pairs nesting within 0.5 miles of the shoreline in any given year.

Shasta Lake Area Various activities have impacted natural resources upstream from Shasta Dam, within the lake, on adjacent lands, and in and near tributary streams. Historical mining, ore processing practices and resulting acid mine drainage, fire suppression, and development in the watershed are among the activities causing the greatest degradation to ecosystem resources in this area. Although most mines in this area are no longer operational and many are currently undergoing remediation, they continue to remain a documented source of metals, acidity, and sediments in the reservoir area.

Aquatic habitats in tributaries to Shasta Lake have been affected by passage barriers and human disturbances that have caused various types of habitat degradation. Fish passage barriers are caused by the presence of road crossings and culverts, grade controls, and adverse water quality conditions, particularly high water temperature or toxic materials. Human disturbances have resulted in downcutting of stream channels, a reduction of shaded riparian habitat, and increased water temperatures. Other types of disturbance (e.g., wildland fire, road construction) have resulted in increased sediment transport into streams and a reduction in spawning habitat due to sedimentation of spawning gravels.

To guide management of the Shasta-Trinity National Forest (STNF), USFS has prepared the *Shasta-Trinity National Forest Land and Resource Management Plan* (STNF LRMP) (USFS 1995). Primary goals of the STNF LRMP, which was implemented in 1995, are to integrate a mix of management activities that allows use and protection of forest resources; meets the needs of guiding legislation; and addresses local, regional, and national issues. The STNF LRMP is intended to guide implementation of the *Aquatic Conservation Strategy of the Northwest Forest Plan* (USFS 1994) for protection and management of riparian and aquatic habitats adjacent to Shasta Lake. However, opportunities exist to further support ongoing USFS programs. These opportunities include improving and restoring environmental conditions by developing self-sustaining natural habitat in the area of Shasta Lake and its tributaries to benefit fish and wildlife resources.

Downstream from Shasta Dam Land and water resources development has caused major resource problems and challenges in the Sacramento River basin, including decreases in anadromous fish and wildlife populations and losses of riparian, wetland, floodplain, and shaded riverine habitat. These decreases and losses have resulted in reduced populations of many plant and animal species.

The quantity, quality, diversity, and connectivity of riparian, wetland, floodplain, and shaded riverine habitat along the Sacramento River have been severely limited through confinement of the river system by levees, reclamation of adjacent lands for farming, bank protection, channel stabilization, and land development. Modification of seasonal flow patterns by dams and water diversions also has inhibited the natural channel-forming processes that drive riparian habitat succession. It is estimated that less than 5 percent of the historical acreage of riparian habitat within the Sacramento River basin remains today (Huber-Lee et al. 2003).

Decreases in quality and quantity of habitat have resulted in reduced populations of various fish and wildlife species. Introduction of nonnative species has also contributed to the decline in native animal and plant species. In addition, lack of linear continuity of riparian habitat has impacted the movement of wildlife species among habitat areas, adversely affecting dispersal, migration, emigration, and immigration. For many species, this has resulted in reduced wildlife numbers and population viability.

Ecosystem restoration along the Sacramento River has been the focus of several ongoing programs, including the Senate Bill 1086 Program, CVPIA, CALFED, and Central Valley Habitat Joint Venture. Despite these efforts, a significant need remains to conserve and restore ecosystem resources along the Sacramento River.

Endangered and threatened fish and wildlife populations, critical habitat, and sensitive Delta ecosystems are also declining. The decline is especially pronounced in the case of pelagic fish species in the Delta, including delta smelt, striped bass, threadfin shad, and longfin smelt. Observations of sharp declines in fish population have resulted in restrictions on Delta water operations to protect fish populations during environmentally sensitive periods. Legal actions concerning the impacts of CVP and SWP operations on fish populations, such as the December 2007 *Natural Resources Defense Council v. Kempthorne* (delta smelt), court decision and the May 2008 *Pacific Coast Federation of Fishermen's Associations vs. Gutierrez* (anadromous fish species) court decision, continue to shape water management in the Sacramento River basin and Delta.

Current planning efforts, such as the Bay Delta Conservation Plan/ Delta Habitat Conservation and Conveyance Program are focused on developing ecological solutions to protect Delta fisheries while providing a sustainable and reliable water conveyance system for the CVP and SWP.

Flood Management

Large and small communities and agricultural lands in the Central Valley are subject to flooding along the Sacramento River. The comprehensive flood control system in the Sacramento River basin includes river, canal, and stream

channels, levees, flood relief bypasses, weirs, flood relief structures, a natural overflow area, outfall gates, and drainage pumping plants.

Flooding poses risks to human life, health, safety, and property. Physical impacts from flooding include damage to buildings, contents, automobiles, agricultural crops, equipment, etc. Threats from flooding are caused by many factors, including overtopping or sudden failures of levees, which can cause deep and rapid flooding with little warning, threatening lives and public safety. In addition, urban development in flood-prone areas has exposed the public to the risk of flooding.

Hydropower

While California is the second largest consumer of electricity, it is also the most energy efficient. Although California has 12 percent of the Nation's population, it uses only 7 percent of the Nation's electricity. Even so, demands for electricity are growing at a rapid pace. Over the next 10 years, California's peak demand for electricity is expected to increase 30 percent, from about 50,000 megawatts (MW) to about 65,000 MW. There are, and will continue to be, increasing demands for new electrical energy supplies, including clean energy sources, such as hydropower. Executive Orders S-14-08 and S-21-09, issued in 2008 and 2009 respectively, established a goal of using renewable energy sources, including hydropower, for 33 percent of the State's energy consumption by 2020 (California Public Utilities Commission 2011). Adding to the need for additional energy sources, existing nuclear power plants are nearing the end of their design lives and some may be offline within the next 10 to 20 years.

Recreation

As the population of the State of California continues to grow, demands will increase substantially for water-oriented recreation at and near the lakes, reservoirs, streams, and rivers of the Central Valley. According to the 2009 *California Water Plan Update* (DWR 2009), the Central Valley is experiencing dramatic population growth, but currently has insufficient access to water-dependent recreation opportunities. Further increases in demand, accompanied by relatively static recreation resources, will cause additional issues at existing recreation areas. These challenges will be especially pronounced at Shasta Lake, which is one of the most visited recreation destinations in the state and in the region. Even under current levels of demand, USFS, which manages recreation at Shasta Lake, has expressed concern about seasonal access and capacity problems at existing marinas and USFS facilities. A substantial and increasing need exists to improve recreation-related facilities and conditions at Shasta Lake.

Water Quality

The Sacramento River and the Delta support fish and wildlife while providing water supplies for urban, agricultural, and environmental uses across the state. Saltwater intrusion, municipal discharges, agricultural drainage, and water

project flows and diversions have led to water quality issues within the Delta, particularly related to salinity, that have resulted in significant declines in pelagic populations (Cal Water Boards, SWRCB, and CalEPA 2006). Urban and agricultural runoff, and runoff and seepage from abandoned mining operations, have resulted in elevated levels of pesticides, phosphorous, mercury, and other metals in the Sacramento River.

Planning efforts, such as the Bay Delta Conservation Plan, are intended to allow implementation of projects that restore and protect water supply and reliability, water quality, and ecosystem health in the Delta to proceed within a stable regulatory framework. Additional operational flexibility could provide further opportunities to improve Sacramento River and Delta water quality conditions.

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. The SLWRI includes both a primary and extended study area because of the potential influence of the proposed modification of Shasta Dam 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
- Sacramento River between Shasta Dam and RBPP, including tributaries at their confluence
- Trinity and Lewiston reservoirs

The extended study area includes the following:

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

The SLWRI study areas include 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 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 Shasta Lake, the lower portions of all contributing major and minor tributaries affected by increasing storage in the reservoir, and the Sacramento River upstream from RBPP. Figure 1-3 shows the portion of the primary study area downstream from Shasta Dam.

Shasta Dam

Shasta Dam is a curved gravity concrete dam on the Sacramento River above Redding, California. The dam is 602 feet high and 3,460 feet long, with a base width or thickness of 543 feet. Upon construction, Shasta Dam was the second tallest and second largest concrete dam in the world, 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 2004).

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. 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. As part of the McCloud-Pit Hydroelectric Project, a majority of the McCloud River flows are diverted to the Pit River at the McCloud Dam, through the McCloud-Iron Canyon Diversion Tunnel and Iron Canyon Reservoir.

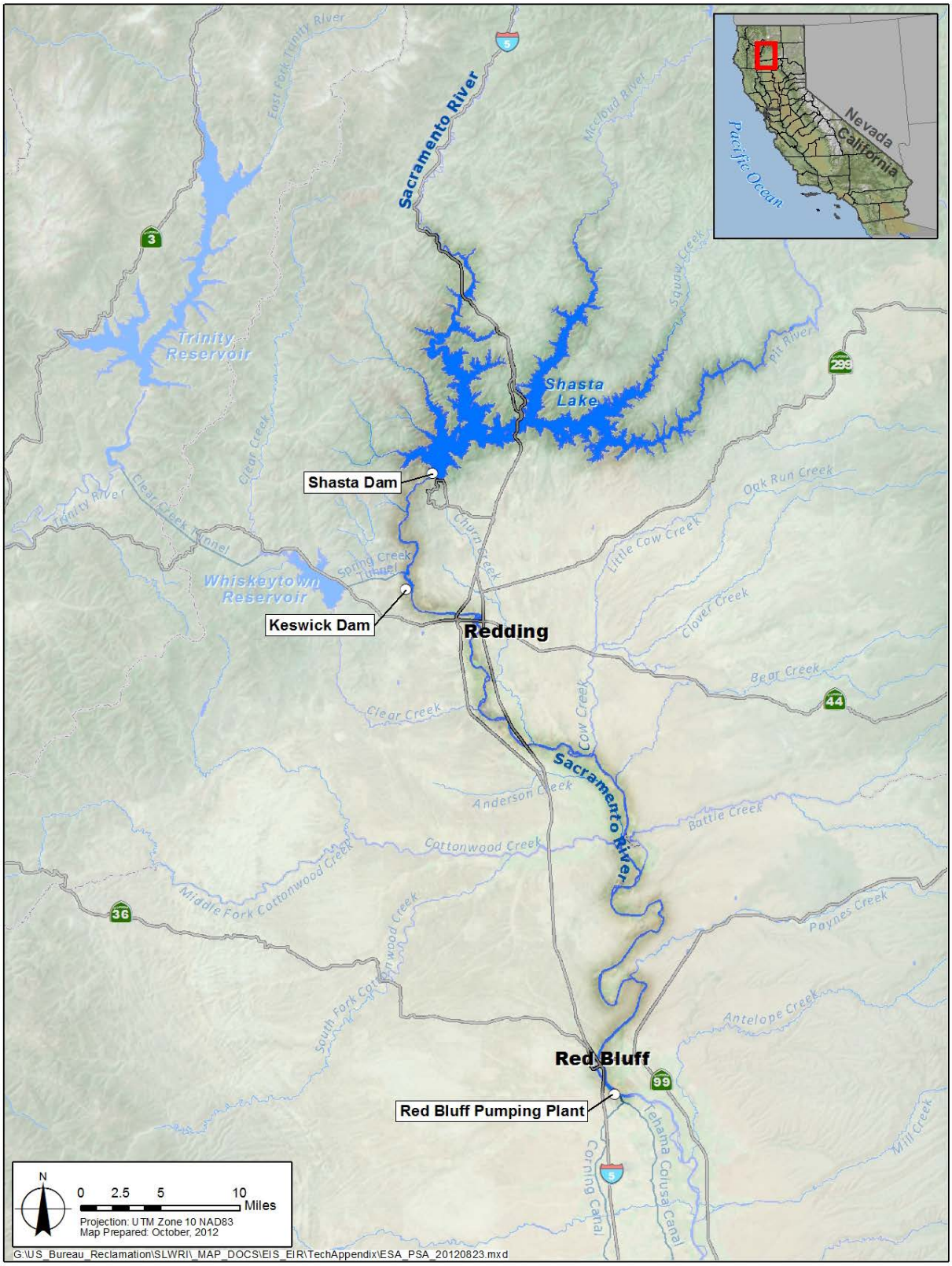


Figure 1-3. Primary Study Area—Shasta Lake Area and Sacramento River from Shasta Dam to Red Bluff Pumping Plant

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.

Upper Sacramento River — Shasta Dam to Red Bluff Pumping Plant

This portion of the primary study area includes an approximately 65-mile-long stretch of the Sacramento River corridor from Shasta Dam to RBPP, including tributaries at their confluence. The Sacramento River corridor within this reach also includes proposed sites for riparian, floodplain, and side channel habitat restoration 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 Red Bluff Diversion Dam are located on the Sacramento River in this area. The recently constructed RBPP is directly adjacent to the Red Bluff Diversion Dam which is currently operated year round with all of the gates removed. Urban, residential, industrial, and agricultural land uses predominate along the upper Sacramento River between Shasta Dam and RBPP.

The location of the RBPP was chosen as the downstream boundary of the primary study area because cold water released from Shasta Dam significantly influences water temperature conditions in the Sacramento River between Keswick Dam and the RBPP (NMFS 1993). After the RBPP, the river landscape changes to a broader, alluvial stream system. The broader, slower nature of an alluvial stream system allows ambient air temperature to have a greater effect on the temperature of the Sacramento River.

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 165 square miles 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 Clear Creek Tunnel and Whiskeytown Lake (See Figure 1-4).

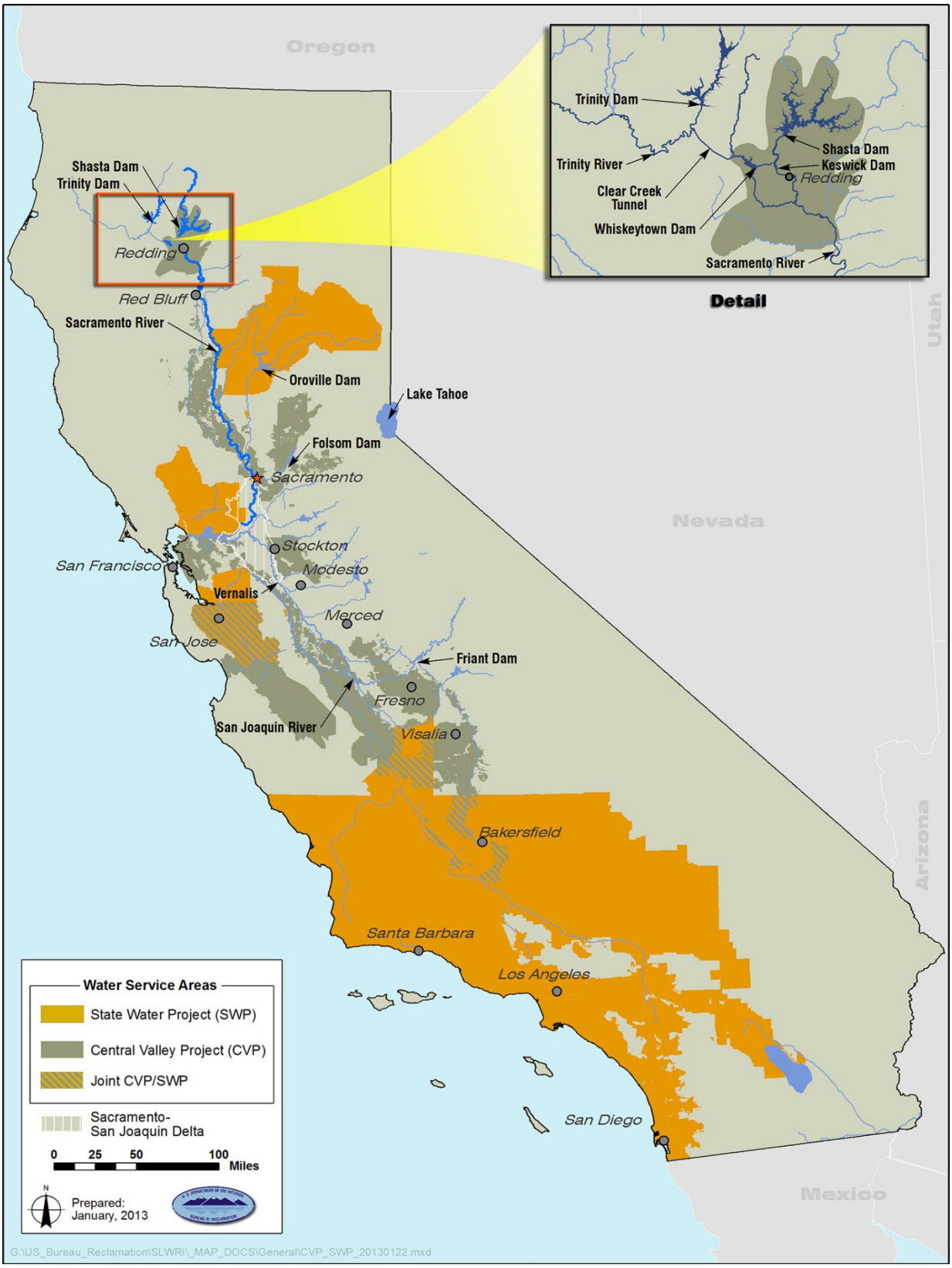


Figure 1-4. Central Valley Project and State Water Project Facilities and Water Service Areas

1.3.1 Extended Study Area

The extended study area includes the Sacramento River downstream from RBPP 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 1-4).

Sacramento River from Red Bluff Pumping Plant to the Delta

The segment of the extended study area between RBPP 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 middle reach of the Sacramento River between Red Bluff and Colusa is approximately 100 miles long. The lower reach of the Sacramento River between Colusa and the Delta is approximately 84 miles long.

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).

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 also is 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 on the Stanislaus River and Friant Dam on the San Joaquin River are 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 power plants, and more than 500 miles of major canals and aqueducts. CVP divisions include 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 700 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. In 1951, the State Legislature authorized the SWP, 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. 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 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 Compliance

NEPA requires 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 impacts of a proposed action on the human environment, including the natural and physical environment and the relationship of people with that environment. The environmental impacts of a

range of reasonable alternatives, including a no-action alternative, are analyzed in this DEIS 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 was the appropriate NEPA document to be prepared. Consequently, this DEIS has been made available for public review and comment, and a Final EIS and ROD will be published subsequently.

The EIS, when finalized, will satisfy NEPA requirements for formulating and evaluating alternative actions, disclosing environmental impacts, and identifying potential mitigation measures. Section 1.5, "Intended Use of 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. The steps in the environmental review process and public and stakeholder outreach are further described in Chapter 27, Public Involvement, Consultation, and Coordination.

1.5 Intended Use of EIS

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. An EIS identifies and evaluates alternatives that meet the project objectives, analyzes the potential environmental effects, and identifies measures to reduce or avoid potential environmental effects resulting from the action alternatives (i.e., mitigation measures). An EIS also must disclose adverse environmental impacts that cannot be avoided, cumulative impacts, the relationship of short-term uses and long-term productivity, and irreversible and irretrievable commitments of resources. In addition, NEPA requires that an EIS consider indirect effects of a project, which are often the result of growth inducement.

This DEIS is being circulated for review and comment by agencies, stakeholders, and the public to inform and engage interested persons in the planning and NEPA processes. Comments received during the public review period will be considered and responses to comments will be included in the Final EIS. Continued public outreach, including public hearings, will be conducted before completion of the Final EIS.

1.5.1 Intended Use of Final EIS

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 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 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 1-5 presents the roles and responsibilities of Federal, State, and local agencies that may use the Final EIS to support their decision-making needs.

The Final EIS will be published along with the Final Feasibility Report. The Final Feasibility Report will incorporate information contained in the Final EIS by reference, and will be used to determine the type and extent of Federal interest in enlarging Shasta Dam and Reservoir. The Final EIS and Final Feasibility Report will be used together to support the Federal decision, which will be documented in the ROD(s).

Table 1-5. Agency Roles and Responsibilities

Agency	Role/Responsibility
Federal	
U.S. Department of the Interior Secretary	Ultimate responsibility for recommending actions to Congress. Also responsible for ROD.
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 the 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
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. 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

Table 1-5. Agency Roles and Responsibilities (contd.)

Agency	Role/Responsibility
Federal (contd.)	
National Marine Fisheries Service	Completing Federal Endangered Species Act consultation and incidental take authorization; verifying compliance with the Magnuson-Stevens Act
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 impacts 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 the EIS
State	
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 Wildlife (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 an encroachment permit and/or approving a transportation management plan
California Department of Water Resources	Operating the SWP; 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	Conducting consultation pursuant to 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

Table 1-5. Agency Roles and Responsibilities (contd.)

Agency	Role/Responsibility
State (contd.)	
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	Issuing 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
Delta Stewardship Council	Consistency with the Delta Plan
California Water Commission	Quantification of public benefits of water storage projects
Local	
Shasta County Air Quality Management District	Reviewing impacts on air quality and granting authority to construct/permit to operate
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
Resource Conservation Districts	Verifying consistency with protected agricultural lands in the project's primary and extended study areas

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

1.5.2 USFS Use of EIS

The following sections describe the USFS purpose and need, proposed USFS permitting actions, and related actions that may be required if a project is authorized for construction.

Background

Reclamation is evaluating the feasibility of raising Shasta Dam to increase water storage capacity in Shasta Lake. The increased reservoir would expand the inundation area onto National Forest System (NFS) lands within the NRA. The USFS has jurisdiction over the NFS lands within the NRA. Expansion of the reservoir will require authorization by permit, or other suitable instrument, issued by the USFS to Reclamation under the authority of the Federal Land Policy and Management Act (43 U.S. Code Section 1761(a)(1)). The USFS would also need to approve other actions associated with expanding the reservoir.

Purpose and Need for USFS Permitting Actions

The purpose of the proposed action is to respond to a proposal from Reclamation to modify Shasta Dam and expand Shasta Lake. The USFS action is needed because much of the increased reservoir inundation and connected actions would occur on NFS lands which are under USFS jurisdiction. The USFS manages the NRA to provide, in a manner coordinated with the other purposes of the CVP, for the public outdoor recreation use and enjoyment of NRA lands, and the conservation of scenic, scientific, historic, and other values contributing to the public enjoyment of such lands and waters.

USFS Decision Framework

Subject to Congressional authorization of a project, the USFS decision will:

- Determine terms and conditions to include in the special use permit, or other suitable instrument, issued to Reclamation
- Identify the specific changes to USFS facilities
- Identify the specific amendments to permits authorizing improvements on NFS lands
- Amend the STNF LRMP standards and guidelines

Proposed USFS Permitting Actions

If Congress authorizes a project involving modifications of Shasta Dam and Reservoir, the USFS proposes to issue a special use permit, or other suitable instrument, to Reclamation for occupancy and use of NFS lands associated with the expanded reservoir and associated facilities. The following actions would be subject to USFS jurisdiction if they are located on NFS land.

Vegetation Clearing in the Inundation Zone Vegetation will be managed within the inundation zone according to an approved vegetation management strategy. Treatments will range from no treatment to full removal as described in Chapter 2 of this EIS. The merchantable timber may be cut and sold without advertisement as provided by 36 CFR 223.12.

Constructing Dikes on NFS lands to Protect Local Infrastructure Dikes would be constructed by Reclamation in select areas to protect local infrastructure from inundation. Reclamation will also develop local sources for fill material. Both dikes and associated borrow sites are proposed on NFS lands in the following areas: dikes in the vicinity of Lakeshore and Bridge Bay, and various locations for borrow area.

Relocation or Replacement of Recreation Facilities Recreation facilities impacted by increased inundation would be relocated or replaced by Reclamation. This includes facilities operated under permit such as resorts and marinas, and USFS operated facilities such as campgrounds and boat ramps.

The USFS would have a connected action to amend the affected permits for privately operated recreation facilities. These facilities include: USFS administrative facilities including Turntable Bay and Lakeshore Fire Station; USFS recreation facilities; and permitted recreation facilities.

Relocation or Replacement of Infrastructure Reclamation will relocate or replace infrastructure such as roads, trails, water systems, and sewer systems impacted by the inundation zone. This includes facilities operated under permit such as power lines and local roads, and USFS infrastructure such as roads and trails. The USFS action includes amending the affected permits for the infrastructure relocated as part of the project. Potential impacted infrastructure may include the following or similar: USFS roads, USFS trails, other permitted roads (e.g., Shasta County, private property access roads, utility access road, railroad access roads), power line permits, water systems (e.g., Lakeshore Heights water storage, Shasta County Service Areas 2 and 6), and telecommunications.

Shasta-Trinity National Forest Land and Resource Management Plan The overall project actions, as authorized by Congress, may not be consistent with the STNF LRMP (USFS 1995) standards and guidelines. A project specific STNF LRMP amendment may be required for the standards associated with caves, visual quality, late successional reserves, riparian reserves, survey and manage species, and Shasta snow-wreath. The USFS decision would include a project specific exception to these standards.

Caves The STNF LRMP adopted a standard for cave management that states:

> *"Manage these unique habitats on a site-by-site basis to protect their existing micro environments and the viability of dependent animal and plant species. Manage nearby water sources to perpetuate natural cave processes."*

Visual Quality The STNF LRMP adopted Visual Quality Objectives (VQO) for the planning area. VQOs that may be affected by action alternatives include retention, partial retention, and modification.

Late Successional Reserves The STNF LRMP adopted standards for the development of new facilities that may adversely affect Late-Successional Reserves. The STNF LRMP specifies:

> *New development proposals that address public needs or provide significant public benefits, such as powerlines, pipelines, reservoirs, recreation sites, or other public works projects will be reviewed on a case-by-case basis and may be approved when adverse effects can be minimized and mitigated. These will be planned to have the least possible adverse impacts on Late-Successional Reserves. Developments will be located*

> *to avoid degradation of habitat and adverse effects on identified late-successional species.*

Riparian Reserves The STNF LRMP direction for surface water developments in Riparian Reserves states:

> *For hydroelectric and other surface water development proposals, give priority emphasis to in-stream flows and habitat conditions that maintain or restore riparian resources, favorable channel conditions, and fish passage. Coordinate this process with the appropriate state agencies.*

Survey and Manage The STNF LRMP direction for survey and manage species generally requires protection of known sites and surveys of other areas prior to ground disturbing activities. This direction was updated in the *Record of Decision and Standards and Guidelines for Amendments to the Survey and Manage, Protection Buffer, and Related Mitigation Measures Standards and Guideline*s (USFS and BLM 2001). These standards are intended to reduce or eliminate (mitigate) potential effects from agency actions to identified flora and fauna species including mosses, liverworts, fungi, lichens, vascular plants, slugs, snails, salamanders, great gray owl, and red tree voles. This ROD is being implemented consistent with species list and exceptions identified in the *Settlement Agreement in litigation over the Survey and Manage Mitigation Measure in Conservation Northwest et al. v. Sherman et al., Case No. 08-1067-JCC* (USFS and BLM 2011). Several known occurrences of survey and manage species occur within the project area, including the Shasta salamander. The STNF LRMP direction requires that know sites be protected from disturbance during management.

Shasta Snow-Wreath The STNF LRMP direction for the Shasta snow-wreath states:

> *Search for additional populations of Shasta snow-wreath and Scott Mountain fawn lily. Avoid disturbance pending completion of a conservation strategy.*

To date, a conservation strategy has not been developed for the Shasta snow-wreath by USFS.

1.6 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 SLWRI public outreach activities, including public scoping activities, agency meetings, and related ongoing public outreach activities. Major concerns include:

- **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 potential effects of inundating the sites they value for current and historical culturalsignificance 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 9 private marinas with 1,040 houseboats and 18 public campgrounds. Stakeholders are concerned about possible adverse effects on recreation at Shasta Lake, such as inundation impacts on concessionaires and their facilities and related potential impacts on the regional economy.

- **Impacts on McCloud River's Free-Flowing Condition or Wild Trout Fishery** – The McCloud River is not formally designated as either a National or State wild and scenic river; however, 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 should be 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 (California Public Resources Code, Sections 5093.50 through 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 was 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.*

In addition, Section 5093.542(d) of the California Public Resources Code 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, has varied by the agency's mandate and Section 5093.542 of the California Public Resources Code. The California Department of Fish and Wildlife (CDFW, formerly known as the California Department of Fish and Game [CDFG]), 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 seeks to protect the free-flowing condition of the McCloud River, it also provides 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 impacts concern property owners around Shasta Lake.

- **Impacts on the 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 along the shoreline
  - 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.

- **CVP and SWP Operational Assumptions** – Operational constraints for the CVP and SWP are affected by changing regulatory conditions in California. For this DEIS, CVP and SWP operational assumptions were based on operations described in Reclamation's 2008 OCAP BA, the 2008 USFWS BO, the 2009 NMFS BO, and Coordinated Operations Agreement between Reclamation and DWR, as ratified by Congress. However, the ongoing reconsultation processes for the 2008 USFWS and 2009 NMFS BOs have resulted in some uncertainty in future CVP and SWP operational constraints.

1.6.2 Issues to Be Resolved

Efforts are underway to resolve the following issues described below.

Native American Concerns and Cultural Resources

This DEIS is consistent with Section 106 of the National Historic Preservation Act and describes 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 National Historic Preservation Act Section 106 process. No Federally recognized tribes reside in the immediate Shasta Lake area. However, the Winnemem Wintu have raised concerns about potential impacts of enlarging Shasta Dam on sites they value for historical and cultural significance. The Winnemem Wintu would continue to have the opportunity to participate, and are anticipated to continue to provide input as an invited consulting party, through the Section 106 process 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 included only 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 use a wide range of habitats for some aspect of their life history, analyses presented in this DEIS 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 project have been identified near the study area. A comprehensive mitigation strategy is currently under development. 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, "Alternatives." Water rights for the expanded Shasta Reservoir, which would be appropriated by the State Water Resources Control Board, would need to be in place before the project could operate. Evaluation of water rights for potential enlargement of Shasta Reservoir will remain a focus of Reclamation.

Identification of Preferred Alternative

Consistent with Council on Environmental Quality (CEQ) guidance and NEPA guidelines, the preferred alternative for implementation will be identified in the Final EIS. The following guidance is provided in the 2009 CEQ Draft *Proposed National Objectives, Principles, and Standards for Water and Related Resources Implementation Studies* (CEQ 2009):

> *Opportunities shall be provided for public reaction and input prior to key study decisions, particularly the tentative and final selection of recommended plans.*

Accordingly, the preferred alternative will be identified in the Final EIS, in consideration of public, stakeholder, and agency comments on this DEIS. Ultimately, the alternative that best meets the stated objectives and maximize net public benefits will be identified with supporting rationale and documentation. The alternative recommended for implementation may or may not be identified as the Environmentally Preferable Alternative, consistent with

NEPA; the National Economic Development (NED) Plan, consistent with the U.S. Water Resources Council ‘s Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies (WRC 1983); the Least Environmentally Damaging Practicable Alternative, consistent with the Clean Water Act; and the Environmentally Superior Alternative, consistent with CEQA.

1.7 Documents Used to Prepare DEIS

The CVPIA and the overall goals and objectives of the CALFED were considered throughout the SLWRI study process and during development of this DEIS. However, the analyses in this DEIS consider but do not tier from the assessments in the *CVPIA Final Programmatic EIS* (Reclamation 1999b) and *CALFED Final Programmatic EIS/Environmental Impact Report* (EIR) (CALFED 2000b).

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 Final Programmatic EIS (Reclamation 1999b) 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 DEIS uses information contained in the CVPIA Programmatic 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/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 studies to-date and this associated EIS would be consistent with applicable components of the CALFED *Programmatic EIS/EIR*, but the SLWRI EIS does not tier from that EIS/EIR.

1.8 Organization of DEIS

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 Final EIS and areas of controversy and issues to be resolved; and discusses documents used to prepare this DEIS.

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

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 resource chapters that follow.

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

- **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 Farmland"**
- **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"**

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 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 DEIS.

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 DEIS.

Chapter 30, "List of EIS Preparers," lists individuals who participated in preparation of this DEIS, and provides the qualifications of 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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