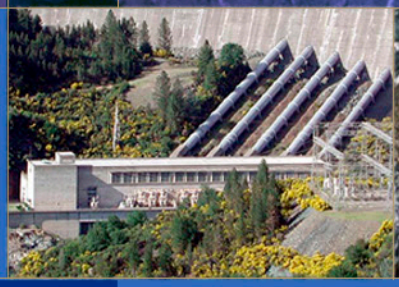
Department of the Interior Final

Shasta Lake Water Resources Investigation

Environmental Impact Statement




December 2014

Mission Statements

Protecting America's Great Outdoors and Powering Our Future

The Department of the Interior protects and manages the Nation's natural resources and cultural heritage; provides scientific and other information about those resources; and honors its trust responsibilities or special commitments to American Indians, Alaska Natives, and affiliated island communities.

The mission of the Bureau of Reclamation is to manage, develop, and protect water and related resources in an environmentally and economically sound manner in the interest of the American public.

Final Environmental Impact Statement
Shasta Lake Water Resources Investigation

United States Department of the Interior
Bureau of Reclamation, Mid-Pacific Region
2800 Cottage Way, MP-700
Sacramento, CA 95825

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

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 EIS evaluates the potential environmental effects of alternative plans to enlarge Shasta Dam and Reservoir to (1) increase anadromous fish survival in the upper Sacramento River, primarily upstream from Red Bluff 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 multiple 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 June 2013, Reclamation released the SLRWI Draft Environmental Impact Statement (DEIS) and appendices to the public. The public comment period closed September 2013. Over 600 comment letters were received on the DEIS. The Final EIS and related appendices include responses to public comments (Chapter 33, “Public Comments and Responses”) and related refinements to alternatives and impact evaluations and the identification of the preferred alternative.

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

Shasta Lake Water Resources Investigation, California Final Environmental Impact Statement

Prepared by:

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

December 2014

Executive Summary

S.1 Introduction and Background

This Environmental Impact Statement (EIS) 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) (WRC 1983), 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 (USACE); and U.S. Department of the Interior (Interior), Bureau of Indian Affairs (BIA). This document has also been prepared in consideration of California Environmental Quality Act (CEQA) requirements.

Reclamation completed the *SLWRI Draft Feasibility Report* (Draft Feasibility Report), *SLWRI Preliminary Draft EIS* (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 the action alternatives that had been evaluated at that time; 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.

After the release of the Draft Feasibility Report and Preliminary DEIS, SLWRI alternatives were refined for the Draft EIS (DEIS) 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 the DEIS and this Final EIS reflect the following:

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

- Additional changes in non-CVP/SWP facilities and operations, such as the addition of the Freeport Regional Water Project

Reclamation released the DEIS for public review and comment in June 2013. In compliance with NEPA, a Notice of Availability (NOA) was published by Reclamation in the *Federal Register* (Federal Register Vol. 78, No. 126, 39315) on Monday, July 1, 2013, and an associated NOA was published by the U.S. Environmental Protection Agency (EPA) in the *Federal Register* (Federal Register Vol. 78, No. 129, 40474) on Friday, July 5, 2013.

Reclamation held three public workshops and three public hearings during the comment period on the DEIS. Each set of meetings were held in Redding, Sacramento, and Los Banos. Written and verbal comments were accepted at meetings and written comments were accepted throughout the comment period. The comment period on the DEIS began on July 1, 2013 and closed on September 30, 2013.

The public comments have been reviewed and, in accordance with NEPA Council on Environmental Quality (CEQ) Regulations, responses have been developed for all substantive comments and revision of the DEIS have been made to clarify and enhance the text to produce this SLWRI Final EIS. This Final EIS consists of revised chapters 1 through 31, a new Chapter 32, “Final EIS,” a new Chapter 33, “Public Comments and Responses,” and revised and new appendices.

During the process of addressing public comments on the DEIS, some notable content changes were made to this Final EIS, including:

- Refinement of the project purpose statement

- Clarification of the relationship of this EIS and tiering to the CALFED Bay-Delta Program (CALFED) Programmatic Environmental Impact Statement/Environmental Impact Report (PEIS/R)

- Refinement of the operational scenarios focused on anadromous fish survival, and the development, evaluation, and incorporation of Comprehensive Plan 4A (CP4A)

- Refinement of facility plans for recreation relocations, Shasta Dam modifications, Pit 7 Dam and Powerhouse modifications, and other reservoir area relocations (e.g., power transmission lines)

- Incorporation of updated resource information related to physical and biological resources in the primary study area

- Refinement of "maximum" affected areas and refinement of "most likely" affected areas for biological resources, based on facility and construction footprints

- Refinement and enhancement of the mitigation measures, including development of a framework to quantify impacts (where appropriate) and establish mitigation ratios that are applicable to a number of impacts related to biological resources, in conjunction with an interagency, interdisciplinary team

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 "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 the CALFED Programmatic Record of Decision (ROD), 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

the authority for conducting a feasibility study for the SLWRI. It 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 Programmatic ROD called for the Secretary of the Interior to conduct feasibility studies for 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.

S.3 Intended Use of Environmental Impact Statement

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.

The SLWRI is one of five surface storage projects recommended for project-specific studies in the 2000 CALFED PEIS/R Preferred Program Alternative and associated CALFED Programmatic ROD. Consistent with guidance in the CALFED Programmatic ROD, this EIS relies on and tiers to the CALFED PEIS/R.

The SLWRI DEIS was released to the public in June 2013 and was circulated for review and comment by agencies, stakeholders, and the public to inform and engage interested persons in the planning and NEPA processes. Public outreach, including public workshops and hearings, was conducted during the 90-day DEIS public review period. Comments received during the public review period were considered and addressed and all comments and responses to comments are included in this Final EIS.

Reclamation posted the Final EIS at http://www.usbr.gov/mp/slwri for public review and issued a notice in the Federal Register and press release describing the public release of the Final EIS. It will 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 this 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.

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” (Title 40, Code of Federal Regulations (CFR) Part 1502.13). In California, the State CEQA Guidelines require a clearly written statement of objectives, including the underlying purpose of a proposed project (Title 14, California Code of Regulations Section 15124(b)).

S.4.1 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 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 declined considerably 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, 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 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) *California Water Plan Update 2013* concludes that California is facing one of the most significant water crises in its history; drought impacts are growing, and climate change is affecting statewide hydrology. Challenges are greatest during dry years, when water supplies are less available. Despite significant physical improvements in water resource systems and in system management over the past few decades, California still faces unreliable water supplies, continued depletion and degradation of

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

groundwater resources, habitat and species declines, and unacceptable risks from flooding.

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 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 along the Sacramento River 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, contributing 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, equipment, etc. 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. According to the California Energy Commission's *2012 Integrated Energy Policy Report Update*, over the next 10 years, California's peak demand for electricity is expected to increase at a rate of approximately 1.5 percent per year through 2022, from about 60,000

megawatts (MW) in 2011 to about 70,000 MW by 2022. 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. To implement recent California renewable resources mandates, significant increases in non-dispatchable intermittent renewable resources, such as wind and solar generation, will need to be added to California's power system. This means that other significant flexible generation resources, such as hydropower, will be needed to support and integrate renewable generation. 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.

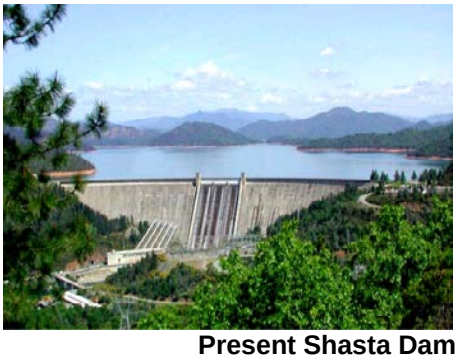
Recreation

As California's population continues to grow, demands will increase substantially for recreation opportunities 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 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. 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 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 Lake; 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 reservoirs and related facilities; the San Francisco Bay/Sacramento-San Joaquin Delta (Bay-Delta); lower portions of the San Joaquin River basin downstream from CVP reservoirs and related facilities (Friant and New Melones reservoirs); and CVP and SWP facilities and water service areas (shown in Figure S-3).

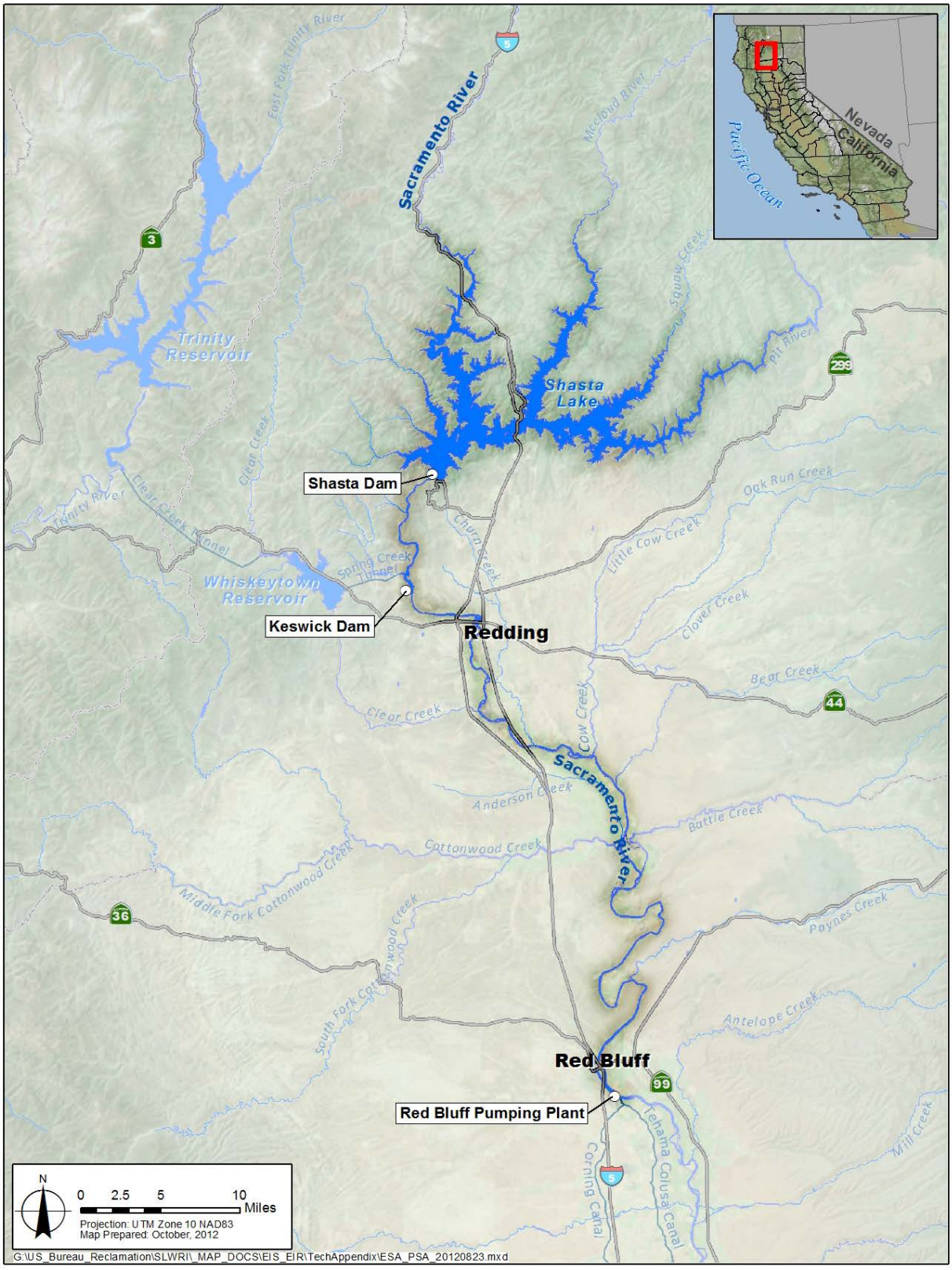


Figure S-2. Primary Study Area – Shasta Lake Area and Sacramento River from Shasta Dam to Red Bluff Pumping Plant

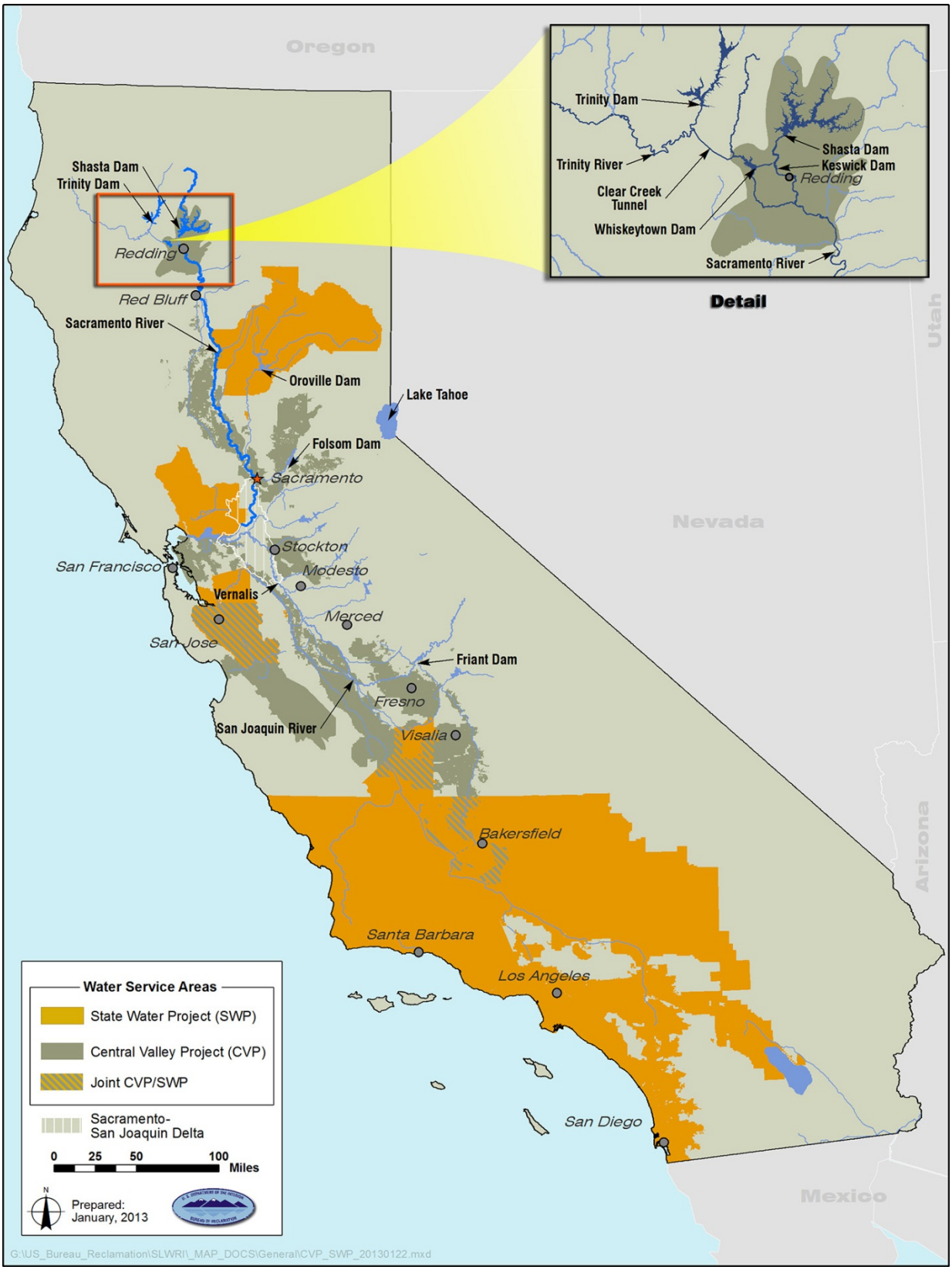


Figure S-3. Central Valley Project and State Water Project Facilities and Water Service Areas

S.6 Summary Description of Alternatives

Consistent with NEPA and the P&G, the plan formulation process for the SLWRI was divided into multiple phases, as shown in Figure S-4. Through this process, comprehensive plans (i.e., action alternatives) were formulated in addition to a No-Action Alternative. Each of the 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 temperature control device** – 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 demand** – All action alternatives would include a water conservation program for increased water deliveries that would be 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.

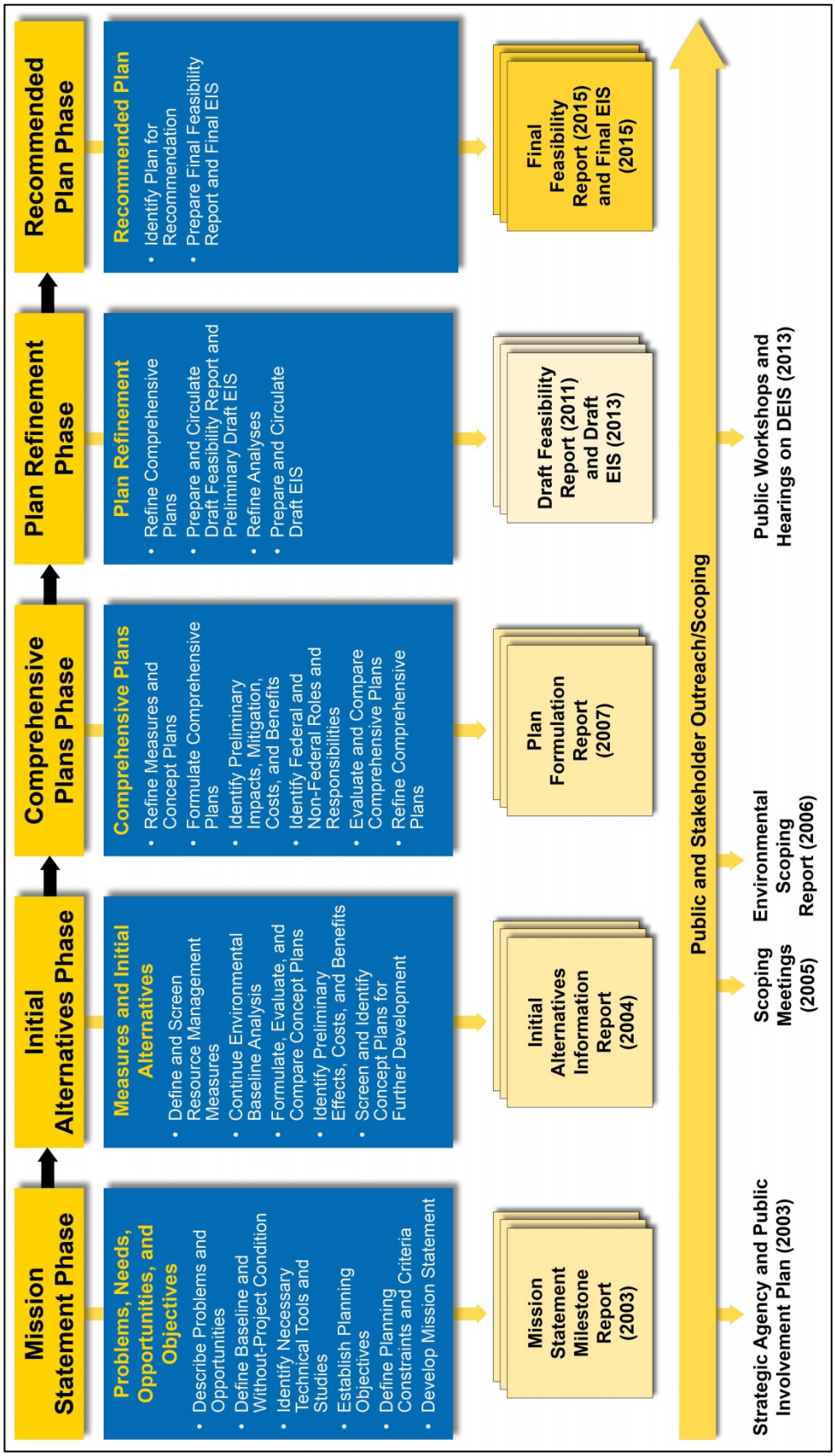


Figure S-4. Plan Formulation Phases

In addition, Reclamation has incorporated environmental commitments into each of the comprehensive plans to avoid or minimize potential impacts. Each comprehensive plan also includes mitigation measures where feasible to avoid, minimize, rectify, reduce, or compensate for significant and potentially significant impacts.

The No-Action Alternative and the 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, to increase anadromous fish survival and reduce the risk of extinction, further water temperatures improvements are needed in the Sacramento River, especially in dry and critical years. According to the NMFS 2014 *Recovery Plan for the Evolutionarily Significant Units of Sacramento River Winter-run Chinook Salmon and Central Valley Spring-run Chinook Salmon and the Distinct Population Segment of Central Valley Steelhead,* 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 substantially 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 and socioeconomic 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 would likely continue to improve environmental conditions on tributaries to Shasta Lake and along the upper Sacramento River. However, overall, future environmental-related conditions in these areas would likely be similar to existing conditions.

- The 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	
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*
	Environmental Commitments & Mitigation Measures

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. CP1 also includes implementing environmental commitments and mitigation measures. 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 (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

[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.

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.

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

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. CP2 also includes implementing environmental commitments and mitigation measures. 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.

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*
	Environmental Commitments & Mitigation Measures

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	
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*
	Environmental Commitments & Mitigation Measures

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 also includes implementing environmental commitments and 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) and Comprehensive Plan 4A (CP4A) – 18.5-Foot Dam Raise, Anadromous Fish Focus with Water Supply Reliability

CP4 and CP4A focus on increasing anadromous fish survival, while also increasing water supply reliability. CP4 and CP4A are identical except for Shasta Dam and reservoir operations. CP4 and CP4A have similar reservoir operations in that they each dedicate a portion of the new storage in Shasta Lake for fisheries purposes; however, the portion of this dedicated storage varies.

CP4 and CP4A	
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 *CP4 –Reserving 378,000 acre-feet of Storage for Cold-Water Pool* *CP4A – Reserving 191,000 acre-feet of Storage for Cold-Water Pool*
	Augment Spawning Gravel
	Restore Riparian, Floodplain, & Side Channel Habitat
	Environmental Commitments & Mitigation Measures

These alternatives primarily consist 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. CP4 and CP4A also include implementing environmental commitments and mitigations measures. In addition, CP4 and CP4A 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 and CP4A also include 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.

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 and CP4A 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 in CP4; 191,000 acre-feet would be dedicated in CP4A. 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. For CP4, 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. For CP4A, operations for the remaining portion of increased storage (approximately 443,000 acre-feet) would be the same as in CP2, with 120,000 acre-feet reserved in dry years and 60,000 acre-feet reserved in critical years to specifically focus on increasing M&I deliveries.

CP4 and CP4A also address 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 and CP4A include 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 CP4A, 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	
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
	Environmental Commitments & Mitigation Measures

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 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. CP5 also includes implementing environmental commitments and mitigations measures. 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 EIS.

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

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

	Action Alternatives					
Main Features	**CP1**	**CP2**	**CP3**	**CP4**	**CP4A**	**CP5**
Dam and Appurtenant Structures						
Shasta Dam						
Crest Raise (feet)	6.5	12.5	18.5	18.5	18.5	18.5
Full Pool Height Increase (feet)	8.5	14.5	20.5	20.5	20.5	20.5
Elevation of Dam Crest (feet)[1]	1084.0	1090.0	1096.0	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	1,090.2
Capacity Increase (acre-feet)	256,000	443,000	634,000	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.	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.	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 fixed-wheel gates.	Raise crest and extend piers. Replace 3 drum gates with 6 sloping fixed-wheel gates.	Raise crest and extend piers. Replace 3 drum gates with 6 sloping fixed-wheel gates.	Raise crest and extend piers. Replace 3 drum gates with 6 sloping fixed-wheel gates.	Raise crest and extend piers. Replace 3 drum gates with 6 sloping fixed-wheel gates.	Raise crest and extend piers. Replace 3 drum gates with 6 sloping fixed-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.	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.	Raise/modify controls.
Shasta Powerplant/ Penstocks	Raise penstock hoists.	Raise penstock hoists.	Raise penstock hoists.	Raise penstock hoists.	Raise penstock hoists.	Raise penstock hoists.
Pit 7 Dam/Powerhouse	Increase height of training walls on dam spillway. Install a tailwater depression system. Modify other Pit 7 ancillary facilities.	Increase height of training walls on dam spillway. Install a tailwater depression system. Modify other Pit 7 ancillary facilities.	Increase height of training walls on dam spillway. Install a tailwater depression system. Modify other Pit 7 ancillary facilities.	Increase height of training walls on dam spillway. Install a tailwater depression system. Modify other Pit 7 ancillary facilities.	Increase height of training walls on dam spillway. Install a tailwater depression system. Modify other Pit 7 ancillary facilities.	Increase height of training walls on dam spillway. Install a tailwater depression system. Modify other Pit 7 ancillary facilities.

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

	Action Alternatives					
Main Features	**CP1**	**CP2**	**CP3**	**CP4**	**CP4A**	**CP5**
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.	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.	Construct 3 railroad embankments and 4 new dikes.
Relocations						
Roadways	Match replacement widths to existing paved roads to be replaced.	Match replacement widths to existing paved roads to be replaced.	Match replacement widths to existing paved roads to be replaced.	Match replacement widths to existing paved roads to be replaced.	Match replacement widths to existing paved roads to be replaced.	Match replacement widths to existing paved roads to be replaced.
Length of Relocated Roadway (linear feet)	16,700	28,400	33,100	33,100	33,100	33,100
Number of Road Segments Affected	10	21	30	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.	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	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.	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.	Relocate inundated utilities. Construct wastewater treatment facilities.

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

	Action Alternatives					
Main Features	**CP1**	**CP2**	**CP3**	**CP4**	**CP4A**	**CP5**
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.	Reserve 191 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

CP4, CP4A, 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.

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, had high social or environmental impacts, or were previously analyzed in or rejected from consideration by the CALFED agencies in the CALFED PEIS/R.

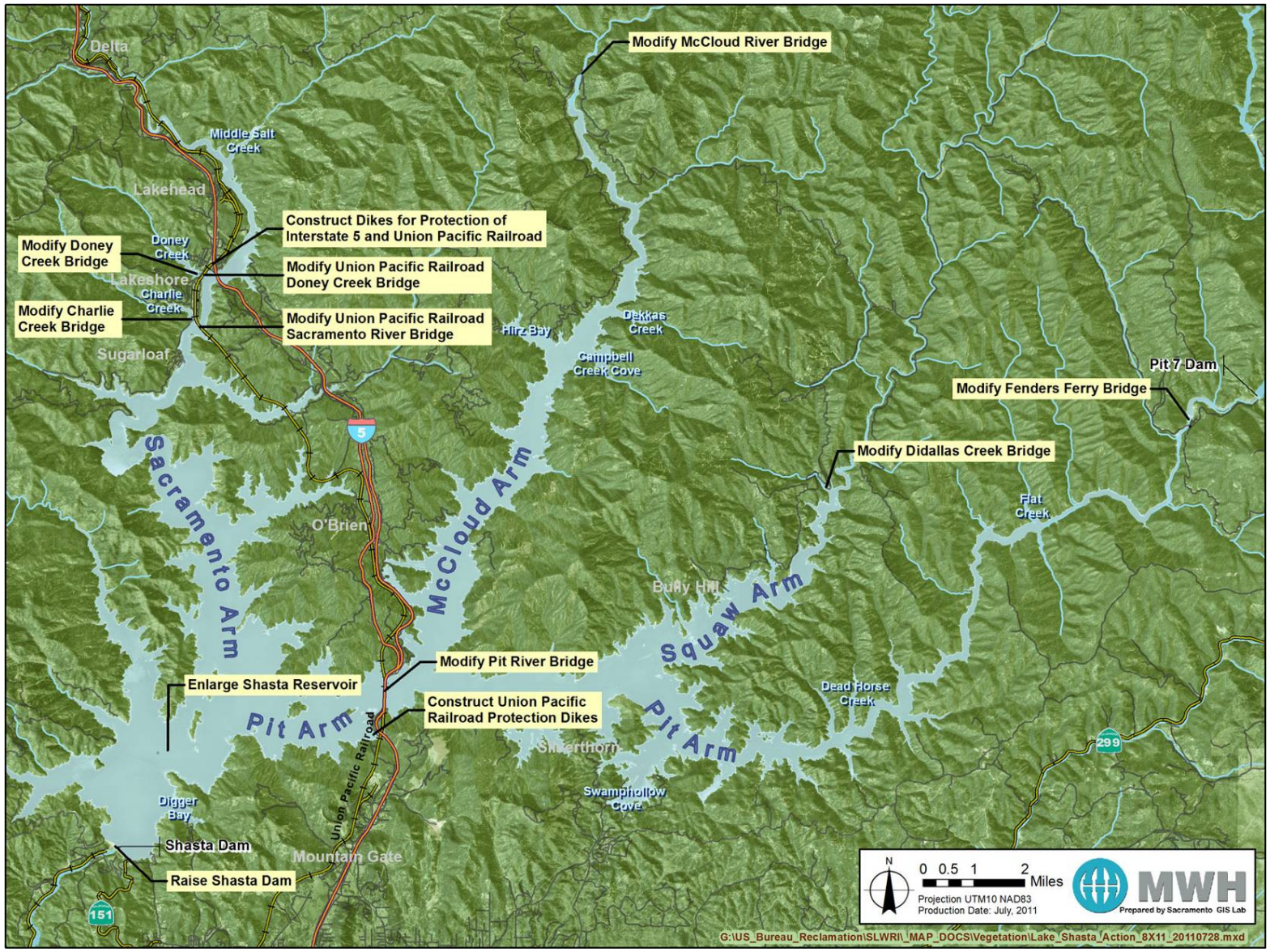


Figure S-5. Major Features Common to All Action Alternatives

Table S-2. Summary of Major Potential Benefits of Action Alternatives

Item	CP1	CP2	CP3	CP4	CP4A	CP5
Shasta Dam Raise (feet)	**6.5**	**12.5**	**18.5**	**18.5**	**18.5**	**18.5**
Total Increased Storage (TAF)	256	443	634	634	634	634
Benefits Related to Project Objectives						
Increase Anadromous Fish Survival						
Dedicated Storage (TAF)	-	-	-	378	191	-
Production Increase (thousand fish)[1]	61	379	207	813	710	378
Spawning Gravel Augmentation (tons)[2]				10,000	10,000	10,000
Side Channel Rearing Habitat Restoration				Yes	Yes	Yes
Increase Water Supply Reliability						
Total Increased Dry and Critical Year Water Supplies (TAF/year)[3]	47.3	77.8	63.1	47.3	77.8	113.5
Increased NOD Dry and Critical Year Water Supplies (TAF/year)[3]	4.5	10.7	35.2	4.5	10.7	25.2
Increased SOD Dry and Critical Year Water Supplies (TAF/year)[3]	42.7	67.1	28.0	42.7	67.1	88.3
Increased Water Use Efficiency Funding	Yes	Yes	Yes	Yes	Yes	Yes
Increased Emergency Water Supply Response Capability	Yes	Yes	Yes	Yes	Yes	Yes
Reduce Flood Damage						
Increased Reservoir Storage Capacity	Yes	Yes	Yes	Yes	Yes	Yes
Additional Hydropower Generation[4]						
Increased Hydropower Generation (GWh/year)[5]	52 - 54	87 - 90	86 - 90	127 - 133	125 - 130	112 - 117
Conserve, Restore, and Enhance Ecosystem Resources						
Shoreline Enhancement (acres)	-	-	-	-	-	130
Tributary Aquatic Habitat Enhancement (miles)[6]	-	-	-	-	-	6
Riparian, Floodplain, and Side Channel Restoration Habitat	-	-	-	Yes	Yes	Yes
Increased Ability to Meet Flow and Temperature Requirements Along Upper Sacramento River	Yes	Yes	Yes	Yes	Yes	Yes
Improve Water Quality						
Improved Delta Water Quality	Yes	Yes	Yes	Yes	Yes	Yes
Increased Delta Emergency Response Capability	Yes	Yes	Yes	Yes	Yes	Yes
Increase Recreation						
Recreation (user days, thousands)[7]	85 - 89	116 - 134	201 - 205	307 - 370	246 - 259	142 - 175
Modernization of Recreation Facilities	Yes	Yes	Yes	Yes	Yes	Yes

Table S-2. Summary of Major Potential Benefits of Action Alternatives (contd.)

Notes:

[1] Numbers were derived from SALMOD and represent an index of production increase, based on the estimated average annual increase in juvenile Chinook salmon surviving to migrate downstream from Red Bluff Pumping Plant.

[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] In addition to increased hydropower generation, all comprehensive plans provide increased capacity benefits (i.e., the rate at which power can be generated) and ancillary services, which provide the ability to manage the electric grid in a reliable manner.

[5] Annual increased in hydropower generation were estimated using two methodologies – at load center (accounting from transmission losses) and at-plant (no transmission losses). To provide a more conservation estimate of potential hydropower benefits, load center generation values were used to estimate potential benefits of increased hydropower generation under comprehensive plans. However, increased generation values reported in Chapter 23, "Power and Energy," of this EIS are based on at-plant generation values to capture the largest potential effects from changes in hydropower generation and pumping.

[6] 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.

[7] Annual recreation visitor user days were estimated using two methodologies. The minimum user day value was used to estimate potential recreation benefits to provide a more conservative estimate of the potential benefits of increased recreation under comprehensive plans. However, the maximum user value was used for direct and indirect effects evaluations in each resource area chapter 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. For more detailed information related to estimated recreation user days, please see Chapter 10, "Recreational Visitation," of the Modeling Appendix.

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.8 Preferred Alternative and Rationale for Selection

A plan recommending Federal action should be the plan that best addresses the targeted water resources problems considering public benefits relative to costs. It is recognized that most of the activities pursued by the Federal Government will require assessing trade-offs by decision makers and that in many cases, the final decision will require judgment regarding the appropriate extent of monetized and nonmonetized effects.

NEPA CEQ Regulations require the identification of the alternative or alternatives that are environmentally preferable in the ROD (40 CFR 1505.2(b)). The environmentally preferable alternative generally refers to the alternative that would result in the fewest adverse effects to the biological and physical environment. It is also the alternative that would best protect, preserve, and enhance historic, cultural, and natural resources. Although this environmentally preferable alternative must be identified in the ROD, it need not be selected for implementation. For the purposes of NEPA, an environmentally preferable alternative will be identified in the ROD associated with this EIS.

The preferred alternative has been identified in the Final EIS in consideration of public, stakeholder, and agency comments on the DEIS. The alternative recommended for implementation may or may not be identified as the "Environmentally Preferable Alternative" consistent with NEPA, the "Least

Environmentally Damaging Practicable Alternative" consistent with the Clean Water Act, and the "Environmentally Superior Alternative" consistent with CEQA.

Consistent with the above CEQ Regulations and NEPA guidelines, the preferred alternative for implementation has been identified in the Final EIS, as described in the following section.

S.8.1 Preferred Alternative

Each of the action alternatives – CP1, CP2, CP3, CP4, CP4A, and CP5 – includes enlarging Shasta Dam and Reservoir and a variety of management measures to address, in varying degrees, all of the project objectives. The major benefits of the action alternatives are summarized in Table S-2, and the impacts and mitigation measures are summarized in Table S-3. The cost estimates are presented in the Engineering Summary Appendix, Attachment 1, "Cost Estimates for Comprehensive Plans."

In the action alternatives, dam raises of three different heights were evaluated – 6.5 feet, 12.5 feet, and 18.5 feet. While all action alternatives provide benefits for the identified primary and secondary project objectives (to varying degrees), the overall benefits of an 18.5-foot raise (CP3, CP4, CP4A, or CP5) were found to be greater than those of either a 6.5-foot raise (CP1) or 12.5-foot raise (CP2). Therefore, only the 18.5-foot raise action alternatives were retained as possibilities for the preferred alternative. For example, the additional reservoir storage would increase from 256,000 acre-feet with the 6.5-foot raise to 634,000 acre-feet with the 18.5-foot raise – nearly 2.5 times the additional reservoir storage of the 6.5-foot raise for between 15-25 percent greater construction costs. This additional reservoir storage space would support both water supply reliability and fisheries objectives.

Reservoir operations and the resulting benefits were the differentiators amongst the 18.5-foot raise action alternatives (CP3, CP4, CP4A, or CP5). For example, CP3 would maximize agricultural water supply reliability, but would be the least beneficial to fisheries of the 18.5-foot raises. CP4 would provide the best opportunity to address anadromous fish survival in the upper Sacramento River; however, CP4 would provide the lowest benefits to water supply reliability.

Below is a summary of each action alternative weighed by Reclamation during the selection of a preferred alternative.

- CP1, formulated to address both anadromous fish survival and water supply reliability, would result in the lowest benefits of all of the action alternatives. Greater project benefits should be realized with higher dam raises for relatively low increases in costs. Therefore, CP1 was not selected as the preferred alternative.

- CP2, formulated to address both anadromous fish survival and water supply reliability, would have relatively low benefits when compared to the other action alternatives. Greater project benefits should be realized with higher dam raises for relatively low increases in costs. Therefore, CP2 was not selected as the preferred alternative.

- CP3, formulated to address both agricultural water supply reliability and anadromous fish survival, would greatly increase agricultural water supply reliability. However, CP3 would have no M&I water supply benefits and very low anadromous fish survival benefits when compared to the other 18.5-foot raises. Therefore, CP3 was not selected as the preferred alternative.

- CP5, formulated as a combination plan focusing on all objectives, would greatly increase water supply reliability. However, CP5 would have relatively low increased anadromous fish survival benefits in comparison with all other 18.5-foot raises. Therefore, CP5 was not selected as the preferred alternative.

- CP4, formulated to focus on anadromous fish survival while increasing water supply reliability, would have the highest increase in anadromous fish survival of all of the alternatives and the lowest increase in water supply reliability compared to all of the considered alternatives (equal to CP1). CP4 would not best meet both of the primary objectives; water supply reliability would be compromised for increased anadromous fish survival. Therefore, CP4 was not selected as the preferred alternative. However, the evaluation of CP4 did indicate that refinements of operations could be made to optimize the amount of water supply targeted for anadromous fish survival and water supply reliability such that both primary objectives could be substantially achieved with an 18.5-foot raise. This evaluation provided the impetus for Reclamation to develop CP4A, which performs better at simultaneously meeting both the anadromous fish survival and water reliability primary objectives.

CP4A would best balance and meet both of the primary objectives. CP4A, formulated to address both anadromous fish survival and water supply reliability, would have relatively high increases in water supply reliability (equal to CP2) and the second highest increase in anadromous fish survival of all of the alternatives. CP4A would have the ability to meet the secondary project objectives, which were considered to the extent possible through pursuit of the primary project objectives. Secondary objectives include ecosystem enhancement, flood damage reduction, improved Delta water quality, increased hydropower generation and increased recreation. As an 18.5-foot raise, CP4A would best maximize benefits relative to costs. For these reasons, CP4A is the preferred alternative.

S.9 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.9.1 Methods and Assumptions

This EIS analyzes the direct and indirect effects of the No-Action Alternative and 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 EIS, the quantitative assessment of actions related to water resources relied primarily on two CalSim-II baselines for CEQA and NEPA:

- "Existing cconditions," based on a 2005 level of development and current facilities, as defined in 2012 (a 2005 baseline)

- "Future cconditions," based on without-project forecasted 2020-2030 level of development and reasonably foreseeable future projects and facilities (a 2030 baseline)[3]

Operational assumptions for refinement, modeling, and evaluation of potential effects of the No-Action Alternative and action alternatives included in this EIS were derived from the 2008 Long-Term Operation BA, the 2008 USFWS BO, the 2009 NMFS BO, and the Coordinated Operations Agreement between Reclamation and DWR for the CVP and SWP, as ratified by Congress (Reclamation and DWR 1986).

Despite the uncertainty resulting from ongoing consultation processes, the 2008 Long-Term Operation BA and 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. If the revised USFWS and NMFS BOs contain new or amended reasonable and prudent alternatives (RPA), such requirements may result in changes to CVP and SWP operational constraints.

Climate Change

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

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 implement energy conservation or reduced energy use or GHG emissions; or would promote cleaner, more efficient renewable-energy technologies.

Each resource area analyzed in the EIS evaluates the effects the action alternatives and No-Action Alternative combined with predicted effects of climate change. The ways that the SLWRI could affect GHG production are

[3] The level of development used for future conditions is a composite of multiple land use scenarios developed by DWR and Reclamation. The Sacramento Valley hydrology, which includes the Sacramento and Feather River basins, is based on projected 2020 land use assumptions associated with DWR Bulletin 160-98 (1998) and the San Joaquin Valley hydrology is based on the 2030 land use assumptions developed by Reclamation. Under any 2020 to 2030 level of development scenario, the majority of the CVP and SWP unmet demand is located south of the Delta, including the San Joaquin Valley. Please see Table 2-1 in the Modeling Appendix for additional information on CalSim-II modeling assumptions.

also addressed. The Climate Change Modeling 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 Modeling Appendix provides context for consideration of cumulative conditions.

S.9.2 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.9.3 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 Farmland** – Direct and indirect conversion of forest land to nonforest uses in the vicinity of Shasta Lake (all action alternatives).

- **Botanical Resources and Wetlands** – 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** – Conflict 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** – Inconsistency with guidelines for visual resources in the USFS 1995 Shasta-Trinity National Forest Land and Resource Management Plan, degradation and/or obstruction of a scenic view from key observation points, and generation of increased daytime glare and/or nighttime lighting (all action alternatives).

- **Wild and Scenic River Considerations for McCloud River** – Effect on McCloud River's eligibility for listing as a Federal Wild and Scenic River and effects to McCloud River resources identified in 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 inundation at Shasta Lake, leading to take and loss of habitat for special-status species at Shasta Lake and vicinity; 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 Traditional Cultural Properties (all action alternatives).

- **Power and Energy Resources** – Changes to net energy values due to energy use for CVP and SWP pumping, and loss of generation (CP1).

- **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.9.4 Environmental Commitments

As part of project planning and environmental assessment, Reclamation has incorporated 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 any authorized project modifications 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 required 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.

- Remain consistent with USFS Built Environment Image Guide for any facilities subject to USFS authorization that are constructed or reconstructed facilities.

- Protect all Public Land Survey System monuments and associated references and all property corners, either by positioning, or, where necessary, creating new references.

- Evaluate and protect paleontological resources discovered during construction.

- 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 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 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 efforts to minimize potential adverse effects to water quality, including:

  – Implement in-water construction work windows to occur when instream flows are managed outside the flood season (e.g., June 15 to September 15).

  - Comply with all additional requirements specified in permits relating to water quality protection.

  - Implement best management practices (BMP) to avoid and/or minimize potential impacts to water quality associated with construction and the 10-year-long spawning gravel augmentation program. These BMPs include:

    - Handle spawning gravel to minimize potential water quality impact.

    - Minimize potential impacts associated with equipment contaminants.

    - Implement feasible spill prevention and hazardous materials management.

    - Minimize potential impacts associated with access and staging.

    - Remove temporary fills as appropriate.

    - Remove equipment from river overnight and during high flows.

- Extend and enhance existing fish habitat structures in Shasta Lake through the placement of manzanita brush structures and vegetation cleared for construction to maintain shallow water and transitional riverine habitat.

- Maintain shallow-water and transitional riverine habitat with placement of manzanita brush structures, large woody debris, and rock-boulder clusters for established USFS habitat program.

- Implement fisheries conservation efforts to minimize potential adverse effects on fish species, including:

  - Implement in-water construction work windows to occur when sensitive fish species are not present, or would be least susceptible to disturbance. In-river work between Keswick Dam and the RBPP would be conducted to minimize impacts to Sacramento River winter-run Chinook salmon, i.e., mid-August through September.

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

  - Perform fish rescue/salvage for fish entrapped within construction structures and cofferdam enclosures, and stop construction activities for spawning activities for sensitive fish species.

  - Prepare a letter report detailing the methodologies used and the findings of fish monitoring and rescue efforts.

- Survey and monitor fish migration between Shasta Lake and Squaw Creek to determine if warm-water fish (bass) actively migrate into and cause adverse effects on native fish, amphibians, and mollusks.

- 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, invasive plants, and other invasive species to project areas.

- Prepare and implement a fire protection and prevention plan to minimize the risk of wildfire or threat to workers, property, and the public.

- Recycle or reuse demolished construction materials where practical. To reduce risk associated with exposure to hazardous materials and waste:

  - Implement a Hazardous Materials Business Plan (HMBP) to provide information regarding hazardous materials to be used for project implementation and hazardous waste that may be generated.

  - Dispose of soil at a landfill or recycling facilities, transported by a licensed waste hauler.

  - Review all relevant available asbestos survey and abatement reports and supplemental asbestos surveys. Removal and disposal of asbestos-containing materials would be performed in accordance with applicable Federal, State, and local regulations.

  - Conduct a lead-based paint survey to determine areas where lead-based paint is present and the possible need for abatement before construction.

- 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).

The environmental commitment section of the DEIS included a commitment to develop and implement a mitigation plan to minimize potential impacts to physical, biological, and socioeconomic resources. In conjunction with an interagency, interdisciplinary team, Reclamation refined and enhanced the mitigation measures, including development of a framework to quantify impacts

(where appropriate) and establish mitigation ratios that were applicable to a number of impacts related to biological resources. The result of the development of the mitigation plan is documented in the Preliminary Environmental Commitments and Mitigation Plan (an appendix to this EIS).

S.10 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 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 Section 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.11 Public Involvement and Next Steps

In accordance with NEPA review requirements, the DEIS was released for public and agency review and comment for a 90-day period. The comment period on the DEIS began on July 1, 2013, and closed on September 30, 2013. Written and verbal comments on the DEIS were accepted at three public workshops and three public hearings, and written comments were accepted throughout the comment period.

More than 5,000 comments were received on the DEIS from elected officials; federal, state, and tribal governments; regional and local governments and agencies; special interest groups, and individuals. The public comments have been reviewed and, in accordance with NEPA CEQ Regulations, responses have been developed for all substantive comments and revision of the DEIS have been made to clarify and enhance the text to produce this Final EIS.

Reclamation posted the Final EIS at http://www.usbr.gov/mp/slwri for public review and issued a notice in the Federal Register and a press release of the Final EIS. Also, elected officials and representatives, government agencies, private organizations, businesses, and individual members of the public on the mailing list have received a copy of this document or a notification of document availability.

The Final EIS and Final Feasibility Report will be used together to support the Federal decision. Typically, a ROD is the final step in the NEPA process and would document any decision on which actions, if any, to take to address the primary objectives.

The Final EIS, Final Feasibility Report, and supporting documents will be submitted by the Principal Deputy 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 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 Final EIS 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	NI
	CP1–CP5	Long-term	Pool level increase would inundate 78 acres (CP1), 110 acres (CP2), or 173 acres (CP3, CP4,CP4A 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	NI
	CP1–CP5	Long-term	–	S	Mitigation Measure Geo-2: Replace Lost Ecological Functions of Aquatic Habitats by Restoring Existing Degraded Aquatic Habitats in the Vicinity of the Impact.	LTS
Impact Geo-3: Loss or Diminished Availability of Known Mineral Resources That Would Be of Future Value to the Region	N-A	NA	–	NI	NA	NI
	CP1–CP5	Long-term	–	S	No feasible mitigation is available to reduce impact.	SU

Notes:

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

[2] NA = not applicable. Short-term = construction-related or 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.

[4] LOS = level of significance. B = beneficial. NA = not applicable. NI = no impact. LTS = less than significant. PS = potentially significant. S = significant. SU = significant and unavoidable.

[5] NA = not applicable, because under the No-Action Alternative, the Federal Government would not implement a plan to raise Shasta Dam, and no mitigation would be required.

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	NI
	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	NI
	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	NI
	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

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.

[4] LOS = level of significance. B = beneficial. NA = not applicable. NI = no impact. LTS = less than significant. PS = potentially significant. S = significant. SU = significant and unavoidable.

[5] NA = not applicable, because under the No-Action Alternative, the Federal Government would not implement a plan to raise Shasta Dam, and no mitigation would be required.

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-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	NI
	CP1–CP5	Long-term	–	LTS	No mitigation needed; thus, none proposed.	LTS
Impact Geo-8: Failure of Septic Tanks or Alternative Wastewater Disposal Systems Due to Soils that are Unsuited to Land Application of Waste	N-A	NA	–	NI	NA	NI
	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	NI
	CP1–CP5	Long-term	–	LTS	Mitigation Measure Geo-9: Modification of Flow Releases in Response to River Management and Habitat Restoration Efforts between Keswick Dam and Red Bluff.	LTS
Impact Geo-10: Substantial Soil Erosion or Loss of Topsoil Due to Construction	N-A	NA	–	NI	NA	NI
	CP1–CP3	Short-term	–	NI	No mitigation needed; thus, none proposed.	NI
	CP4–CP5	Short-term	–	LTS	No mitigation needed; thus, none proposed.	LTS
Impact Geo-11: Alteration of Fluvial Geomorphology	N-A	NA	–	NI	NA	NI
	CP1–CP3	Long-term	–	NI	No mitigation needed; thus, none proposed.	NI
	CP4–CP5	Long-term	–	LTS	No mitigation needed; thus, none proposed.	LTS

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-12: Alteration of Downstream Tributary Fluvial Geomorphology Due to Shasta Dam Operations	N-A	NA	–	NI	NA	NI
	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	NI
	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	NI
	CP1–CP5	Long-term	–	LTS	No mitigation needed; thus, none proposed.	LTS
Air Quality and Climate						
Impact AQ-1: Short-Term Emissions of Criteria Air Pollutants and Precursors at Shasta Lake and Vicinity During Project Construction	N-A	NA	–	NI	NA	NI
	CP1–CP5	Short-term	NO_X emissions >137 lb/day, possible ROG & PM_{10} emissions >137 lb/day	S	Mitigation Measure AQ-1: Implement Standard Measures and Best Available Mitigation Measures to Reduce Emissions Levels.	SU

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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	LTS
	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
	CP4A	Long-term	Increase of an average of 460 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	NI
	CP1–CP5	Short-term and long-term	Exposure to CO, PM_{10}, $PM_{2.5}$, diesel PM	LTS	No mitigation needed; thus, none proposed.	LTS
Impact AQ-4: Exposure of Sensitive Receptors to Odor Emissions	N-A	NA	–	NI	NA	NI
	CP1–CP5	Short-term and long-term	–	LTS	No mitigation needed; thus, none proposed.	LTS

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Impact AQ-5: Short-Term Emissions of Criteria Air Pollutants and Precursors Below Shasta Dam During Project Construction	N-A,	NA	–	NI	NA	NI
	CP1–CP3	Short-term	–	NI	No mitigation needed; thus, none proposed.	NI
	CP4–CP5	Short-term	Would add an additional 1 lb/day of ROG, 16 lb/day of NO_X, & 1 lb/day of PM_{10} to construction	LTS	No mitigation needed; thus, none proposed.	LTS
Impact AQ-6: Generation of Greenhouse Gases	N-A	NA	–	LTS	NA	LTS
	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	NI
	CP1–CP5	Long-term	–	B	No mitigation needed; thus, none proposed.	B
Impact H&H-2: Place Housing or Other Structures Within a 100-Year Flood Hazard Area as Mapped on a Federal Flood Hazard Boundary or Flood Insurance Rate Map or Other Flood Hazard Delineation Map	N-A	NA	–	NI	NA	NI
	CP1–CP5	NA	–	NI	No mitigation needed; thus, none proposed.	NI

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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	NI
	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	LTS
	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	LTS
	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	LTS
	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	NI
	CP1 & CP4	NA	–	NI	No mitigation needed; thus, none proposed.	NI
	CP2, CP3, CP4A, & 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	LTS
	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	PS	NA	PS
	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	PS
	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	B
	CP1–CP5	Long-term	–	LTS	No mitigation needed; thus, none proposed.	LTS
Impact H&H-12: Change in Groundwater	N-A	NA	–	LTS	NA	LTS
	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	LTS
	CP1–CP5	Short-term and long-term	–	LTS	No mitigation needed; thus, none proposed.	LTS

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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	NI
	CP1	Short-term	Short-term changes in the amount of exposed area that would be subject to erosion	PS	Mitigation Measure WQ-1: Develop and Implement a Comprehensive Multi-scale Sediment Reduction and Water Quality Improvement Program Within Watersheds Tributary to the Primary Study Area.	LTS
	CP2	Short-term	Similar to CP1, but greater area and longer duration	PS	Mitigation Measure WQ-1: Develop and Implement a Comprehensive Multi-scale Sediment Reduction and Water Quality Improvement Program Within Watersheds Tributary to the Primary Study Area.	LTS
	CP3–CP5	Short-term	Similar to CP1 and CP2, but greater area and longer duration	PS	Mitigation Measure WQ-1: Develop and Implement a Comprehensive Multi-scale Sediment Reduction and Water Quality Improvement Program Within Watersheds Tributary to the Primary Study Area.	LTS

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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	NI
	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	NI
	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	NI
	CP1–CP5	Long-term	–	PS	Mitigation Measure WQ-4: Implement Mitigation Measure WQ-1 (CP1): Develop and Implement a Comprehensive Multi-scale Sediment Reduction and Water Quality Improvement Program Within Watersheds Tributary to the Primary Study Area.	LTS

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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	NI
	CP1	Long-term	5 percent increase in the end-of-month storage on an annual basis compared to No-Action Alternative	LTS	No mitigation needed; thus, none proposed.	LTS
	CP2	Long-term	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	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
	CP4	Long-term	17 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
	CP4A	Long-term	16 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
	CP5	Long-term	13 percent increase in the end-of-month storage on an annual basis compared to No-Action Alternative	LTS	No mitigation needed; thus, none proposed.	LTS
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	LTS
	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	NI
	CP1–CP3	Temporary	–	PS	Mitigation Measure WQ-7 (CP1–CP3): Implement Mitigation Measure WQ-1 (CP1): Develop and Implement a Comprehensive Multi-scale Sediment Reduction and Water Quality Improvement Program Within Watersheds Tributary to the Primary Study Area.	LTS
	CP4 & CP4A	Temporary	Similar to CP1–CP3, but greater	PS	Mitigation Measure WQ-7 (CP4): Implement Mitigation Measure WQ-1 (CP1): Develop and Implement a Comprehensive Multi-scale Sediment Reduction and Water Quality Improvement Program Within Watersheds Tributary to the Primary Study Area.	LTS
	CP5	Temporary	Similar to CP4, but greater	PS	Mitigation Measure WQ-7 (CP5): Implement Mitigation Measure WQ-1 (CP1): Develop and Implement a Comprehensive Multi-scale Sediment Reduction and Water Quality Improvement Program Within Watersheds Tributary to the Primary Study Area.	LTS

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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	NI
	CP1–CP5	Temporary	–	LTS	No mitigation needed; thus, none proposed.	LTS
Impact WQ-9: Temporary Construction-Related Metal Effects on the Upper Sacramento River that Would Cause Violations of Water Quality Standards or Adversely Affect Beneficial Uses	N-A	NA	–	NI	NA	NI
	CP1–CP5	Temporary	–	LTS	No mitigation needed; thus, none proposed.	LTS
Impact WQ-10: Long-Term Sediment Effects that Would Cause Violations of Water Quality Standards or Adversely Affect Beneficial Uses in the Upper Sacramento River	N-A	NA	–	LTS	NA	LTS
	CP1–CP5	Long-term	–	LTS	No mitigation needed; thus, none proposed.	LTS

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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	LTS
	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 13 percent under existing conditions and future conditions	B	No mitigation needed; thus, none proposed.	B
	CP4A	Long-term	Reduce temperature exceedences at Bend Bridge by 11 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 Would Cause Violations of Water Quality Standards or Adversely Affect Beneficial Uses in the Upper Sacramento River	N-A	NA	–	LTS	NA	LTS
	CP1–CP5	Long-term	–	PS	Mitigation Measure WQ-12: Implement Mitigation Measure WQ-6 (CP1): Prepare and Implement a Site-Specific Remediation Plan for Historic Mine Features Subject to Inundation in the Vicinity of the Bully Hill and Rising Star Mines	LTS

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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	NI
	CP1–CP5	Temporary	–	LTS	No mitigation needed; thus, none proposed.	LTS
Impact WQ-14: Temporary Construction-Related Temperature Effects on the Extended Study Area that Cause Violations of Water Quality Standards or Adversely Affect Beneficial Uses	N-A	NA	–	NI	NA	NI
	CP1–CP5	Temporary	–	LTS	No mitigation needed; thus, none proposed.	LTS
Impact WQ-15: Temporary Construction-Related Metal Effects on the Extended Study Area that Would Cause Violations of Water Quality Standards or Adversely Affect Beneficial Uses	N-A	NA	–	NI	NA	NI
	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	LTS
	CP1–CP5	Long-term	–	LTS	No mitigation needed; thus, none proposed.	LTS

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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	LTS
	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	LTS
	CP1–CP5	Long-term	–	PS	Mitigation Measure WQ-18: Implement Mitigation Measure WQ-6 (CP1): Prepare and Implement a Site-Specific Remediation Plan for Historic Mine Features Subject to Inundation in the Vicinity of the Bully Hill and Rising Star Mines	LTS
Impact WQ-19a: Delta Salinity on the Sacramento River at Collinsville	N-A	NA	–	LTS	NA	LTS
	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	LTS
	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	LTS
	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	LTS
	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	LTS
	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	LTS
	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	LTS
	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	LTS
	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	LTS
	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	LTS
	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.)

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Impact WQ-20: X2 Position	N-A	NA	–	PS	NA	SU
	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	LTS
	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	LTS
	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	LTS
	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]
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	NI
	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	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
	CP4–CP5	Short-term	Similar to CP3, 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	NI
	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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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 Haz-3: Exposure of Workers to Hazardous Materials (Shasta Lake and Vicinity and Upper Sacramento River)	N-A	NA	–	NI	NA	NI
	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	NI
	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	NI
	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	NI
	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	NI
	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	NI
	CP1–CP5	Short-term	–	LTS	No mitigation needed; thus, none proposed.	LTS
Agriculture and Important Farmlands						
Impact Ag-1: Direct and Indirect Conversion of Important Farmland to Nonagricultural Uses and Cancellation of Williamson Act Contracts in the Vicinity of Shasta Lake	N-A	Permanent	–	PS	NA	SU
	CP1–CP5	Permanent	–	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 Ag-2: Direct and Indirect Conversion of Forest Land to Nonforest Uses in the Vicinity of Shasta Lake	N-A	NA	NA	NI	NA	NI
	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	SU
	CP1 & CP4	Permanent	Inundation of lands or soil saturation due to increased flows.	LTS	No mitigation needed; thus, none proposed.	LTS
	CP2 & CP4A	Permanent	Similar to CP1, but greater	LTS	No mitigation needed; thus, none proposed.	LTS
	CP3	Permanent	Similar to CP1 & CP2, but greater	LTS	No mitigation needed; thus, none proposed.	LTS
	CP5	Permanent	Similar to CP1, CP2, & CP3 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	LTS
	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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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	SU
	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	LTS
	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	LTS
	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	NI
	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	PS
	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	LTS
	CP1–CP5	Permanent	–	PS	Mitigation Measure Aqua-4: Implement Mitigation Measure Geo-2: Replace Lost Ecological Functions of Aquatic Habitats by Restoring Existing Degraded Aquatic Habitats in the Vicinity of the Impact.	LTS
Impact Aqua-5: Effects on Special-Status Fish Species	N-A	–	–	LTS	NA	LTS
	CP1–CP5	–	–	LTS	No mitigation needed; thus, none proposed.	LTS
Impact Aqua-6: Creation or Removal of Barriers to Fish Between Tributaries and Shasta Lake	N-A	NA	–	NI	NA	NI
	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	NI
	CP1	Permanent	5.4 miles of low-gradient reaches	PS	Mitigation Measure Aqua-7: Implement Mitigation Measure Aqua-4: 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	PS	Mitigation Measure Aqua-7: Implement Mitigation Measure Aqua-4: 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	PS	Mitigation Measure Aqua-7: Implement Mitigation Measure Aqua-4: 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	NI
	CP1	Permanent	12.6 miles of non-fish-bearing tributary habitat	LTS	No mitigation needed; thus, none proposed.	LTS
	CP2	Permanent	17.3 miles of non-fish-bearing tributary habitat	LTS	No mitigation needed; thus, none proposed.	LTS
	CP3–CP5	Permanent	24.0 miles of non-fish-bearing tributary habitat	LTS	No mitigation needed; thus, none proposed.	LTS

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Impact Aqua-9: Effects on Water Quality at Livingston Stone Hatchery	N-A	NA	–	NI	NA	NI
	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	NI
	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	NI
	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 and Steelhead	N-A	NA	–	PS	NA	PS
	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 & CP4A	Long-term	Similar to CP1- CP3 & CP5, but greater benefits	B	No mitigation needed; thus, none proposed.	B

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Impact Aqua-13: Changes in Flow and Water Temperature in the Upper Sacramento River Resulting from Project Operation—Steelhead, Green Sturgeon, Sacramento Splittail, American Shad, and Striped Bass	N-A	NA	–	PS	NA	PS
	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 & CP4A	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	NI
	CP1–CP5	Long-term	–	PS	Mitigation Measure Aqua-14: Implement Mitigation Measure Bot-7: 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 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	NI
	CP1–CP5	Long-term	–	PS	Mitigation Measure Aqua-15: Maintain Flows in the Feather River, American River, and Trinity River Consistent with Existing Regulatory and Operational Requirements and Agreements.	LTS
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	NI
	CP1–CP5	Long-term	–	PS	Mitigation Measure Aqua-16: Implement Mitigation Measure Bot-7: 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	NI
	CP1–CP5	Long-term	–	LTS	No mitigation needed; thus, none proposed.	LTS
Impact Aqua-18: Effects to Delta Fisheries Resulting from Changes to Delta Inflow	N-A	NA	–	NI	NA	NI
	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	NI
	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	NI
	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	NI
	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	NI
	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	NI
	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, and thus reduce impacts to non-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	NI
	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	NI
	CP1–CP5	NA	–	NI	No mitigation needed; thus, none proposed.	NI
Impact Bot-2: Loss of MSCS Covered Species	N-A	Permanent	–	NI	NA	NI
	CP1	Permanent	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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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-3: Loss of USFS Sensitive, BLM Sensitive, or CRPR Species	N-A	Permanent	–	NI	NA	NI
	CP1	Permanent	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	NI
	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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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-5: Loss of General Vegetation Habitats	N-A	Permanent	–	NI	NA	NI
	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	NI
	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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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-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	LTS
	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: 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 & CP4A	Long-term	Greater than CP1	S	Mitigation Measure Bot-7: 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 &	Long-term	Greater than CP1 &CP2	S	Mitigation Measure Bot-7: 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
	CP5	Long-term	Greater than CP1, CP2, & CP3	S	Mitigation Measure Bot-7: 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-8: Conflict with Approved Local or Regional Plans with Objectives of Riparian Habitat Protection or Watershed Management	N-A	Long-term	–	LTS	NA	LTS
	CP1–CP5	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: 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 Bot-9: Disturbance or Removal of Designated Critical Habitat for Special-Status Species	N-A	Long-term and/or permanent	–	LTS	NA	LTS
	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 & CP4A	Long-term and/or permanent	Greater than CP1	LTS	No mitigation needed; thus, none proposed.	LTS
	CP3	Long-term and/or permanent	Greater than CP1 & CP2	LTS	No mitigation needed; thus, none proposed.	LTS
	CP5	Long-term and/or permanent	Greater than CP1, CP2, & CP3	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-10: Loss of Sensitive Plant Communities and Special-Status Plant Species Resulting from Induced Growth	N-A	Permanent	–	LTS	NA	LTS
	CP1 & CP4	Permanent	Increased water supplies for deliveries to water districts in the primary study area	LTS	No mitigation needed; thus, none proposed.	LTS
	CP2 & CP4A	Permanent	Greater than CP1	LTS	No mitigation needed; thus, none proposed.	LTS
	CP3	Permanent	Greater than CP1 & CP2	LTS	No mitigation needed; thus, none proposed.	LTS
	CP3 & CP5	Permanent	Greater than CP1, CP2, & CP3	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	NI
	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, and Mitigate Loss of Jurisdictional Waters.	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 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	NI
	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	NI
	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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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	LTS
	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: 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 & CP4A	Long-term	Greater than CP1	S	Mitigation Measure Bot-14: Implement Mitigation Measure Bot-7: 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		Greater than CP1 & CP2		Mitigation Measure Bot-14: Implement Mitigation Measure Bot-7: 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
	CP5	Long-term	Greater than CP1, CP2, & CP5	S	Mitigation Measure Bot-14: Implement Mitigation Measure Bot-7: 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 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	SU
	CP1–CP5	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: 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-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	LTS
	CP1 & CP4	Long-term	Increased water supplies for deliveries to water districts in the extended study area along the lower Sacramento River	LTS	No mitigation needed; thus, none proposed.	LTS
	CP2 & CP4A	Long-term	Greater than CP1	LTS	No mitigation needed; thus, none proposed.	LTS
	CP3	Long-term	Greater than CP1 & Cp2	LTS	No mitigation needed; thus, none proposed.	LTS
	CP5	Long-term	Greater than CP1, CP2 & CP3	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	LTS
	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 & CP4A	Long-term	Greater than CP1	LTS	No mitigation needed; thus, none proposed.	LTS
	CP3		Greater than CP1 & CP2	LTS	No mitigation needed; thus, none proposed.	LTS
	CP5	Long-term	Greater than CP1, CP2, & CP3	LTS	No mitigation needed; thus, none proposed.	LTS

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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	LTS
	CP1–, CP5	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
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	LTS
	CP1 & CP4	Long-term	Increased water supplies for deliveries to water districts in the CVP/SWP service areas	LTS	No mitigation needed; thus, none proposed.	LTS
	CP2 & CP4A	Long-term	Greater than CP1	LTS	No mitigation needed; thus, none proposed.	LTS
	CP3		Greater than CP1 & CP2	LTS	No mitigation needed; thus, none proposed.	LTS
	CP5	Long-term	Greater than CP1, CP2, & CP3	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	NI
	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	NI
	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	NI
	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	NI
	CP1–CP5	Short-term	Loss of nests	PS	Mitigation Measure Wild-4: Conduct Preconstruction Surveys for the American Peregrine Falcon and Establish Buffers.	LTS

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Impact Wild-5: Take and Loss of Habitat for the Bald Eagle	N-A	NA	–	NI	NA	NI
	CP1	Long-term	Inundation of nest trees, increase of prey habitat in primary study area	S	Mitigation Measure Wild-5: Acquire and Preserve Mitigation Lands; Conduct Protocol-Level Surveys for the Bald Eagle and Establish Buffers.	SU
	CP2	Long-term	Similar to CP1, but greater	S	Mitigation Measure Wild-5: Acquire and Preserve Mitigation Lands; Conduct Protocol-Level Surveys for the Bald Eagle and Establish Buffers.	SU
	CP3–CP5	Long-term	Similar to CP1 & CP2, but greater	S	Mitigation Measure Wild-5: Acquire and Preserve Mitigation Lands; Conduct Protocol-Level Surveys for the Bald Eagle and Establish Buffers.	SU
Impact Wild-6: Loss of Dispersal Habitat for the Northern Spotted Owl	N-A	NA	–	NI	NA	NI
	CP1	Short-term and permanent	Loss of nests and habitat	PS	Mitigation Measure Wild-6: Acquire and Preserve Mitigation Lands, Habitat Enhancement.	LTS
	CP2	Short-term and permanent	Similar to CP1, but greater (larger area of inundation)	PS	Mitigation Measure Wild-6: Acquire and Preserve Mitigation Lands, Habitat Enhancement.	LTS
	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, Habitat Enhancement.	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-7: Impact on the Purple Martin and Its Habitat	N-A	NA	–	NI	NA	NI
	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	NI
	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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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-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	NI
	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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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-10: Take and Loss of Habitat for the Pacific Fisher	N-A	NA	–	NI	NA	NI
	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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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-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	NI
	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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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	NI
	CP1	Short-term and permanent	Ground-disturbing activities, inundation of habitat	S	Mitigation Measure Wild-12: Avoid Suitable Habitat; Acquire and Preserve Mitigation Lands for Special-Status Terrestrial Mollusks.	SU
	CP2	Short-term and permanent	Similar to CP1, but greater (larger area of inundation)	S	Mitigation Measure Wild-12: Avoid Suitable Habitat; Acquire and Preserve Mitigation Lands for Special-Status Terrestrial Mollusks.	SU
	CP3–CP5	Short-term and permanent	Similar to CP1 & CP2, but greater (larger area of inundation)	S	Mitigation Measure Wild-12: Avoid Suitable Habitat; Acquire and Preserve Mitigation Lands for Special-Status Terrestrial Mollusks.	SU
Impact Wild-13: Permanent Loss of General Wildlife Habitat	N-A	NA	–	NI	NA	NI
	CP1	Permanent	Inundation of habitat	PS	Mitigation Measure Wild-13: Acquire and Preserve Mitigation Lands for Permanent Loss of General Wildlife Habitat.	SU
	CP2	Permanent	Similar to CP1, but greater (larger area of inundation)	PS	Mitigation Measure Wild-13: Acquire and Preserve Mitigation Lands for Permanent Loss of General Wildlife Habitat.	SU
	CP3–CP5	Permanent	Similar to CP1 & CP2, but greater (larger area of inundation)	PS	Mitigation Measure Wild-13: Acquire and Preserve Mitigation Lands for Permanent Loss of General Wildlife Habitat.	SU

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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	NI
	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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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-15: Loss of Critical Deer Winter and Fawning Range	N-A	NA	–	NI	NA	NI
	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	NI
	CP1–CP5	Long-term	[TBD]	[TBD]	[TBD]	[TBD]

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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-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	LTS
	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: 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 & CP4A	Long-term	CP2 similar to CP1 but greater in magnitude	PS	Mitigation Measure Wild-17: Implement Mitigation Measure Bot-7: 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: 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-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	LTS
	CP1 & CP4,	Long-term		LTS	No mitigation needed; thus, none proposed.	LTS
	CP2 & CP4A	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	NI
	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	NI
	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: 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 & CP4A	Long-term	CP2 & CP4A similar to CP1, but greater in magnitude	PS	Mitigation Measure Wild-20: Implement Mitigation Measure Bot-7: 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-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: 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	NI
	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

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 Wild-22: Impacts on Riparian-Associated Special-Status Wildlife Species Resulting from Restoration Projects	N-A	NA	–	NI	NA	NI
	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	LTS
	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: 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-24: Impacts on Bank Swallow Along the Lower Sacramento River Resulting from Modifications of Geomorphic Processes	N-A	Long-term	–	LTS	NA	LTS
	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	NI
	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	NI
	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: 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	–	LTS	NA	LTS
	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	NI
	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	NI
	CP1–CP5	Permanent	–	S	Mitigation Measure Culture-2: 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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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 Culture-3: Disturbance or Destruction of Archaeological and Historical Resources near the Upper Sacramento River Due to Construction	N-A	NA	–	NI	NA	NI
	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	PS
	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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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-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	PS
	CP1	Temporary	300 new construction jobs, 400 new indirect jobs, and 610 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, & CP4A	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	PS
	CP1–CP5	Short-term	–	LTS	No mitigation needed; thus, none proposed.	LTS

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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	PS
	CP1	Short-term	$134.2 million in personal annual incomes in the local economic study area	B	No mitigation needed; thus, none proposed.	B
	CP2	Short-term	$132.8million in personal annual incomes	B	No mitigation needed; thus, none proposed.	B
	CP3	Short-term	$153.3 million in personal annual incomes	B	No mitigation needed; thus, none proposed.	B
	CP4	Short-term	$154.2 million in personal annual incomes	B	No mitigation needed; thus, none proposed.	B
	CP4 A	Short-term	$154.3 million in personal annual incomes			
	CP5	Short-term	$156.5 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	–	NA	NA	NA
	CP1	Short-term	– (4.5-year construction period)	B	No mitigation needed; thus, none proposed.	B
	CP2	Short-term	Similar to CP1, but more beneficial (5-year construction period)	B	No mitigation needed; thus, none proposed.	B
	CP3–CP5	Short-term	Similar to CP1 & CP2, but more beneficial (5-year 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	–	NA	NA	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 Impact Socio-8: Long-Term Increases in Direct Employment in the Primary Study Area Related to Project Operations	N-A	NA	–	NA	NA	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
	N-A	NA	–	NA	NA	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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Impact Socio-9: Potential Temporary Increase in Indirect Employment in Construction-Related Businesses of the Lower Sacramento River and Delta	N-A	NA	–	NA	NA	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	–	NA	NA	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	–	NA	NA	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	–	NA	NA	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	–	NA	NA	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	–	NA	NA	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	–	NA	NA	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	–	NA	NA	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	–	NA	NA	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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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	NI
	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	NI
	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	NI
	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	NI
	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	LTS
	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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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-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	LTS
	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	LTS
	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	LTS
	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	NI
	CP1 & CP4	Long-term	Flow increases of <8 percent; inundation of small additional area	LTS	No mitigation needed; thus, none proposed.	LTS
	CP2 & CP4A	Long-term	Similar to CP1, but greater	LTS	No mitigation needed; thus, none proposed.	LTS
	CP3	Long-term	Similar to CP1 & CP2,, but greater	LTS	No mitigation needed; thus, none proposed.	LTS
	CP5	Long-term	Similar to CP1, CP2, & CP3, 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	NI
	CP1 & CP4	Long-term	Flow increases of <8 percent; inundation of small additional area	LTS	No mitigation needed; thus, none proposed.	LTS
	CP2 & CP4A	Long-term	Similar to CP1, but greater	LTS	No mitigation needed; thus, none proposed.	LTS
	CP3	Long-term	Similar to CP1 & CP2, but greater	LTS	No mitigation needed; thus, none proposed.	LTS
	CP5	Long-term	Similar to CP1, CP2, & CP3, 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	NI
	CP1 & CP4	Long-term	Flow increases of <8 percent; inundation of small additional area	LTS	No mitigation needed; thus, none proposed.	LTS
	CP2 & CP4A	Long-term	Similar to CP1, but greater	LTS	No mitigation needed; thus, none proposed.	LTS
	CP3	Long-term	Similar to CP1 & CP2, , but greater	LTS	No mitigation needed; thus, none proposed.	LTS
	CP5	Long-term	Similar to CP1, CP2, & CP3, 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	NI
	CP1 & CP4	Long-term	Flow decreases of <7 percent; inundation of small additional area	LTS	No mitigation needed; thus, none proposed.	LTS
	CP2 & CP4A	Long-term	Similar to CP1, but greater	LTS	No mitigation needed; thus, none proposed.	LTS
	CP3	Long-term	Similar to CP1 & CP2, but greater	LTS	No mitigation needed; thus, none proposed.	LTS
	CP5	Long-term	Similar to CP1, CP2, & CP3 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	NI
	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
	CP3	Long-term	Similar to but greater than CP1 and less than CP2 & CP5	B	No mitigation needed; thus, none proposed.	B
	CP4	Long-term	Similar to but greater than CP1, CP2, & CP3	B	No mitigation needed; thus, none proposed.	B
	CP44	Long-term	Similar to but greater than CP1, CP2, & CP3, but less than CP4	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	NI
	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	NI
	CP1–CP3	Long-term	–	NI	No mitigation needed; thus, none proposed.	NI
	CP4–CP5	Long-term	–	B	No mitigation needed; thus, none proposed.	B
Impact Rec-12 (CP1–CP5): Seasonal Inundation of Portions of River Recreation Facilities or Informal River Access Sites on the Lower Sacramento River and Rivers Below CVP and SWP Reservoirs as a Result of Increased River Flows	N-A	NA	–	NI	NA	NI
	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 & CP4A	Long-term	Similar to CP1, but greater	LTS	No mitigation needed; thus, none proposed.	LTS
	CP3	Long-term	Similar to CP1 & CP2, but greater	LTS	No mitigation needed; thus, none proposed.	LTS
	CP5	Long-term	Similar to CP1, CP2, & CP3, 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	NI
	CP1 & CP4	Long-term	Increased mean monthly flows within the extended study area	LTS	No mitigation needed; thus, none proposed.	LTS
	CP2 & CP4A	Long-term	Similar to CP1, but greater	LTS	No mitigation needed; thus, none proposed.	LTS
	CP3	Long-term	Similar to CP1 & CP2, but greater	LTS	No mitigation needed; thus, none proposed.	LTS
	CP5	Long-term	Similar to CP1, CP2, & CP3, 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	NI
	CP1 & CP4	Long-term	Increased mean monthly flows within the extended study area	LTS	No mitigation needed; thus, none proposed.	LTS
	CP2 & CP4A	Long-term	Similar to CP1, but greater	LTS	No mitigation needed; thus, none proposed.	LTS
	CP3	Long-term	Similar to CP1 & CP2, but greater	LTS	No mitigation needed; thus, none proposed.	LTS
	CP5	Long-term	Similar to CP1, CP2, & CP3, 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	NI
	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 & CP4A	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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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	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
	CP5	Long-term	Similar to but potentially greater than CP1, CP2, & CP3	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	NI
	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 area.	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	NI
	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	NI
	CP1	Short-term and long-term	Increased glare in primary study area	S	Mitigation Measure Vis-3: Minimize or Avoid Visual Impacts of Daytime Glare and Nighttime Lighting.	SU
	CP2	Short-term and long-term	Similar to CP1, but greater (amount, duration)	S	Mitigation Measure Vis-3: Minimize or Avoid Visual Impacts of Daytime Glare and Nighttime Lighting.	SU
	CP3–CP5	Short-term and long-term	Similar to CP1 & CP2, but greater (amount, duration)	S	Mitigation Measure Vis-3: Minimize or Avoid Visual Impacts of Daytime Glare and Nighttime Lighting.	SU
Impact Vis-4: Consistency with Federal and State Scenic Highway Requirements (Shasta Lake and Vicinity and Upper Sacramento River)	N-A	NA	–	NI	NA	NI
	CP1	Permanent	Visible from SR 151.	LTS	No mitigation needed; thus, none proposed.	LTS
	CP2	Permanent	Similar to CP1, but greater vegetation removal would be visible	LTS	No mitigation needed; thus, none proposed.	LTS
	CP3–CP5	Permanent	Similar to CP1 & CP2, but greater vegetation removal would be visible	LTS	No mitigation needed; thus, none proposed.	LTS

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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	LTS
	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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Impact Trans-2: Adverse Effects on Access to Local Streets or Adjacent Uses in the Primary Study Area	N-A	NA	–	LTS	NA	LTS
	CP1	Permanent and/or temporary	Road closures and detours or partial road closures, or a combination of both, at Shasta Lake	PS	Mitigation Measure Trans-2: 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	LTS
	CP1	Permanent	Relocated road segments and vehicular and railroad bridges would be designed to current engineering design standards	B	No mitigation needed; thus, none proposed.	B
	CP2	Permanent	Similar to CP1, but more road segments and bridges would be replaced	B	No mitigation needed; thus, none proposed.	B
	CP3–CP5	Permanent	Similar to CP1 and CP2, but more road segments & bridges would be replaced	B	No mitigation needed; thus, none proposed.	B

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Impact Trans-4: Adverse Effects on Emergency Access in the Primary Study Area	N-A	NA	–	LTS	NA	LTS
	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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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 Trans-5: Accelerated Degradation of Surface Transportation Facilities in the Primary Study Area	N-A	NA	–	LTS	NA	LTS
	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		Similar to CP1 & CP2, but greater	PS	Mitigation Measure Trans-5: Identify and Repair Roadway Segments Damaged by the Project.	LTS
	CP4–CP5	Permanent	Similar to CP1, CP2, & CP3, 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	LTS
	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	LTS
	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	LTS
	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	LTS
	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	LTS
	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	NI
	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	NI
	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	NI
	CP1	Short-term	176,627 cubic yards of solid waste	LTS	No mitigation needed; thus, none proposed.	LTS
	CP2	Short-term	188,584 cubic yards of solid waste	LTS	No mitigation needed; thus, none proposed.	LTS
	CP3	Short-term	219,889 cubic yards of solid waste	LTS	No mitigation needed; thus, none proposed.	LTS
	CP4 & CP4A	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	NI
	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	NI
	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	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	NA
	CP1–CP5	Short-term	–	NI	No mitigation needed; thus, none proposed.	NI

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

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

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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]
Public Services						
Impact PS-1: Disruption of Public Services(Shasta Lake and Vicinity and Upper Sacramento River)	N-A	NA	–	NI	NA	NI
	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	NI
	CP1	Short-term	– Risk of degraded level of public services during construction	PS	Mitigation Measure PS-2: Provide Support to Public Services Agencies.	LTS
	CP2	Short-term	Similar to CP1, but greater construction duration	PS	Mitigation Measure PS-2: Provide Support to Public Services Agencies.	LTS
	CP3–CP5	Short-term	Similar to CP1 & CP2, but greater construction duration	PS	Mitigation Measure 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	NI
	CP1	Long-term	–	LTS	No mitigation needed; thus, none proposed.	LTS
	CP2	Long-term	Greater than CP1	LTS	No mitigation needed; thus, none proposed.	LTS
	CP3–CP5	Long-term	Greater than CP1 & CP2	LTS	No mitigation needed; thus, none proposed.	LTS

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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 PS-4: Short-Term Disruption of Public Services (Lower Sacramento River, Delta, CVP/SWP Service Areas)	N-A	NA	–	NI	NA	NI
	CP1–CP5	Short-term	–	NI	No mitigation needed; thus, none proposed.	NI
Impact PS-5: Degraded Levels of Public Services (Lower Sacramento River, Delta, CVP/SWP Service Areas)	N-A	NA	–	NI	NA	NI
	CP1–CP5	Short-term	–	LTS	No mitigation needed; thus, none proposed.	LTS
Impact PS-6: Relocation of Public Services Facilities (Lower Sacramento River, Delta, CVP/SWP Service Areas)	N-A	NA	–	NI	NA	NI
	CP1–CP5	Long-term	–	NI	No mitigation needed; thus, none proposed.	NI
Power and Energy						
Impact Hydro-1: Decrease in Shasta Powerplant Energy Generation	N-A,	Long-term	Increase in Shasta Powerplant energy generation	B	NA	B
	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%	LTS	NA	LTS
	CP1–CP5	Long-term	<5% decrease in CVP system energy generation	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 Hydro-3: Decrease in SWP System Energy Generation	N-A,	Long-term	Increase in SWP system energy generation	B	NA	B
	CP1, CP2, CP4 – CP5	Long-term	Increase in SWP system energy generation	B	No mitigation needed; thus, none proposed.	B
	CP3	Long-term	<5% decrease in SWP system energy generation	LTS	No mitigation needed; thus, none proposed.	LTS
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	LTS
	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	LTS
	CP1–CP5	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	NI	NA	NI
	CP1–CP5	Long-term	<5% decrease in Pit 7 Powerplant energy generation	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]
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	NDHA
	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	NDHA
	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	NDHA
	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	NDHA
	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	NDHA
	CP1–CP5	Long-term	–	NDHA	No mitigation needed; thus, none proposed.	NDHA

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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]
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	NI
	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	NI
	CP1–CP5	Permanent	–	NI	No mitigation needed; thus, none proposed.	NI

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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 WASR-3: Effects to McCloud River Wild Trout Fishery, as Identified in the California Public Resources Code, Section 5093.542	N-A	NA	–	NI	NA	NI
	CP1	Long-term	Increased inundation could affect the wild trout fishery (access and ecology) of the lower McCloud River identified in the State Public Resources Code.	PS	Mitigation Measure WASR-3 (CP1-CP5): Develop and Implement a Comprehensive Multi-scale Fishery Protection, Restoration and Improvement Program for the Lower McCloud River Watershed.	PS
	CP2	Long-term	Similar to CP1, but greater inundation.	PS	Mitigation Measure WASR-3 (CP1-CP5): Develop and Implement a Comprehensive Multi-scale Fishery Protection, Restoration and Improvement Program for the Lower McCloud River Watershed.	PS
	CP3–CP5	Long-term	Similar to CP1 and CP2, but greater inundation.	PS	Mitigation Measure WASR-3 (CP1-CP5): Develop and Implement a Comprehensive Multi-scale Fishery Protection, Restoration and Improvement Program for the Lower McCloud River Watershed.	PS

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Impact WASR-4: Effects to McCloud River Free-Flowing Conditions, as Identified in the California Public Resources Code, Section 5093.542	N-A	NA	–	NI	NA	NI
	CP1	Long-term	Increased inundation could affect the free-flowing conditions of the McCloud River, as identified in the State Public Resources Code.	S	Mitigation Measure WASR-4: Develop and Implement Protection, Restoration, and Improvement Measures to Benefit Hydrologic Functions Within the Lower McCloud River Watershed	SU
	CP2	Long-term	Similar to CP1, but greater inundation.	S	Mitigation Measure WASR-4: Develop and Implement Protection, Restoration, and Improvement Measures to Benefit Hydrologic Functions Within the Lower McCloud River Watershed	SU
	CP3–CP5	Long-term	Similar to CP1 and CP2, but greater inundation.	S	Mitigation Measure WASR-4: Develop and Implement Protection, Restoration, and Improvement Measures to Benefit Hydrologic Functions Within the Lower McCloud River Watershed	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

Shasta Lake Water Resources Investigation, California

Shasta Lake Water Resources Investigation, California Final Environmental Impact Statement

Prepared by:

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

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Appendices

Abbreviations and Acronyms

°F	degrees Fahrenheit
µS/cm	microSiemens per centimeter
µg/L	micrograms per liter
µg/m^3	micrograms per cubic meter
2004 NMFS BO	NMFS 2004 Biological Opinion on the Long-Term CVP and SWP Operations Criteria and Plan
2004 OCAP BA	Reclamation 2004 Long-Term CVP and SWP Operations Criteria and Plan Biological Assessment
2005 USFWS BO	USFWS 2005 Reinitiation of Formal and Early Section 7 Endangered Species Consultation on the Coordinated Operations of the CVP and SWP and the Operational Criteria and Plan to Address Potential Critical Habitat Issues
2008 Long-Term Operation BA	Reclamation 2008 Biological Assessment on the Continued Long-Term Operations of the CVP and SWP
2008 USFWS BO	USFWS 2008 Formal Endangered Species Act 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
AF	acre-feet
AFRP	Anadromous Fish Restoration Program
AFS	anadromous fish survival
Ag	Agricultural Water Service Contractor
Alquist-Priolo Act	Alquist-Priolo Earthquake Fault Zoning Act
Alt	alternative
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
Avg	average
B	beneficial
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 Delta
BDCP	Bay Delta Conservation Plan
BIA	U.S. Department of the Interior, Bureau of Indian Affairs
BLM	U.S. Department of the Interior, Bureau of Land Management
BLMS	BLM sensitive
BMO	Basin Management Objective
BMP	best management practice
BO	Biological Opinion
BP	before present
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
$CaCO_3$	calcium carbonate
Cal EMA	California Emergency Management Agency
Cal Fire	California Department of Forestry and Fire Protection
CalEPA	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
CD	California Delisted
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])
CE	California Endangered
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	combined objective
CO	carbon monoxide
CO_2	carbon dioxide
CO_2e	carbon dioxide equivalent
COA	Coordinated Operations Agreement
County	Shasta County
County	Tehama County Department of Public Works
CP	California Fully Protected
CP	Comprehensive Plan
CRMP	coordinated resource management plan
CRPR	California Rare Plant Rank
CSA	community service area
CSAMP	Collaborative Science and Adaptive Management Process
CSC	California Species of Special Concern
CT	California Threatened
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	Federal Clean Water Act
CWHR	California Wildlife Habitat Relationship
CWP	cold-water pool
D-1275	State Water Board Water Rights Decision 1275

D-1379	State Water Board Water Rights Decision 1379
D-1641	State Water Board Water Right Decision 1641
dB	decibel
dBA	A-weighted decibel
dBA/DD	dBA per doubling of distance
DCC	Delta Cross Channel
DEIR	Draft Environmental Impact Report
DEIR/S	Draft Environmental Impact Report/Statement
DEIS	Draft Environmental Impact Statement
Delta	Sacramento-San Joaquin Delta
DHA	disproportionately high and adverse
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
DPS	Distinct Population Segment
Draft Feasibility Report	Shasta Lake Water Resources Investigation Draft 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
Exh	exhaust
FAC	facultative plants
FACU	facultative upland plants
FACW	facultative wetland plants
FB	Federal Bald and Golden Eagle Protection Act
FC	Federal candidate for listing
FD	Federally delisted
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
FHA	Federal Highway Administration
FP	Federally petitioned for listing
FPD	Proposed for Federal delisting
FSSC	Forest Service Site Class
FSZ	Farmland Security Zone
FT	Federally listed as threatened
FTA	Federal Transit Administration
FWCA	Fish and Wildlife Coordination Act
GAMA	Groundwater Ambient Monitoring and Assessment
General Industrial Permit	Industrial Stormwater General Permit
GHG	greenhouse gas
GIS	geographic information system
GW	Groundwater
GWh	gigawatt-hour
GWh/yr	gigawatt-hour per year
GWM	Groundwater Management
GWMP	Groundwater Management Plan
GWP	global warming potential
H&H	hydrology, hydraulics, and water management
HAP	hazardous air pollutant
HCP	Habitat Conservation Plan
HMBP	Hazardous Materials Business Plan
hp	horsepower
HVAC	heating, ventilation, and air conditioning
Hz	Hertz
I-5	Interstate 5
ICOLD	International Commission of Large Dams
ID	Irrigation District
IFIM	Instream Flow Incremental Methodology
IFPSC	Interagency Fish Passage Steering Committee
IL4	Incremental Level 4
IMPLAN	IMpact analysis for PLANning
in/sec	inches per second
Interior	U.S. Department of the Interior
IRA	Inventoried Roadless Area

ITA	Indian Trust Assets
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
L2	Level 2
L4	Level 4
lb	pound
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
LOS	level of significance
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
LTS	less than significant
L_x	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
mg/m^3	milligrams per cubic meter
MGCSD	Mountain Gate Community Services District
mgd	million gallons per day
mmhos/cm	millimhos per centimeter
MMT	million metric ton
MOA	Memorandum of Agreement
mph	miles per hour

MSCS	Multi-Species Conservation Strategy
msl	mean sea level
MT	metric ton
MW	megawatt
MWh	megawatt-hour
N	nitrogen
N-A	No-Action Alternative
N/A	not applicable
NA	not applicable
NAHC	Native American Heritage Commission
NAVD88	North American Vertical Datum of 1988
NDHS	not disproportionately high and adverse
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
ng/L	nanograms per liter
NGVD29	National Geodetic Vertical Datum 1929
NHPA	National Historic Preservation Act
NI	no impact
NL	Not Listed
NMFS	National Marine Fisheries Service
NO_2	nitrogen dioxide
NO_2	nitrate
NO_3	nitrite
NOA	Notice of Availability
NOD	north of Delta
NOI	Notice of Intent
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
NRDC	National Resources Defense Council
NRHP	National Register of Historic Places
NRI	National Rivers Inventory
NSVAB	Northern Sacramento Valley Air Basin

ntu	nephelometric turbidity units
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 value
OSHA	Occupational Safety and Health Administration
P	phosphorus
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
PEIS/R	Programmatic Environmental Impact Statement/Environmental Impact Report
PG&E	Pacific Gas and Electric Company
PLSS	Public Land Survey System
PM	particulate matter
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
PMF	probable maximum flood
Porter-Cologne Act	Porter-Cologne Water Quality Control Act
ppm	parts per million
PPV	peak particle velocity
PRC	Public Resources Code
PS	potentially significant
PSD	New Source Review Prevention of Significant Deterioration
PUD	Public Utilities District
RABA	Redding Area Bus Authority
RAP	Road Analysis Process

RBPP	Red Bluff Pumping Plant
RCD	resource conservation district
RCRA	Resource Conservation and Recovery Act
RD-1641	State Water Board Revised Water Right Decision 1641
Reclamation	U.S. Department of the Interior, Bureau of Reclamation
Recovery Plan	NMFS 2014 Recovery Plan for the Evolutionarily Significant Units of Sacramento River Winter-run Chinook Salmon and Central Valley Spring-run Chinook Salmon and the Distinct Population Segment of Central Valley Steelhead
Ref	refuge
Refuge	Level 2 Federal Refuge
Reporting Rule	Greenhouse Gas Reporting Rule
Resources Agency	California Natural Resources Agency (formerly known as the California Resources Agency or State 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
RTS	reservoir triggered seismicity
RV	recreational vehicle
RWQCB	regional water quality control board
S	significant
S&M	Survey and Manage
SALMOD	SALMOD, Version 3.8
SB	Senate Bill
SCAQMD	Shasta County Air Quality Management District
SCC	Shasta County Code
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
SLFPD	Shasta Lake Fire Protection District
SLWRI	Shasta Lake Water Resources Investigation
SMAQMD	Sacramento Metropolitan Air Quality Management District
SMARA	California Surface Mining and Reclamation Act of 1975
SMM	standard mitigation measure
SO_2	sulfur dioxide
SOD	south of Delta
SR	State Route
SRA	shaded riverine aquatic
SRCA	Sacramento River Conservation Area
SRNWR	Sacramento River National Wildlife Refuge
SRTTG	Sacramento River Temperature Task Group
SRWRS	Sacramento River Water Reliability Study
SSI	sediment source inventory
SSLE	Security, Safety and Law Enforcement
State	State of California
State Parks	California Department of Parks and Recreation
State Water Board	State Water Resources Control Board
STATSGO	State Soil Geographic Database
STNF	Shasta-Trinity National Forest
STNF LRMP	Shasta-Trinity National Forest Land and Resource Management Plan
SU	significant and unavoidable
SVAB	Sacramento Valley Air Basin
SVI	Sacramento Valley Index
SWAP	Statewide Agriculture Production
SWP	State Water Project
SWP Power	State Water Project Power, BST April 2010 Version
SWPPP	Stormwater Pollution Prevention Plan
TAC	toxic air contaminants
TAF	thousand acre-feet

TBD	to be determined
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
TS	too speculative for meaningful consideration
UC	University of California
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	United States Code
USFS	U.S. Department of Agriculture, Forest Service
USFS E	USFS Endemic Species
USFS M	USFS Survey and Manage Species
USFS S	USFS Sensitive Species
USFWS	U.S. Department of the 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
WCD	Water Conservation District
WD	Water District
WDR	waste discharge requirements
WEPP	Watershed Erosion Prediction Project
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
WUI	wildland-urban interface
WWTP	Wastewater Treatment Plant
X2	2 parts per thousand isohaline

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Chapter 1
Introduction

This Environmental Impact Statement (EIS) 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 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 (USACE); and U.S. Department of the Interior, Bureau of Indian Affairs (BIA). This document has also been prepared in consideration of California Environmental Quality Act (CEQA) requirements 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 Draft EIS (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 the action alternatives that had been evaluated at that time; 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.

After the release of the Draft Feasibility Report and Preliminary DEIS, SLWRI alternatives were refined for the Draft EIS (DEIS) 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 the DEIS and this Final EIS reflect the following:

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

- The U.S. Department of the 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 2009)

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

- Additional changes in non-CVP/SWP facilities and operations, such as the addition of the Freeport Regional Water Project

Reclamation released the DEIS for public review and comment in June 2013. During the process of addressing public comments on the DEIS, some notable content changes were made to the Final EIS, including:

- Refinement of the project purpose statement

- Clarification of the relationship of this EIS and tiering to the CALFED Bay-Delta Program (CALFED) Programmatic Environmental Impact Statement/Environmental Impact Report (PEIS/R)

- Refinement of the operational scenarios focused on anadromous fish survival, and the development, evaluation, and incorporation of Comprehensive Plan 4A (CP4A) Refinement of facility plans for recreation relocations, Shasta Dam modifications, Pit 7 Dam and Powerhouse modifications, and other reservoir area relocations (e.g., power transmission lines)

- Incorporation of updated resource information related to physical and biological resources in the primary study area

- Based on facility and construction footprints, refinement of "maximum" affected areas and refinement of "most likely" affected areas for biological resources

- In conjunction with an interagency, interdisciplinary team, refinement and enhancement of the mitigation measures, including development of a framework to quantify impacts (where appropriate) and establish mitigation ratios that are applicable to a number of impacts related to biological resources

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 "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 EIS. 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 discussions related to broader CVP and SWP operations or facilities. Members of the public often refer to both the reservoir and its location as Shasta Lake.

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, including preparing 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.

Figure 1-1. Location of Shasta Dam and Reservoir

1.1.1 Study Authorization

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

> *(a)…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.*
>
> *(b) The Secretary of the Interior is further authorized to engage in feasibility studies for the purpose of determining the potential costs, benefits, environmental impacts, and feasibility of using the Sacramento River for conveying water from the enlarged Shasta Dam and Reservoir or the larger dam to points of use downstream from the dam.*

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 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 Programmatic Record of Decision (ROD) (CALFED 2000a) called for the Secretary of the Interior to conduct feasibility studies for 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 Secretary of the Interior to develop a least-cost plan to increase water supplies for CVP deliveries 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 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. Reclamation completed the DEIS and supporting technical appendices for the SLWRI in June 2013 and released the documents to the public in the same month.

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" (Title 40, Code of Federal Regulations (CFR) Part 1502.13). In California, the State CEQA Guidelines require a clearly written statement of objectives, including the underlying purpose of a proposed project (Title 14, California Code of Regulations (CCR) 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 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.

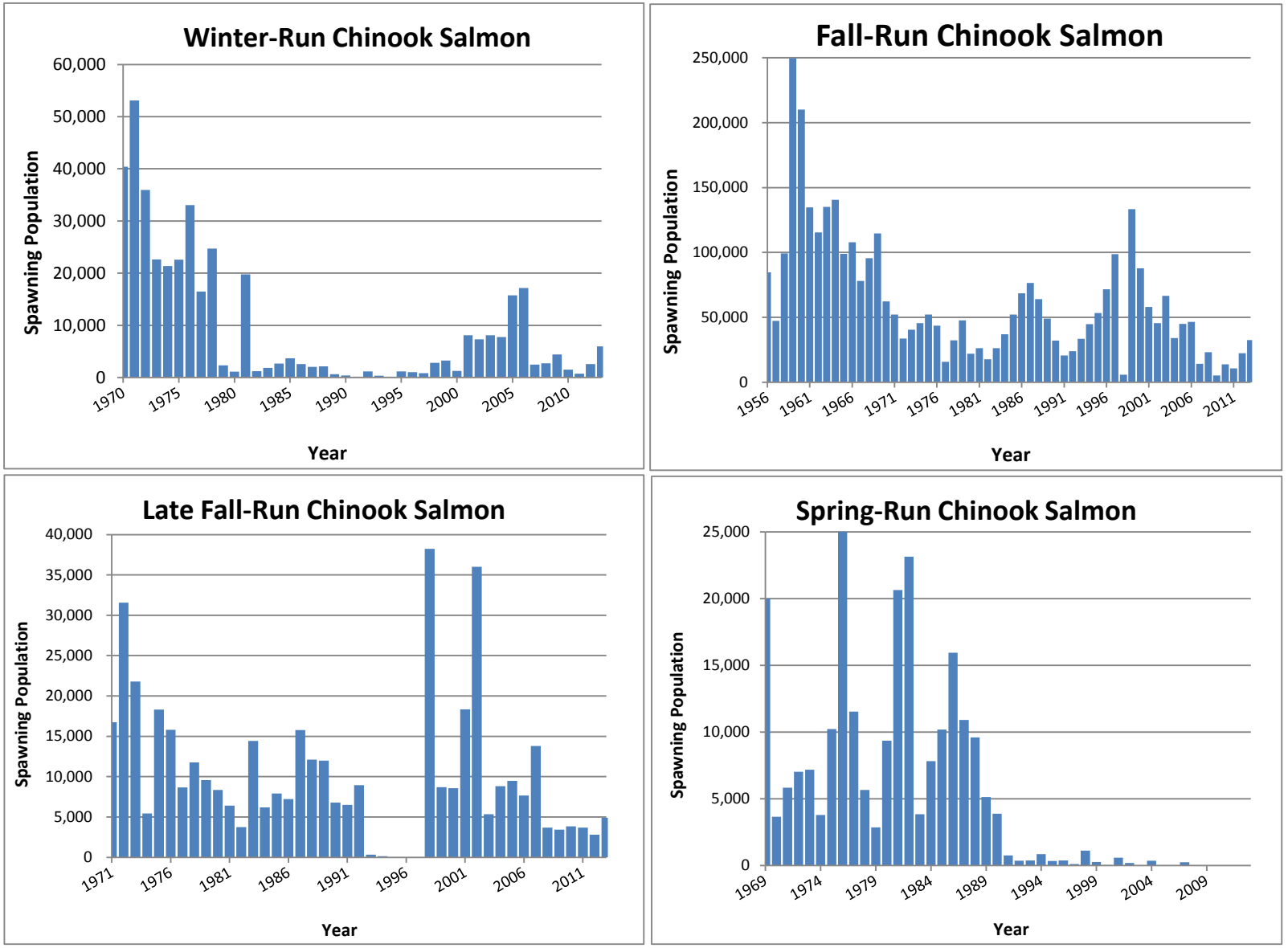
1.2.2 Project Need

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) (CDFW 2014).

Several fish species in the upper Sacramento River have been listed as endangered or threatened under 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 (DPS) 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 2014). 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.



Source: CDFW 2014

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

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 *Recovery Plan for the Evolutionarily Significant Units of Sacramento River Winter-run Chinook Salmon and Central Valley Spring-run Chinook Salmon and the Distinct Population Segment of Central Valley Steelhead* (Recovery Plan) (NMFS 2014) 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 2014). 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 (State Water Board) issued Water Right Order 90-5, which included temperature objectives for the Sacramento River to protect winter-run Chinook salmon. Three NMFS BO documents (NMFS 1993, 2004, 2009) for Sacramento River winter-run Chinook salmon reinforced this order and established certain operating parameters for Shasta Reservoir. The State Water 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 changes in 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 in 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.

With the exception of spring-run Chinook salmon, the average Chinook salmon spawning population in the Sacramento River since 1999 has increased compared with the previous 20 years (1979 to 1998) (CDFW 2014a). This increase in salmon populations is likely due primarily to minimum release requirements at Shasta Dam and the TCD. Additionally, changes in operating the Red Bluff Diversion Dam and the RBPP have benefited Chinook salmon populations in the Sacramento River. However, there is a continual need for

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

cool water in the Sacramento River, especially in dry and critical years, to promote anadromous fish survival and reduce the risk of extinction.

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 California Department of Water Resources (DWR) *California Water Plan Update 2013* (DWR 2014) concludes that California is facing one of the most significant water crises in its history; drought impacts are growing, and climate change is affecting statewide hydrology. Despite significant physical improvements in water resource systems and in system management over the past few decades, California still faces unreliable water supplies, continued depletion and degradation of groundwater resources, habitat and species declines, and unacceptable risks from flooding (DWR 2014). Compounding these issues, Reclamation's *Water Supply and Yield Study* (2008b) 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 2008b). Current water supply shortages for the State are estimated at 2.3 and 4.1 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 *California Water Plan Update 2005* (DWR 2005), 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.

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 California Water Plan Update 2005 (DWR 2005).

[3] Year 2005 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 (e.g., North Coast, Sacramento River) and, therefore, may not equal the difference between total demands and 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. Detailed estimates of shortages for each region can be found in the 2008 Reclamation Water Supply and Yield Study in Table A-1 (dry year) and Table A-2 (average year). 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 California Water Plan Update 2005 (DWR 2005) adjusted for population growth, increasing urban water use, and reductions in irrigated acreage and environmental flow due to insufficient water supplies.

[3] 2030 Population estimates are from the California Department of Finance (2007)

[4] Total shortages are calculated as the sum of shortages for each category by region (e.g., North Coast, Sacramento River) and, therefore, may not equal the difference between demands and 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. Detailed estimates of shortages for each region can be found in the 2008 Reclamation Water Supply and Yield Study in Table A-4 (dry year) and Table A-5 (average year). 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 above 2005 levels by 2050 (DOF 2007) and could force some of the existing water supplies currently identified for agricultural uses to be redirected to urban uses. A portion of the 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 urban demands. However, since much of the growth would occur on non-irrigated agricultural lands, the required agricultural-to-urban water conversion needed to sustain projected urban water demands would be only partially offset.

The *California Water Plan Update 2013* (DWR 2014) estimates changes in future water demands by 2050, considering three different population growth scenarios as well as climate change. Assuming that recent population growth trends will continue until 2050, Table 1-3 shows the results of this study for an average water year (DWR 2014) for one of three scenarios, the Current Trends scenario.

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

Item	Current Trends
Population (million)	51.0
Irrigated Crop Acreage (million)	8.9
Water Demand Change[1] (MAF)	
Urban	2.9
Agricultural	-3.6
Total	***3.5***

Source: DWR 2014

Note:

[1] Estimated water demand change is the difference between the average demands for 2043—2050 and 1998—2005.

Key:

MAF = million acre-feet

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, there is potential for climate change to increase annual water demand compared to a repeat of historical climate (DWR 2014). 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 snowpack 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 used by population growth and increased environmental and ecosystem commitments and requirements since the projects were constructed (Reclamation 2008b).

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 among 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 water supplies to environmental purposes. Existing NMFS and USFWS BOs, resulting in increased Delta pumping constraints and other operational restrictions, coupled with drought conditions, have even further decreased CVP deliveries.

Potential Approaches to Address Water Supply Needs As noted by Reclamation's *Water Supply and Yield Study* (Reclamation 2008b), the *California Water Plan Update 2013* (DWR 2014), and the CALFED Programmatic 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 *California Water Plan Update 2013* concluded that to improve public safety, foster environmental stewardship, and support economic stability, California must continue its commitment to integrated water management, promote better alignment of government agency efforts at all levels, and encourage greater investment in innovation and infrastructure, including increased surface storage. Accordingly, California must invest in reliable, high quality, and affordable water conservation; efficient water management; and development of water supplies. Major efforts by multiple agencies are needed to address the complex water resources issues in the State, as demands are expected to continue to exceed supplies in the future.

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 a substantial concentration of nesting bald eagles in California.

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 prepared the *Shasta-Trinity National Forest Land and Resource Management Plan* (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 requirements 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 riparian vegetation habitat within the Sacramento River basin remains today (USFWS 2014).

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, the 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, these conditions have 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. Monitoring results indicate that the threatened delta smelt population continues to remain at or near all-time lows. In 2006, the USFWS was petitioned to upgrade the status of delta smelt to endangered (The Center for Biological Diversity et al. 2006). In 2010, the USFWS conducted a 5-year review and found delta smelt warranted the upgrade in status; however, the listing was precluded by other higher priority listing actions (Volume 75, Federal Register (FR), page 17667 (75 FR 17667 (April 7, 2010)). Longfin smelt were petitioned for listing as endangered in 2007 (The Center for Biological Diversity et al. 2007). The USFWS found that the Bay-Delta DPS does warrant listing; however, as with the delta smelt, the listing is precluded by other higher priority actions. Therefore, longfin smelt have been added to the candidate list (77 FR 19756 (April 2, 2012)). Current planning efforts, such as the Bay Delta Conservation Plan (BDCP)/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 in the nation, 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 (DOE 2014). Even so, demands for electricity are growing at a rapid pace. California's peak demand for electricity is expected to increase at a rate of approximately 1.5 percent per year through 2022, from about 60,000 megawatts (MW) in 2011 to about 70,000 MW by 2022 (California Energy Commission 2012). 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). To meet renewable energy goals, significant increases in non-dispatchable intermittent renewable resources, such as wind and solar generation, will need to be added to California's power system. This means that other significant flexible generation resources will be needed to support and integrate renewable generation. 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. For example, the San Onofre Nuclear Generating Station in San Diego County is in the process of decommissioning.

Recreation

As the population of the State 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 *California Water Plan Update 2013* (DWR 2014), the Central Valley is experiencing dramatic population growth, but currently has insufficient access to 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 (Regional Water Boards, State Water Board, 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 BDCP, 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 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 area includes other parts of California with resource programs or projects that could potentially be directly or indirectly influenced by modifying Shasta Dam and Reservoir. As discussed above, the study area includes 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, the 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 that would be affected by increasing storage in the reservoir, and the Sacramento River upstream from RBPP to Shasta Dam. 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 north of 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, the 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.

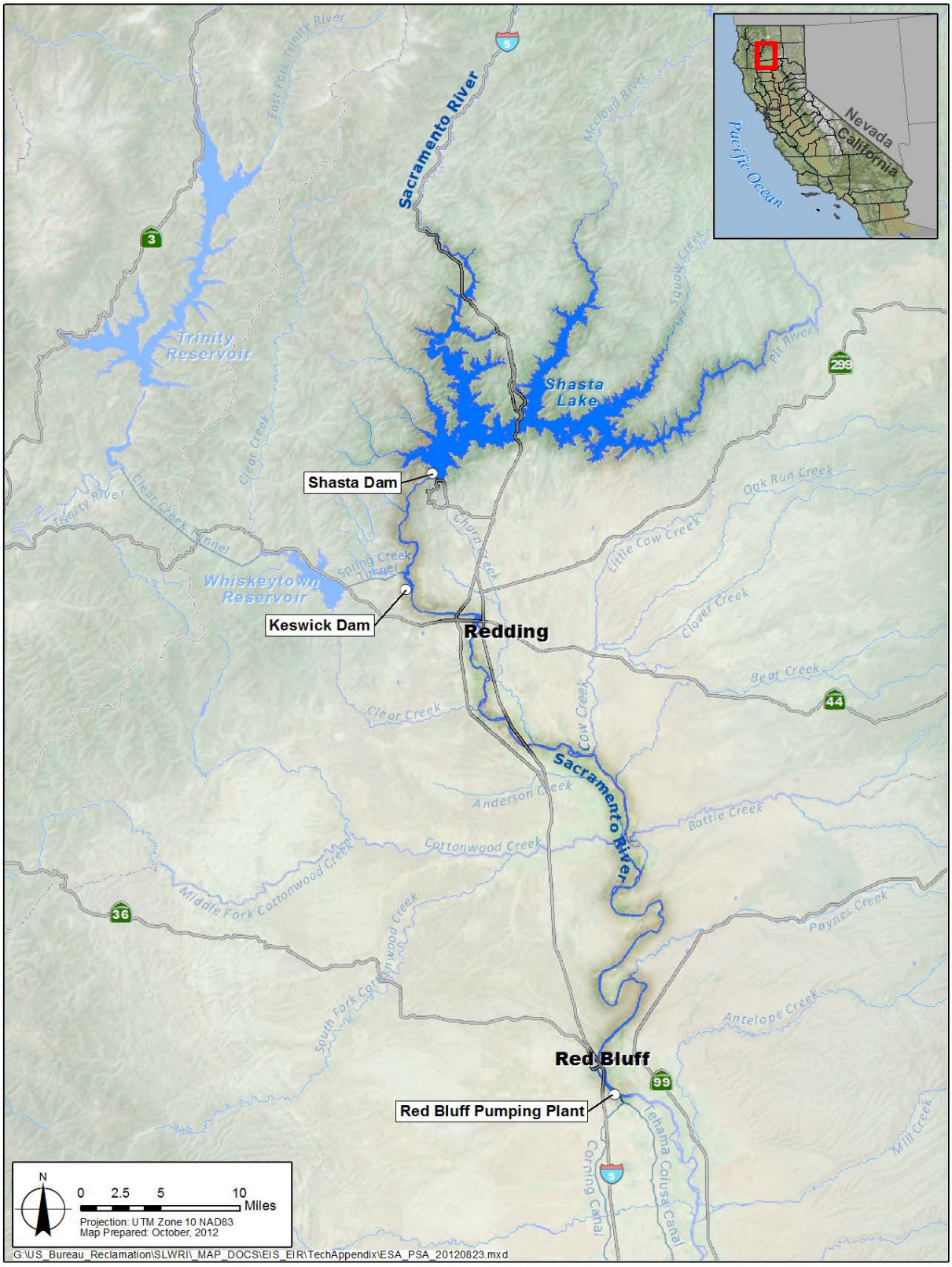


Figure 1-3. Primary Study Area—Shasta Lake Area and Sacramento River from Shasta Dam to Red Bluff Pumping Plant

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 RBPP is directly adjacent to the Red Bluff Diversion Dam, which is currently operated year round with all of the gates permanently raised. 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).

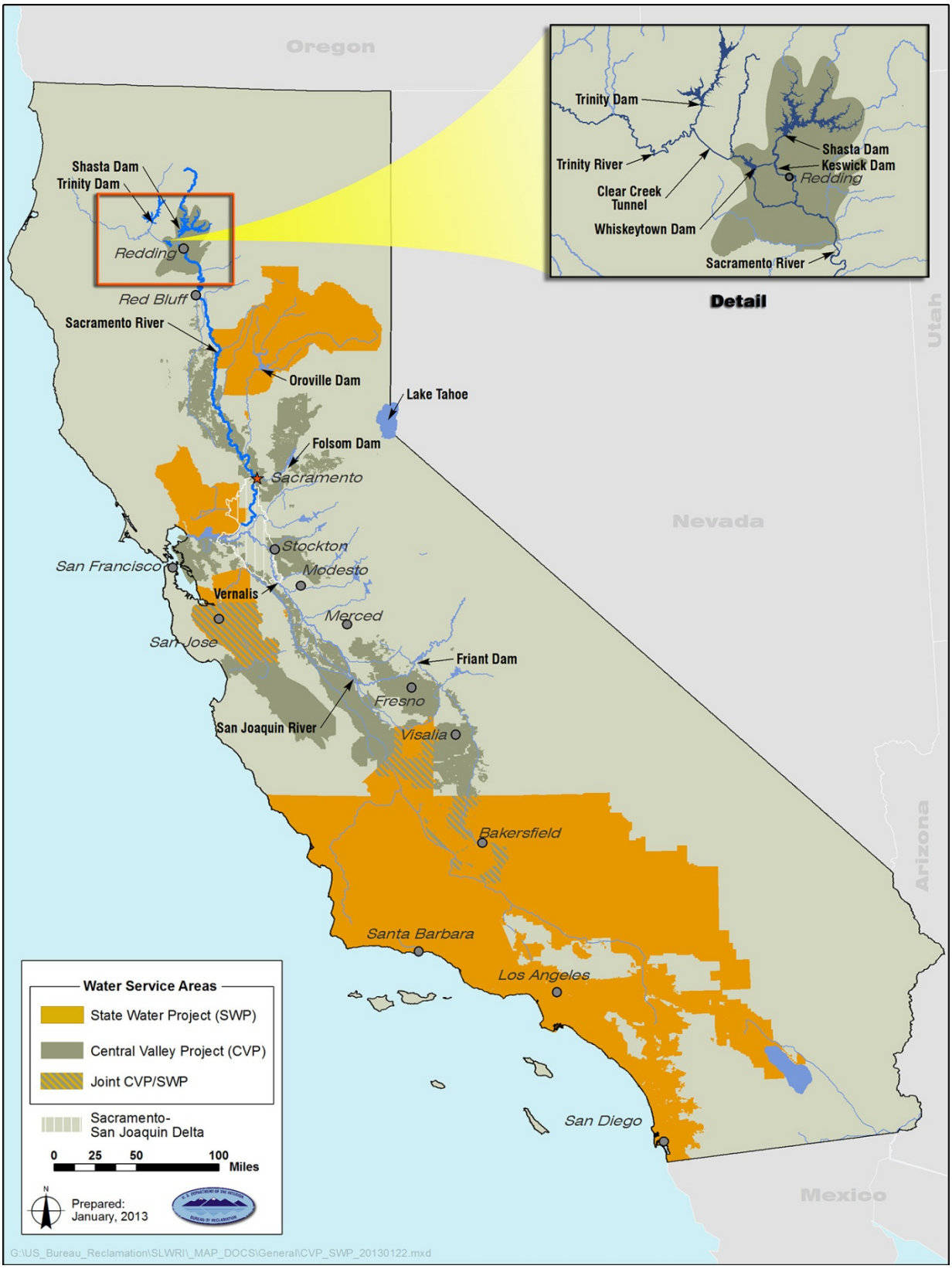


Figure 1-4. Central Valley Project and State Water Project Facilities and Water Service Areas

1.3.2 Extended Study Area

The extended study area includes the Sacramento River downstream from RBPP south (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 SWP facility on the Feather River, and Folsom Lake is a major 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 San Francisco 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 smaller 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. Upstream from the Merced River, nonflood flows in the San Joaquin River consist primarily of Restoration Flows released under the San Joaquin River Restoration Program (SJRRP). Restoration Flows are currently recaptured from the river at Mendota Pool (approximately 87 miles upstream from the Merced River confluence). As the capacity of the San Joaquin River downstream from Mendota Pool is gradually increased as part of the SJRRP, Restoration Flows will increase downstream from Mendota Pool, and will ultimately reach the Delta.

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 CVP 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. The SWP is operated in conjunction with the CVP according to the 1986 *Agreement Between the United States and the State of California for the Coordinated Operation of the Central Valley Project and the State Water Project*, commonly known as the "Coordinated Operations Agreement." This agreement defines how Reclamation and DWR share their joint responsibility to meet Delta water quality standards and the water demands of senior water right holders, and how the two agencies share surplus flows.

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 southern 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. Some of the water delivered to Bethany Reservoir is pumped at South Bay Pumping Plant for delivery through the South Bay Aqueduct to SWP contracting agencies in the San Francisco Bay Area. Most of 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 EIS 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, the DEIS was made available for public review and comment in June 2013, followed by the release of this Final EIS.

The EIS satisfies 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 for NEPA compliance or to inform decisions regarding resources within their jurisdictions. Chapter 32, “Final EIS,” provides an overview of the Final EIS, including public involvement, consultation, and coordination efforts for the EIS; a description of the preferred alternative; document availability and distribution; and next steps.

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.

The DEIS was released to the public in June 2013 and was circulated for review and comment by agencies, stakeholders, and the public to inform and engage interested persons in the planning and NEPA processes. Public outreach, including public workshops and hearings, was conducted during the 90-day public review period for the DEIS. Comments received during the public review period were considered and addressed and all comments and responses to comments are included in this Final EIS in Chapter 33, "Public Comments and Responses."

1.5.1 CALFED Tiering

The 2000 CALFED PEIS/R Preferred Program Alternative and associated CALFED Programmatic ROD recommended five surface water storage projects to be pursued with project specific studies. These studies included Shasta Lake Enlargement, Los Vaqueros Reservoir Enlargement, Sites Reservoir, In-Delta Storage, and development of storage in the upper San Joaquin River Basin. As described in the CALFED Programmatic ROD:

> *For actions contained within the Preferred Program Alternative that are undertaken by a CALFED Agency or funded with money designated for meeting CALFED purposes, environmental review will tier from the [CALFED] Final Programmatic EIS/R.*

Accordingly, since the SLWRI is an action contained within the CALFED Preferred Program Alternative, this EIS tiers to the CALFED PEIS/R. The CALFED Programmatic ROD describes tiering as follows:

> *Whenever a broad environmental impact analysis has been prepared and a subsequent narrower analysis is then prepared on an action included within the entire program or policy, the subsequent analysis need only summarize the issues discussed in the broader analysis and incorporate discussions from the broader analysis by reference. This is known as tiering. Tiered documents focus on issues specific to the subsequent action and rely on the analysis of issues already decided in the broader programmatic review. Absent new information or substantially changed circumstances, documents tiering from the CALFED Final Programmatic EIS/R will not revisit the alternatives that were considered alongside CALFED's Preferred Program Alternative nor will they revisit alternatives that were rejected during CALFED's alternative development process.*

As discussed in more detail in Chapter 2, Section 2.1.3, "Planning Constraints and Other Considerations," preliminary studies in support of the CALFED PEIS/R considered more than 50 surface water storage sites throughout California and recommended more detailed study of the five sites identified in the CALFED Programmatic ROD (CALFED 2000a, 2000b, 2000c). Consistent with the above guidance in the CALFED Programmatic ROD, this EIS relies on evaluations and alternatives development and screening included in the CALFED PEIS/R, and focuses on the subsequent action of evaluating the enlargement of Shasta Lake.

Although conditions have changed since the CALFED Programmatic ROD was issued in July 2000, the Bay-Delta problems for which the alternatives were formulated persist today. The purpose of CALFED was to develop and implement a long-term comprehensive plan that would restore ecological health and improve water management for beneficial uses of the Bay-Delta system. The goal of CALFED was to concurrently and comprehensively address problems of the Bay-Delta system within four critical resource categories: ecosystem quality, water quality, water supply reliability, and levee system integrity. Although conditions have changed in the system since 2000 and progress has been made towards the CALFED goals, the fundamental needs for which the CALFED alternatives were formulated to address are still relevant today. For example, unreliable water supply, declining fish and wildlife habitat, continuing water quality issues, and the levee system are still key concerns for the Bay-Delta system. Accordingly, there is no new information or substantially changed circumstances that require Reclamation to revisit the CALFED alternatives as the alternatives, analyses, and recommended actions remain relevant today.

The CALFED PEIS/R was a programmatic-level document to select a long-term plan – Preferred Program Alternative – for implementation over a 30-year time frame. As described in the CALFED Programmatic ROD:

> *The Preferred Program Alternative is a set of programmatic actions, studies, and conditional decisions. It includes the broadly described actions that set the long-term overall direction of the Program. The description of the alternative is programmatic in nature, intended to help agencies and the public make decisions on the broad methods to meet program purposes. The Preferred Program Alternative description is an important legal element of compliance with CEQA and NEPA. The Preferred Program Alternative is not intended to define the site specific actions that will ultimately be implemented.*

This EIS builds on the CALFED PEIS/R analysis to account for updates to hydrology, demands, facilities, and CVP and SWP water operations; recent and relevant BOs; and reasonably foreseeable actions expected to occur in the study

area to provide more specific information about the potential for the action alternatives to cause wide-ranging effects.

1.5.2 Intended Use of Final EIS

Reclamation posted the Final EIS at http://www.usbr.gov/mp/slwri for public review and issued a notice in the Federal Register and press release describing the public release of the Final EIS. It will 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 this 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 1-4 presents the roles and responsibilities of Federal, State, and local agencies that may use the Final EIS to support their decision-making needs.

This Final EIS is being published along with the Final Feasibility Report. The Final Feasibility Report incorporates information contained in this Final EIS by reference, and will be used to determine the type and extent of Federal interest in enlarging Shasta Dam and Reservoir. This Final EIS and the Final Feasibility Report will be used together to support the Federal decision. Typically, a ROD is the final step in the NEPA process and would document any decision on which actions, if any, to take to address the primary objectives.

Table 1-4. 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

Table 1-4. Agency Roles and Responsibilities (contd.)

Agency	Role/Responsibility
Federal (contd.)	
U.S. Department of Agriculture, 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 System (NFS) lands under the Federal Land Policy Management Act and other authorities as appropriate
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 Natural Resources Agency	Verifying that California's natural and cultural resources are protected, and complying with the California Wild and Scenic River Act
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 1-4. 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
NFS = National Forest System
SLWRI = Shasta Lake Water Resources Investigation
SWP = State Water Project
ROD = Record of Decision
State = State of California

1.5.3 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 would require modifications or relocations of USFS facilities, revisions to special use permits, and amendments to the STNF LRMP that would be affected by the expansion of the reservoir. Reclamation and the USFS would work cooperatively to implement the decisions identified below.

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 public outdoor recreation use and enjoyment of NRA lands, and conservation of scenic, scientific, historic, and other values contributing to public enjoyment of such lands and waters.

USFS Decision Framework

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

- Determine how to remove merchantable timber or other vegetation that would be cleared as part of this project Identify the specific modifications or relocations of USFS facilities

- Identify the specific permits authorizing improvements on NFS lands that are affected by the project and that will require new authorization or permit amendment

- Amend the STNF LRMP standards and guidelines as necessary

Reclamation and the USFS entered into a Memorandum of Agreement (MOA) in 1986 for the coordinated administration of the Shasta and Trinity Units of the NRA with the CVP. Reclamation and the USFS will develop a supplemental agreement that will address agency specific responsibilities for management of resources affected by project implementation.

Proposed USFS Actions

If Congress authorizes a project involving modifications of Shasta Dam and Reservoir, the following actions would be subject to USFS jurisdiction if they are located on NFS land.

Vegetation Clearing in the Inundation Zone Vegetation would be managed within the inundation zone, consistent with the treatments proposed for vegetation management areas described in Chapter 2 of this EIS. Treatments would range from no treatment to full removal. The merchantable timber may be cut and sold without advertisement, as provided by 36 CFR Section 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 would 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 the borrow areas.

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 or issue new permits for privately operated recreation facilities. Facilities impacted include USFS administrative facilities including Turntable Bay and Lakeshore Fire Station; USFS recreation facilities; and permitted recreation facilities.

Relocation, Modification, or Protection of Infrastructure Reclamation would relocate or modify 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. For these facilities, the USFS action would include amending the affected permits for the infrastructure relocated or modified as part of the project. Potential modified or relocated 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. For some facilities, dikes would be constructed by Reclamation to protect local infrastructure from inundation. Reclamation would 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 the borrow areas.

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 to resolve conflicts with USFS actions described above and the LRMP 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 if a conflict exists.

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 before 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 the 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 most known sites be managed for persistence of the referenced survey and manage species and protected from disturbance during management.

Shasta Snow-Wreath The STNF LRMP supplemental direction that applies to all Sensitive and Endemic plant species, including specific direction pertaining to the Shasta snow-wreath and Scott Mountain fawn lily 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 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, a non-federally recognized Native American group, continue to raise concerns about impacts of the original construction of Shasta Dam and potential impacts of enlarging Shasta Dam on sites they value for historical and cultural significance.

  Reclamation has invited Federally recognized tribes and non-Federally recognized Native American groups to be consulting parties to the National Historic Preservation Act Section 106 process. 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 Recreation** – Shasta Lake is the principal recreation destination in Shasta County, which annually realizes 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 includes provisions that are intended to protect the free-flowing condition and wild trout fishery of the McCloud River. Section 5093.542(a) of the California Public Resources Code states that "maintaining the McCloud River in

its free-flowing condition to protect its fishery is the highest and most beneficial use of the waters of the McCloud River within the segments designated in subdivision (b)." Section 5093.542(b) prohibits any "dam, reservoir, diversion, or other water impoundment facility " 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 area would be occasionally inundated if Shasta Dam were modified. Thus, action alternatives related to enlargement of Shasta Dam and Reservoir would have some effect on the free-flowing condition of the lower McCloud River and the wild trout fishery within the part of the lower McCloud River protected by Section 5093.542 of the California Public Resources Code. 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.

Additionally, it is possible that State agency participation may be limited for 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 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. If the preferred alternative or an action alternative is ultimately authorized and approved, it is possible that some State agencies will be unable to process and issue permits and approvals identified above in Table 1-4. This could preclude Reclamation from obtaining State approvals and permits, which could impede a project and frustrate Congressional intent.

In addition, effects to the McCloud River and related provisions in the Public Resources Code are also relevant to the recently passed Proposition 1. California voters approved Proposition 1, "Water Bond. Funding for Water Quality, Supply, Treatment, and Storage Projects," on November 4, 2014, for $7.5 billion, which includes $2.7 billion for storage projects. However, Proposition 1, section 79751 specifies:

> *Projects for which the public benefits are eligible for funding under this chapter consist of only the following:*
>
> *(a) Surface storage projects identified in the CALFED Bay-Delta Program Record of Decision, dated August 28, 2000, except for projects prohibited by Chapter 1.4 (commencing with Section 5093.50) of Division 5 of the Public Resources Code.*

Accordingly, these provisions in Proposition 1 may limit bond funding for a project if the State or its agencies determine that such actions are prohibited by Chapter 1.4 of the Public Resources Code. Section 79751 does not amend or modify the State Public Resources Code. Whether the State of California can use Proposition 1 funds in support of any alternative potentially authorized related to enlargement of Shasta Dam and Reservoir is outside of Reclamation's authority and to be determined by the State of California.

- **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 EIS, CVP and SWP operational assumptions were based on operations described in Reclamation's 2008 Long-Term Operation BA, the 2008 USFWS BO, the 2009 NMFS BO, and the Coordinated Operations Agreement between Reclamation and DWR, as ratified by Congress. However, the ongoing remand processes for the 2008 USFWS and 2009 NMFS BOs have resulted in some uncertainty about future CVP and SWP operational constraints.

1.7 Documents Used to Prepare EIS

This EIS considers and relies on the assessments in the *CVPIA Final* PEIS (Reclamation 1999b) and CALFED Final PEIS/R (CALFED 2000b). In addition, the CVPIA and the overall goals and objectives of CALFED were considered throughout the SLWRI study process.

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

1.7.2 CALFED PEIS/R

CALFED is a collaboration of numerous 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 PEIS/R (CALFED 2000b), which analyzed a range of alternatives to solve Bay-Delta system problems. In August 2000, the CALFED agencies issued the CALFED Programmatic ROD which 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 Programmatic 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 are consistent with applicable components of the CALFED PEIS/R, and the SLWRI EIS tiers to that PEIS/R.

1.8 Organization of EIS

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

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

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 projects considered in the cumulative effects analysis. 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 EIS, 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, "DEIS Distribution List," lists the elected officials; government departments; Federal, State, and local agencies; and interested parties that received notice of the availability of the SLWRI DEIS.

Chapter 29, "List of EIS Preparers," lists individuals who participated in preparation of this EIS, and provides the qualifications of those individuals, in order of organization and agency.

Chapter 30, "References," lists the sources of information used to prepare this EIS.

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

Chapter 32, "Final EIS," provides an overview of the Final EIS, including public involvement and consultation and coordination efforts for the EIS, a description of the preferred alternative, document availability and distribution, and next steps.

Chapter 33, "Public Comments and Responses," contains the comments received on the DEIS and responses to those comments.