Chapter 2 Alternatives

NEPA and CEQA require consideration of the potential effects of a range of action alternatives that would feasibly attain the majority of a project's basic objectives and accomplish the specified project purpose and need, while avoiding and/or minimizing adverse environmental impacts, in addition to the No-Action/No-Project Alternative. The purpose of including alternatives in an EIS is to offer a clear basis for choice by decision makers and the public about whether to proceed with a proposed action or project.

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

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

NEPA and CEQA require consideration of future conditions No-Action/No Project Alternative as a basis of comparison with the action alternatives.

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

- **Section 2.1, Alternatives Development Process,** describing the overall plan formulation process and phases for the SLWRI, project objectives, planning constraints and considerations, management measures, and development and refinement of alternatives.

- **Section 2.2, No-Action Alternative,** describing the No-Action/No Project alternative, representing a scenario in which a project is not implemented.
- **Section 2.3, Action Alternatives,** describing the comprehensive plans (action alternatives) evaluated in this DEIS, including major components, potential benefits, operations and maintenance, and physical features/construction activities for each action alternative.
- **Section 2.4, Alternatives Considered and Eliminated from Further Analysis,** describing alternatives considered but eliminated from further development and consideration during formulation of initial alternatives and comprehensive plans.
- **Section 2.5, Summary of Potential Benefits of Action Alternatives,** summarizing the major potential benefits of proposed comprehensive plans (action alternatives).
- **Section 2.6, Preferred Alternative and Rationale for Selection,** describing the basis for selecting a plan for recommendation, including the criteria and considerations used in selecting a recommended course of action by the Federal Government.

2.1 Alternatives Development Process

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

2.1.1 Plan Formulation Process

Consistent with NEPA, the plan formulation process for Federal water resources studies and projects identified in the *Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies* (P&G) (WRC 1983) begins with identifying existing and projected future resources conditions likely to occur in a study area. This is followed by defining water resources problems, needs, and opportunities to be addressed, and developing planning objectives, constraints, and criteria.

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

- **Mission Statement Phase –** This study phase consisted of projecting without-project future conditions, defining resulting resource problems and needs, defining a specific set of planning objectives, and identifying constraints and criteria for addressing the planning objectives. These activities were documented in the 2003 *SLWRI Mission Statement Milestone Report*.

- **Initial Alternatives Phase –** This phase included developing a number of potential management measures, or project actions or features designed to address planning objectives. These measures were then used to formulate a set of plans that were conceptual in scope (concept plans). These initial plans were evaluated and compared to the planning objectives to identify the most suitable plans for further development. This phase concluded with the release of the 2004 *SLWRI Initial Alternatives Information Report* describing the formulation and evaluation of management measures and initial plans.

- **Comprehensive Plans Phase –** The measures and concept plans carried forward were further refined and developed with more specificity to formulate comprehensive alternative plans to address the planning objectives. These plans were then evaluated and compared. This phase included the release of the 2007 *SLWRI Plan Formulation Report* describing the formulation, evaluation, and comparison of comprehensive plans.

- **Plan Refinement Phase –** This phase focuses on further refinement of the comprehensive plans to identify a plan suitable to be recommended for implementation. This phase includes preparing and circulating a Draft Feasibility Report, which was completed in November 2011 and released to the public in February 2012, and this Draft EIS.

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

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

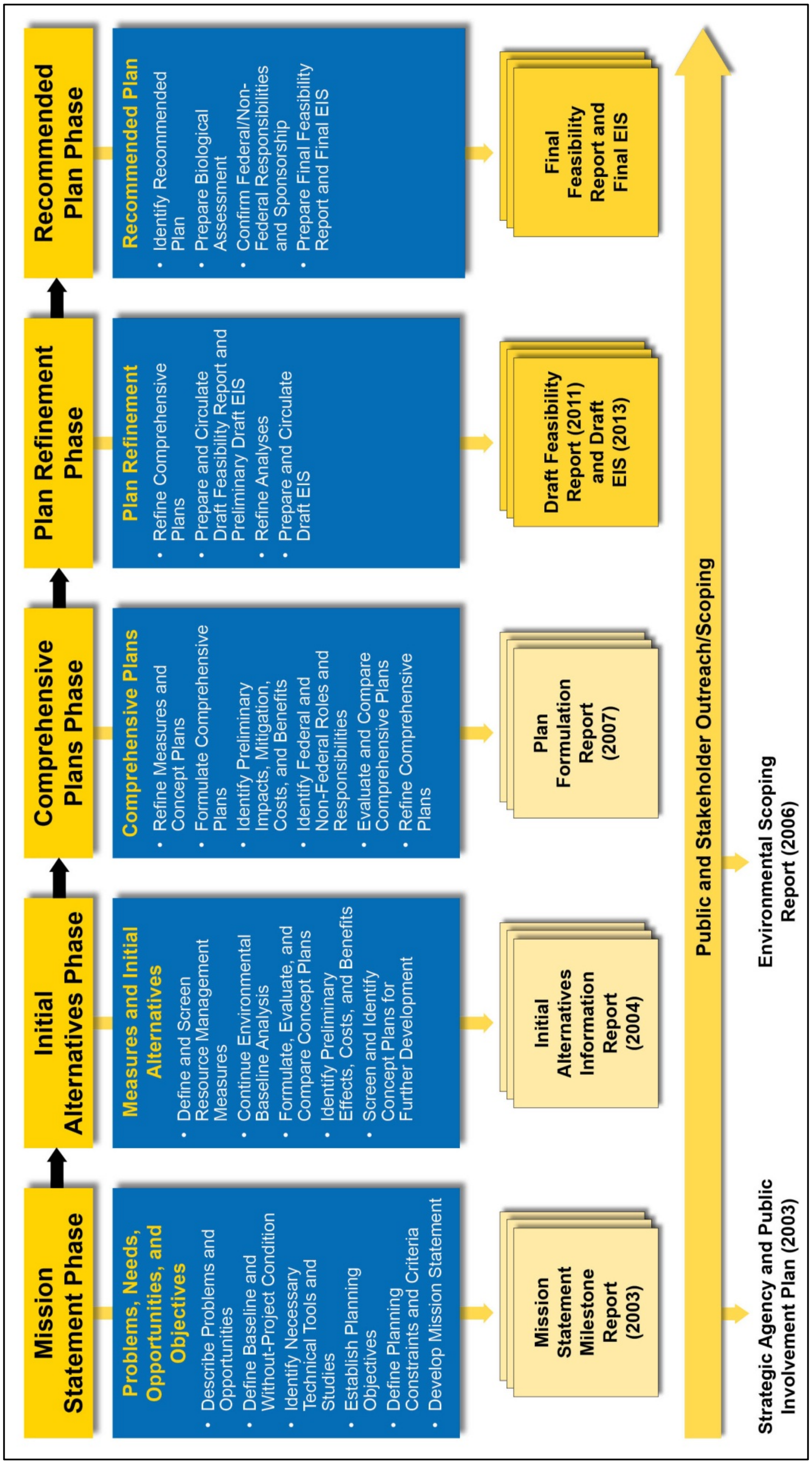

Figure 2-1. Plan Formulation Phases

2.1.2 Project Objectives

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

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

2.1.3 Planning Constraints and Other Considerations

The P&G provides fundamental guidance for the formulation of Federal water resources projects. In addition, basic constraints and considerations specific to this investigation were developed and identified. Following is a summary of the constraints and considerations relevant to the SLWRI. These planning constraints and considerations are described in more detail in the Plan Formulation Appendix.

Planning Constraints

Planning constraints help guide the plan formulation process. Some planning constraints are more rigid than others. Examples of more rigid constraints include congressional direction in study authorizations; other current applicable laws, regulations, and policies; and physical conditions (e.g., topography, hydrology). Other planning constraints are less restrictive but are still influential in guiding the process. Examples include water resource planning efforts such as the CALFED ROD.

Planning Considerations

Planning considerations were specifically identified to help formulate, evaluate, and compare initial plans and, later, detailed alternatives:

- Alternative plans should incorporate results of coordination with other Federal and State agencies such as the USFWS; NMFS; USFS; U.S. Department of Interior, Bureau of Indian Affairs; U.S. Department of Interior, Bureau of Land Management (BLM); DWR; and CDFW.
- A direct and significant geographical, operational, and/or physical dependency must exist between major components of alternatives.
- Alternative plans should address, at a minimum, each of the identified primary planning objectives and, to the extent possible, the secondary planning objectives.
- Measures to address secondary planning objectives should be either directly or indirectly related to the primary planning objectives (i.e., plan features should not be independent increments).
- Alternatives should strive to first avoid potential adverse effects to environmental resources, or then should include features to mitigate for unavoidable adverse effects through enhanced designs, construction methods, and/or facilities operations.
- Alternatives should avoid any increases in flood damage or other significant, adverse hydraulic effects to areas downstream along the Sacramento River.
- Alternatives should strive to first avoid potential adverse effects to present or historical cultural resources, or then include features to mitigate unavoidable adverse effects.
- Alternatives should not result in significant adverse effects to existing and future water supplies, hydropower generation, or related water resources conditions.

- Alternatives should strive to balance increased water supply reliability between agricultural and M&I uses.

- Alternatives should not result in a reduction in existing recreation capacity at Shasta Lake.

- Alternatives are to consider the purposes, operations, and limitations of existing projects and programs and be formulated to not adversely impact those projects and programs.

- Alternatives are to be formulated and evaluated based on a 100-year period of analysis.

- Construction costs for alternatives are to reflect current prices and price levels, and annual costs are to include the current Federal discount rate and an allowance for interest during construction.

- Alternatives are to be formulated to neither preclude nor enhance development and implementation of other elements included in the CALFED ROD or other water resources programs and projects in the Central Valley.

- Alternatives should have a high certainty for achieving intended benefits and not significantly depend on long-term actions (past the initial construction period) for success. Alternatives that require future and ongoing action specific for success have a higher uncertainty than other plans.

2.1.4 Management Measures

Following development of objectives, constraints, and other considerations for the SLWRI, the next major step in plan formulation was to identify and evaluate potential management measures. A management measure is any structural or nonstructural project action or feature that could address the objectives and satisfy the other applicable planning considerations. Numerous potential management measures were identified based on coordination with agencies, public and stakeholder outreach activities, and previous studies, programs, and projects. These measures were developed through study team meetings, field inspections, outreach, and environmental scoping for the SLWRI. Management measures are listed in Table 2-1 and described in detail in the Plan Formulation Appendix.

Table 2-1. Management Measures to Address Objectives

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

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

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

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

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

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

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

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

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

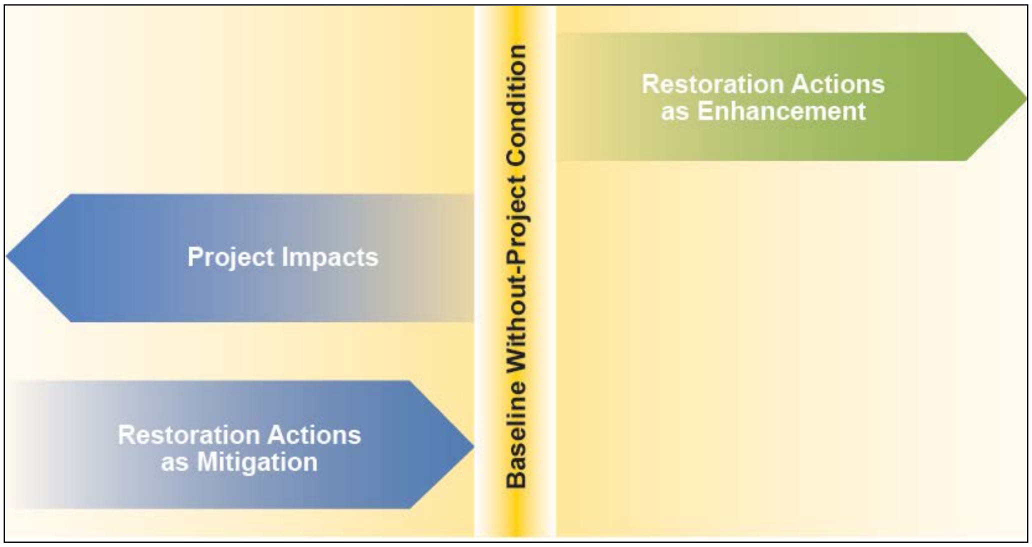

Figure 2-2. Conceptual Schematic of Restoration Actions as Enhancement Versus Restoration Actions as Mitigation

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

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

2.1.5 Initial Alternatives Phase

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

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

Table 2-2. Summary of Concept Plan Features

<table>
<tr><th rowspan="4">Plan</th><th colspan="13">Features</th></tr>
<tr><th rowspan="2">Dam Raise</th><th colspan="7">Primary Objective Focus</th><th colspan="5">Secondary Objectives Addressed[4]</th></tr>
<tr><th colspan="3">Water Supply Reliability[2]</th><th colspan="4">Anadromous Fish Survival</th><th colspan="3">Environmental Restoration</th><th colspan="2">Flood Control and Hydropower</th></tr>
<tr><th>Raise Shasta Dam[1] (feet)</th><th>Increase Conservation Storage</th><th>Perform Conjunctive Water Management[3]</th><th>Reoperate Shasta Dam</th><th>Modify TCD</th><th>Replenish Spawning Gravel</th><th>Enlarge Shasta Lake Cold-Water Pool</th><th>Increase Minimum Flows[3]</th><th>Restore Shoreline Aquatic Habitat</th><th>Restore Tributary Aquatic Habitat</th><th>Restore Riparian Habitat</th><th>Modify Flood Control Operations and Implement Shasta Public Safety[3] Features</th><th>Modify Hydropower Facilities</th></tr>
<tr><td>AFS-1</td><td>6.5</td><td>*</td><td></td><td colspan="2" rowspan="12">Changes to water supply operations and modification of the TCD would likely be included, to some extent, in any alternative that includes raising Shasta Dam.</td><td></td><td>X</td><td></td><td></td><td></td><td></td><td colspan="2" rowspan="12">Changes to flood control operations at Shasta Dam, Public Safety,[3] and hydropower facilities would likely be part of any alternative that includes physically modifying Shasta Dam; the degree and details of these changes will be included in feasibility level alternative plans.</td></tr>
<tr><td>AFS-2</td><td>6.5</td><td>*</td><td></td><td></td><td>*</td><td>X</td><td></td><td></td><td></td></tr>
<tr><td>AFS-3</td><td>6.5</td><td>*</td><td></td><td>X</td><td>*</td><td>X</td><td></td><td></td><td></td></tr>
<tr><td>WSR-1</td><td>6.5</td><td>X</td><td></td><td></td><td>*</td><td></td><td></td><td></td><td></td></tr>
<tr><td>WSR-2</td><td>18.5</td><td>X</td><td></td><td></td><td>*</td><td></td><td></td><td></td><td></td></tr>
<tr><td>WSR-3</td><td>202.5</td><td>X</td><td></td><td></td><td>*</td><td></td><td></td><td></td><td></td></tr>
<tr><td>WSR-4</td><td>18.5</td><td>X</td><td>X</td><td></td><td>*</td><td></td><td></td><td></td><td></td></tr>
<tr><td>CO-1</td><td>6.5</td><td>X</td><td></td><td>X</td><td>X</td><td></td><td></td><td></td><td></td></tr>
<tr><td>CO-2</td><td>18.5</td><td>X</td><td></td><td>X</td><td>X</td><td></td><td></td><td></td><td></td></tr>
<tr><td>CO-3</td><td>18.5</td><td>X</td><td></td><td>X</td><td>X</td><td>X</td><td></td><td></td><td></td></tr>
<tr><td>CO-4</td><td>6.5</td><td>X</td><td>X</td><td>X</td><td>X</td><td></td><td>X</td><td>X</td><td>X</td></tr>
<tr><td>CO-5</td><td>18.5</td><td>X</td><td>X</td><td>X</td><td>X</td><td></td><td>X</td><td>X</td><td>X</td></tr>
</table>

Notes:

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

2 All concept plans will include water demand reduction.

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

4 Water quality and recreation were added as secondary objectives after development of concept plans, and are not considered in this table.

Key:
* Coincidental benefit, although not a primary focus of the concept plan.
AFS-x = anadromous fish survival
CO-x = combined objectives
TCD = temperature control device
WSR-x = water supply reliability
X = Primary focus of concept plan

The 12 concept plans were compared considering two basic planning criteria: effectiveness and efficiency. Effectiveness is the extent to which an alternative alleviates problems and achieves objectives; efficiency is the measure of how efficiently an alternative alleviates identified problems and meets specified objectives to protect the Nation's environment. These, along with completeness and acceptability, are the four general criteria identified in the *Federal Water Resources Council Principles and Guidelines for Water and Related Land Resources Implementation Studies* (WRC 1983). Based on this comparison, and the relative ability of plans to address both primary objectives, five of the concept plans were initially recommended for further development as comprehensive plans: WSR-1, WSR-2, WSR-4, CO-2, and CO-5. None of the AFS plans were recommended for further development because AFS-1 did not contribute to the primary objective of increasing water supply reliability, and evaluations indicated that AFS-2 and AFS-3 would result in less benefits to anadromous fish survival than any of the WSR and CO plans. This is because AFS-2 and AFS-3 focused on increasing minimum flows in the upper Sacramento River, which resulted in a reduced cold-water pool during drought periods in comparison to WSR and CO plans.

Through subsequent evaluations, CO-2 was also eliminated from further consideration because continued evaluation concluded that restoration of existing gravel mines would have a low efficiency and likelihood of successfully benefiting salmon resources. Subsequent analysis of WSR-4 and the conjunctive use component of CO-5 indicated tradeoffs between conjunctive use water supply benefits and critical gains in fisheries benefits. The resulting reduction in benefits to fisheries operations in dry and critical years[1] was deemed unacceptable in terms of meeting primary project objectives. Thus, WSR-4 and the conjunctive use component of CO-5 were eliminated from further consideration.

The eight concept plans eliminated from further consideration are described in Section 2.5, “Alternatives Considered and Eliminated from Further Consideration.” Although these concept plans were not further considered as stand-alone plans, major features of some of these plans were refined for further development into alternatives. Concept plans eliminated from further consideration, and rationale for their elimination, are discussed in greater detail in the Plan Formulation Appendix.

2.1.6 Development and Refinement of Comprehensive Plans

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

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

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

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

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

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

Comprehensive Plans in the Draft Feasibility Report and Supporting Documents

Using the general rationale described above, and incorporating input from the public scoping process and continued coordination with resource agencies and other interested parties, five comprehensive plans were developed for the Draft Feasibility Report and Preliminary DEIS:

- **Preliminary Comprehensive Plan 1 (PCP1) –** 6.5-foot dam raise, enlarging the reservoir by 256,000 acre-feet, focusing on both anadromous fish survival and water supply reliability.

- **Preliminary Comprehensive Plan 2 (PCP2) –** 12.5-foot dam raise, enlarging the reservoir by 443,000 acre-feet, focusing on both anadromous fish survival and water supply reliability.

- **Preliminary Comprehensive Plan 3 (PCP3) –** 18.5-foot dam raise, enlarging the reservoir by 634,000 acre-feet, focusing on both anadromous fish survival and water supply reliability.

- **Preliminary Comprehensive Plan 4 (PCP4) –** 18.5-foot dam raise, enlarging the reservoir by 634,000 acre-feet, focusing on anadromous fish survival while increasing water supply reliability.

- **Preliminary Comprehensive Plan 5 (PCP5) –** 18.5-foot dam raise, enlarging the reservoir by 634,000 acre-feet, a combination plan focusing on all objectives.

Because of the large number of possibilities for increasing anadromous fish survival, additional analyses were conducted to determine the combination of actions that would provide the greatest overall benefits within PCP4. These analyses are described below.

Refinement of Plan for Anadromous Fish Survival Focus with Water Supply Reliability Primarily using the SALMOD model, and based on output from the water operations (CalSim-II), reservoir temperature, and river temperature models, a suite of flow- and temperature-focused actions (scenarios) were investigated to assess which combination of actions would likely result in the maximum increase in fish populations.

To formulate PCP4, three dam height raises were considered (6.5 feet, 12.5 feet, and 18.5 feet), resulting in 256,000 acre-feet, 443,000 acre-feet, and 634,000 acre-feet of increased storage, respectively. For each of these proposed dam raises, several combinations for allocating the increased storage were analyzed. For instance, assuming a dam raise of 12.5 feet, three options were considered: (1) no increase in the minimum pool, (2) an increase in the minimum pool similar to a 6.5-foot dam raise, and (3) all of the increased space dedicated to increased fisheries. The combinations considered represent scenarios developed to focus on increasing the cold-water pool, and are listed in Table 2-3.

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

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

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

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

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

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

Quantitative analysis indicated that increasing the minimum pool in Shasta Reservoir would have the greatest net fishery benefit. By increasing the minimum pool, the allowable carryover pool storage would increase in the reservoir. This carryover would act to conserve cold water that could be managed to better benefit anadromous fish. Scenarios 1, 2, 3, and 4 (flow augmentation scenarios) showed limited benefits to anadromous fish compared with other scenarios, and were eliminated from further analysis. Scenarios B, E, and I would not contribute to increased water supply reliability. Although PCP4 focuses on anadromous fish survival, because these three scenarios would not contribute to a primary objective, they were deleted from further consideration. Of the remaining scenarios, Scenarios D and H were deemed to be the most cost-effective. Based on further analysis, Scenario H was chosen to represent reservoir operations in PCP4 because this scenario would provide the greatest benefit to anadromous fish and still meet the primary objective of water supply reliability. Scenario comparison and selection are discussed further in the Plan Formulation Appendix.

Refinement of Comprehensive Plans for the DEIS

Comprehensive plans were further refined for the DEIS based on several factors, including updates to CVP and SWP water operations and stakeholder input. Since the release of the Draft Feasibility Report and Preliminary DEIS, water operations modeling in CalSim-II and related analyses were updated to include the following:

- The 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 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 the enlarged Los Vaqueros Reservoir and implementation of the San Joaquin River Restoration Program

Preliminary analyses based on these updated operations indicated shifts in the distribution of water supply benefits from M&I to agricultural uses, resulting in decreased M&I water supply benefits for the Draft Feasibility Report comprehensive plans.

To improve the balance between agricultural and M&I water supply benefits, a portion of the increased storage capacity in Shasta Reservoir was reserved to specifically focus on increasing M&I deliveries during dry and critical years under Comprehensive Plan 1 (CP1), Comprehensive Plan 2 (CP2), Comprehensive Plan 4 (CP4), and Comprehensive Plan 5 (CP5). Operations targeting increased M&I deliveries were based on existing and anticipated future demands, operational priorities, and facilities of the SWP, which provides M&I water to a majority of the State's population.

In addition, to provide a greater range of focus and operations within the set of comprehensive plans, water supply operations for Comprehensive Plan 3 (CP3) were focused on agricultural water supply reliability and anadromous fish survival. Accordingly, for CP3, none of the increased storage capacity in Shasta Reservoir was reserved for increasing M&I deliveries.

Based on these refinements, this DEIS includes the following five comprehensive plans:

- **CP1** – 6.5-foot dam raise, enlarging the reservoir by 256,000 acre-feet, focusing on both anadromous fish survival and water supply reliability.

- **CP2** – 12.5-foot dam raise, enlarging the reservoir by 443,000 acre-feet, focusing on both anadromous fish survival and water supply reliability.

- **CP3** – 18.5-foot dam raise, enlarging the reservoir by 634,000 acre-feet, focusing on both agricultural water supply reliability and anadromous fish survival.

- **CP4** – 18.5-foot dam raise, enlarging the reservoir by 634,000 acre-feet, focusing on anadromous fish survival while increasing water supply reliability.

- **CP5** – 18.5-foot dam raise, enlarging the reservoir by 634,000 acre-feet, a combination plan focusing on all objectives.

Comprehensive plans for this DEIS are described in detail in Section 2.4 below.

2.2 No-Action Alternative

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

Under CEQA, the No-Project Alternative is similar to NEPA's No-Action Alternative, but it involves the review of two scenarios: the existing condition baseline, which represents only current conditions at the time the Notice of Preparation is published, and "reasonably foreseeable" future conditions without the project (which is equivalent to the NEPA No-Action Alternative).

For the SLWRI, the No-Action/No-Project Alternative is based on CVP and SWP operational conditions described in the 2008 *Biological Assessment on the Continued Long-Term Operations of the CVP and SWP* (2008 OCAP BA), and the BOs issued by USFWS and NMFS in 2008 and 2009, respectively. The No-Action Alternative also includes key projects assumed to be in place and operating in the future, including the Freeport Regional Water Project, Delta Water Supply Project, South Bay Aqueduct Improvement and Enlargement Project, a functional equivalent of the Vernalis Adaptive Management Plan, full restoration flows under the San Joaquin River Restoration Program, and full implementation of the Grassland Bypass Project. Table 2-1 of the Modeling Appendix describes the existing condition, and shows which actions were assumed to be part of the future condition (or No-Action /No-Project Alternative) in the SLWRI 2012 Benchmark CalSim-II model.

For this DEIS, the No-Action Alternative is considered to be the basis for comparison with potential action alternatives, consistent with NEPA and P&G guidelines. Thus, if no proposed action is determined to be feasible, the No-Action Alternative is the default option.

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

2.2.1 Anadromous Fish Survival

Much has been done to address anadromous fish survival problems in the upper Sacramento River. Solutions have ranged from changes in the timing and magnitude of releases from Shasta Dam to constructing and operating the temperature control device (TCD) at the dam. Actions also include site-specific projects, such as introducing spawning gravel to the Sacramento River, and work to improve or restore spawning habitat in tributary streams. However, some actions have had an adverse effect on Sacramento River habitat, including implementing requirements of the Trinity River ROD, as amended (Reclamation 2000), which reduced flows from the Trinity River basin into Keswick Reservoir and then into the Sacramento River. Water diverted from the Trinity River is generally cooler than flows released from Shasta Dam. Accordingly, since implementation of the Trinity River ROD, some of the benefits derived from flow changes and the Shasta TCD have been offset by the reduction in cooler water from the Trinity River. Increased demand for water for agricultural, M&I, and environmental uses is also expected to reduce the reliability of cold water for anadromous fish. Prolonged drought that depletes the cold-water pool in Shasta Reservoir could put populations of anadromous fish at risk of severe population decline or extirpation in the long-term (NMFS 2009). The risk associated with a prolonged drought is especially high in the Sacramento River because Shasta Reservoir is operated to maintain only 1 year of carryover storage.

Under the No-Action Alternative, 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.

2.2.2 Water Supply Reliability

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

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

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

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

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 conditions in these areas would likely be similar to existing conditions. The quantity, quality, diversity, and connectivity of riparian, wetland, and riverine habitats along the Sacramento River have been limited by confinement of the river system by levees, reclamation of adjacent lands for farming, bank protection, channel stabilization, and land development.

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

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

As California's population continues to grow, demands would grow 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 and endangered and threatened fish populations, several environmental flow goals and objectives in the Central Valley (including the Delta) have been established through legal mandates aimed at maintaining and recovering endangered and threatened fish and wildlife, and protecting designated critical habitat. Despite these efforts, under the No-Action Alternative, these resources would continue to decline and ecosystems would continue to be impacted. In addition, Delta water quality may continue to decline.

2.3 Action Alternatives

The five comprehensive plans designated as the action alternatives for the purpose of this DEIS include:

- **CP1 –** 6.5-Foot Dam Raise, Anadromous Fish Survival and Water Supply Reliability
- **CP2 –** 12.5-Foot Dam Raise, Anadromous Fish Survival and Water Supply Reliability
- **CP3 –** 18.5-Foot Dam Raise, Agricultural Water Supply Reliability and Anadromous Fish Survival
- **CP4 –** 18.5-Foot Dam Raise, Anadromous Fish Focus with Water Supply Reliability
- **CP5 –** 18.5-Foot Dam Raise, Combination Plan

Management measures and environmental commitments common to all action alternatives are described first, in Sections 2.3.1 and 2.3.2. Then, major components, potential benefits, and operations and maintenance for each action alternative are described in Sections 2.3.3 through 2.3.7. Physical features and related construction activities for each action alternative are described in Section 2.3.8. Detailed discussions of potential effects and proposed mitigation measures for each action alternative are included in Chapters 4 through 25 of the DEIS. If any action alternative was authorized by Congress, Reclamation would implement the components of the plans, environmental commitments, mitigation measures, and permit and approval conditions, as described throughout this DEIS and in any permits or approvals issued for implementation.

2.3.1 Management Measures Common to All Action Alternatives

Eight of the management measures retained during the alternatives development process are included, to some degree, in all of the action alternatives. These measures were included because they (1) would either be incorporated or required with any dam raise, (2) were logical and convenient additions that would significantly improve any alternative, or (3) should be considered with any new water increment developed in California. The eight measures include enlarging the Shasta Lake cold-water pool, modifying the TCD, increasing conservation storage, reducing demand, modifying flood operations, modifying hydropower facilities, maintaining or increasing recreation opportunities, and maintaining or improving water quality.

Enlarge Shasta Lake Cold-Water Pool

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

Modify Temperature Control Device

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

Increase Conservation Storage

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

Reduce Demand

All action alternatives include a water conservation program for new water supplies that would be created by the project to augment current water use efficiency practices. The proposed program would consist of a 10-year initial program to which Reclamation would allocate approximately $1.6 million to $3.8 million to fund water conservation efforts. Funding would be proportional to additional water supplies delivered and would focus on assisting project beneficiaries (agencies receiving increased water supplies because of the project), with developing new or expanded urban water conservation, agricultural water conservation, and water recycling programs. Program actions would be a combination of technical assistance, grants, and loans to support a variety of water conservation projects, such as recycled wastewater projects, irrigation system retrofits, and urban utilities retrofit and replacement programs. The program could be established as an extension of existing Reclamation programs, or as a new program through teaming with cost-sharing partners.

Combinations and types of water use efficiency actions funded would be tailored to meet the needs of identified cost-sharing partners, including consideration of cost-effectiveness at a regional scale for agencies receiving funding.

Modify Flood Operations

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

Modify Hydropower Facilities

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

Maintain and Increase Recreation Opportunities

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

Maintain or Improve Water Quality

All action alternatives could contribute to improved Delta water quality conditions and Delta emergency response. Additional storage in Shasta Reservoir would provide improved operational flexibility. Shasta Dam has the ability to provide increased releases and high-flow releases to improve Delta water quality. Improved Delta water quality conditions could provide benefits for both water supply reliability and ecosystem restoration by potentially increasing Delta outflow during drought years and reducing salinity during critical periods.

2.3.2 Environmental Commitments Common to All Action Alternatives

Reclamation and/or its contractors would incorporate certain environmental commitments and best management practices (BMP) into any plan identified for implementation to avoid or minimize potential impacts. Reclamation would also coordinate planning, engineering, design and construction, operation, and maintenance phases of any authorized project modifications with applicable resource agencies.

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

Develop and Implement Construction Management Plan

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

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

Comply with Permit Terms and Conditions

If any action alternative is approved and authorized for construction, Reclamation would require its contractors and suppliers, its general contractor, and all of the general contractor's subcontractors and suppliers to comply with all of the terms and conditions of all required project permits, approvals, and conditions attached thereto. If necessary, additional information (e.g., detailed designs and additional documentation) may be prepared and provided for review by decision makers and the public. Compliance with applicable laws, policies, and plans for this project is discussed in Section 26.6 of this DEIS.

Provide Relocation Assistance through Federal Relocation Assistance Program

All Federal, State, local government agencies, and others receiving Federal financial assistance for public programs and projects that require the acquisition of real property must comply with the policies and provisions set forth in the

Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, as amended (Uniform Act) (49 CFR 24). All relocation and property acquisition activities, such as those associated with temporary easements during construction or with permanent changes in the study area, would be performed in compliance with the Uniform Act. Any individual, family, or business displaced by implementation of any of the action alternatives would be offered relocation assistance services for the purpose of locating a suitable replacement property, to the extent consistent with the Uniform Act.

Under the Uniform Act, relocation services for residences would include providing a determination of the housing needs and desires, a determination of the amount of replacement housing each individual or family qualifies for, a list of comparable properties, transportation to inspect housing referrals, and reimbursement of moving costs and related expenses. For business relocation activities, relocation services would include providing a determination of the relocation needs and requirements; a determination of the need for outside specialists to plan, move, and reinstall personal property; advice as to possible sources of funding and assistance from other local, State, and Federal agencies; listings of commercial properties, and reimbursement for costs incurred in relocating and reestablishing the business. No relocation payment received will be considered as income for the purpose of the Internal Revenue Code.

Develop and Implement Comprehensive Mitigation Strategy

Reclamation would develop and implement a comprehensive mitigation strategy (CMS) to minimize potential impacts to physical, biological, and socioeconomic resources described in this DEIS. The CMS described in this section is still under development at this stage in the planning process. The CMS is being developed consistent with the guidance provided in Council on Environmental Quality (CEQ) Regulations for Implementing Procedural Provisions of NEPA (40 CFR Parts 1500–1508) and consistent with CEQA requirements (CEQA Guidelines 15096, 15097) for lead, responsible, and trustee agencies. The CMS is intended to minimize the potential adverse impacts associated with action alternatives described in this chapter as required under NEPA and/or CEQA and to provide a means to reduce significant CEQA impacts to the extent possible.

The CMS will be multi-faceted in terms of spatial and temporal scales. Based on the nature of some impacts described in this DEIS, the CMS may include one or more of the following types of mitigation as defined under CEQ Guidelines, Section 1508.20–Mitigation:

- Avoiding the impact altogether by not taking a certain action or parts of an action.

- Minimizing the impact by limiting the degree or magnitude of the action and its implementation.

- Rectifying the impact by repairing, rehabilitating, or restoring the affected environment.
- Reducing or eliminating the impact over time through preservation and maintenance operations during the life of the action.
- Compensating for the impact by replacing or providing substitute resources or environments.

At this stage in the planning process, the following components are being considered for the CMS:

- Land acquisition
- Conservation easements
- Upland habitat improvements
- Wetland mitigation
- Riparian habitat improvements (riparian reserves)
- Aquatic habitat improvements (river and tributaries)
- Water quality actions (metals, temperature, sediment)
- Visuals and aesthetics actions

Reclamation will address CEQ's guidance on establishing, implementing, and monitoring mitigation which specifies that when environmental analyses are premised on commitments to mitigate environmental impacts of action alternatives, agencies should adhere to those commitments during project implementation and monitor the implementation and effectiveness of mitigation (CEQ 2011). The CMS will incorporate elements intended to comply with these requirements, specifically those requirements directing agencies to also publicly report on these efforts. The CMS, including a framework for mitigation implementation and monitoring, will be included in the Final EIS.

Cultural Resources

If a project is authorized, Reclamation would follow the process in the implementing regulations at 36 CFR part 800 to identify historic properties, assess effects, and resolve adverse effects through the consultation process. Consulting parties for the National Historic Preservation Act Section 106 process will include the State Historic Preservation Office (SHPO), the Advisory Council on Historic Preservation (if they choose to participate), other federal agencies where applicable, tribal representatives, and other interested parties (including non-Federally recognized Native Americans, members of the public, and other state or local agencies) to develop methods to avoid, minimize, or mitigate impacts. Measures to avoid, minimize, or mitigate impacts will be funded through the project. Reclamation may enter into a Programmatic Agreement with the Advisory Council on Historic Preservation, the SHPO, and other consulting parties that would identify how the Section 106 process would be completed for the authorized project. The Programmatic Agreement may include alternative methods for compliance or phased identification efforts/phased finding of effects efforts, as agreed upon with the consulting parties. Any human remains, funerary objects, sacred objects, or objects of cultural patrimony that are removed from federally managed lands during any project activities would be treated consistent with the Native American Graves Protection and Repatriation Act. If human remains are removed from non-federally managed lands, they would be subject to the California Public Resources Code regarding the treatment of human remains outside a dedicated cemetery.

Develop and Implement Erosion and Sediment Control Plan

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

Develop and Implement Stormwater Pollution Prevention Plan

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

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

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

- Storage of hazardous materials in double-containment and, if possible, under a roof or other enclosure.
- Disposal of all hazardous and nonhazardous products in a proper manner.
- Monitoring of on-site vehicles for fluid leaks and regular maintenance to reduce the chance of leakage.
- Containment (using a prefabricated temporary containment mat, a temporary earthen berm, or other measure can provide containment) of bulk storage tanks.

Fisheries Conservation

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

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

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

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

A qualified biologist would identify any fish species that may be affected by the project. The biologist would facilitate rescue and salvage of fish and other aquatic organisms that become entrapped within construction structures and cofferdam enclosures in the construction area. Any rescue, salvage, and handling of listed species would be conducted under appropriate authorization (i.e., incidental take statement/permit for the project, Federal Endangered Species Act Section 4(d) scientific collection take permit, or a Memorandum of Understanding). If fish are identified as threatened with entrapment in construction structures, construction would be stopped and efforts made to allow fish to leave the project area before resuming work. If fish are unable to leave the project area of their own volition, then fish would be collected and released outside the work area. Fish entrapped in cofferdam enclosures would be rescued and salvaged before the cofferdam area was completely dewatered. Appropriately sized fish screens would be installed on the suction side of any pumps used to dewater in-water enclosures.

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

Water Quality Protection

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

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

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

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

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

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

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

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

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

Revegetation Plan

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

Invasive Species Management

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

- Preinspection and cleaning of all construction vehicles, watercraft, and equipment before being shipped to project areas
- Reinspection of all construction vehicles, watercraft, and equipment on arrival at project areas
- Inspection and cleaning of all personnel before work in project areas

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

Approved cleaning methods would include a combination of the following:

- **Precleaning –** Draining, brushing, vacuuming, high-pressure water treatment, thermal treatment
- **Cleaning –** Freezing, desiccation, thermal treatment, high-pressure water treatment, chemical treatment

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

Construction Material Disposal

Reclamation's contractors would take measures to recycle or reuse demolished materials, such as steel or copper wire, concrete, asphalt, and reinforcing steel, as required and where practical. Other demolished materials would be disposed of in compliance with applicable requirements.

Asphalt Removal

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

2.3.3 CP1 – 6.5-Foot Dam Raise, Anadromous Fish Survival and Water Supply Reliability

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

Major Components of CP1

CP1 includes the following major components:

- Raising Shasta Dam and appurtenant facilities by 6.5 feet
- Implementing the set of eight common management measures described above
- Implementing the common environmental commitments described above

By raising Shasta Dam 6.5 feet, from a crest elevation of 1,077.5 feet to 1,084.0 feet (based on the National Geodetic Vertical Datum 1929 (NGVD29)),[2] CP1 would increase the height of the reservoir full pool by 8.5 feet. The additional 2-foot increase in the height of the full pool above the dam raise height would result from spillway modifications, including replacing the three drum gates with six sloping, fixed-wheel gates. This increase in full pool height would add approximately 256,000 acre-feet of additional storage to the overall reservoir capacity. Accordingly, the overall full pool storage would increase from 4.55 million acre feet (MAF) to 4.81 MAF. Table 2-5 summarizes major physical features associated with CP1.

[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.

Table 2-5. Physical Features of Action Alternatives

Main Features	Action Alternatives				
	CP1	**CP2**	**CP3**	**CP4**	**CP5**
Dam and Appurtenant Structures					
Shasta Dam					
Crest Raise (feet)	6.5	12.5	18.5	18.5	18.5
Full Pool Height Increase (feet)	8.5	14.5	20.5	20.5	20.5
Elevation of Dam Crest (feet)[1]	1084.0	1090.0	1096.0	1096.0	1096.0
Elevation of Full Pool (feet)[2]	1,078.2	1,084.2	1,090.2	1,090.2	1,090.2
Capacity Increase (acre-feet)	256,000	443,000	634,000	634,000	634,000
Main Dam	Raise dam crest. Construct new parapets and utility gallery. Raise existing elevator tower and hoist tower.	Raise dam crest. Construct new parapets and utility gallery. Raise existing elevator tower and hoist tower.	Raise dam crest. Construct new parapets and utility gallery. Raise existing elevator tower and hoist tower.	Raise dam crest. Construct new parapets and utility gallery. Raise existing elevator tower and hoist tower.	Raise dam crest. Construct new parapets and utility gallery. Raise existing elevator tower and hoist tower.
Wing Dams	Raise to meet dam crest. Build new visitor center along left wing dam. Relocate gantry crane on right wing dam.	Raise to meet dam crest. Build new visitor center along left wing dam. Relocate gantry crane on right wing dam.	Raise to meet dam crest. Build new visitor center along left wing dam. Relocate gantry crane on right wing dam.	Raise to meet dam crest. Build new visitor center along left wing dam. Relocate gantry crane on right wing dam.	Raise to meet dam crest. Build new visitor center along left wing dam. Relocate gantry crane on right wing dam.
Spillway	Raise crest and extend piers. Replace 3 drum gates with 6 sloping wheel gates.	Raise crest and extend piers. Replace 3 drum gates with 6 sloping wheel gates.	Raise crest and extend piers. Replace 3 drum gates with 6 sloping wheel gates.	Raise crest and extend piers. Replace 3 drum gates with 6 sloping wheel gates.	Raise crest and extend piers. Replace 3 drum gates with 6 sloping wheel gates.
River Outlets	Replace 4 lower-tier tube valves with jet flow gates.	Replace 4 lower-tier tube valves with jet flow gates.	Replace 4 lower-tier tube valves with jet flow gates.	Replace 4 lower-tier tube valves with jet flow gates.	Replace 4 lower-tier tube valves with jet flow gates.
Temperature Control Device	Raise/modify controls.	Raise/modify controls.	Raise/modify controls.	Raise/modify controls.	Raise/modify controls.
Shasta Powerplant/Penstocks	Raise penstock hoists.	Raise penstock hoists.	Raise penstock hoists.	Raise penstock hoists.	Raise penstock hoists.
Pit 7 Dam/Powerhouse	Install a tailwater depression system.	Install a tailwater depression system.	Install a tailwater depression system.	Install a tailwater depression system.	Install a tailwater depression system.
Reservoir Area Clearing	Clear 150 acres completely and 220 acres with overstory removal.	Clear 240 acres completely and 350 acres with overstory removal.	Clear 340 acres completely and 500 acres with overstory removal.	Clear 340 acres completely and 500 acres with overstory removal.	Clear 340 acres completely and 500 acres with overstory removal.
Reservoir Area Dikes and Railroad Embankments	Construct 3 railroad embankments and 2 new dikes.	Construct 3 railroad embankments and 3 new dikes.	Construct 3 railroad embankments and 4 new dikes.	Construct 3 railroad embankments and 4 new dikes.	Construct 3 railroad embankments and 4 new dikes.
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.

Table 2-5. Physical Features of Action Alternatives (contd.)

Main Features	Action Alternatives				
	CP1	**CP2**	**CP3**	**CP4**	**CP5**
Length of Relocated Roadway (linear feet)	17,409	29,054	33,788	33,788	33,788
Number of Road Segments Affected	10	21	30	30	30
Vehicle Bridges	Relocate 4 bridges, modify 1 bridge.	Relocate 4 bridges, modify 1 bridge.	Relocate 4 bridges, modify 1 bridge.	Relocate 4 bridges, modify 1 bridge.	Relocate 4 bridges, modify 1 bridge.
Railroad	Relocate 2 bridges and realign track in-between, modify 1 bridge	Relocate 2 bridges and realign track in-between, modify 1 bridge	Relocate 2 bridges and realign track in-between, modify 1 bridge	Relocate 2 bridges and realign track in-between, modify 1 bridge	Relocate 2 bridges and realign track in-between, modify 1 bridge
Recreation Facilities	Modify or replace 9 marinas, 6 public boat ramps, 6 resorts, 202 campsites/day-use sites/RV sites, 2 USFS facilities, 8.1 miles of trail, and 2 trailheads.	Modify or replace 9 marinas, 6 public boat ramps, 6 resorts, 261 campsites/ day-use sites/RV sites, 2 USFS facilities, 9.9 miles of trail, and 2 trailheads.	Modify or replace 9 marinas, 6 public boat ramps, 6 resorts, 328 campgrounds/day-use areas/RV sites, 2 USFS facilities, 11.6 miles of trail, and 2 trailheads.	Modify or replace 9 marinas, 6 public boat ramps, 6 resorts, 328 campgrounds/day-use areas/RV sites, 2 USFS facilities, 11.6 miles of trail, and 2 trailheads.	Modify or replace 9 marinas, 6 public boat ramps, 6 resorts, 328 campgrounds/day-use areas/RV sites, 2 USFS facilities, 11.6 miles of trail, and 2 trailheads. Add 6 trailheads and18 miles of new hiking trails.
Utilities	Relocate inundated utilities. Construct wastewater treatment facilities.	Relocate inundated utilities. Construct wastewater treatment facilities.	Relocate inundated utilities. Construct wastewater treatment facilities.	Relocate inundated utilities. Construct wastewater treatment facilities.	Relocate inundated utilities. Construct wastewater treatment facilities.
Ecosystem Enhancements	None	None	None	Reserve 378 TAF of the additional storage for cold-water supply for anadromous fish. Implement adaptive management plan to benefit anadromous fish. Augment spawning gravel in the upper Sacramento River at the rate of up to 10,000 tons per year. Restore 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

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. This alternative (and all comprehensive plans) involves extending the existing TCD for efficient use of the expanded cold-water pool. 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 capacity 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.

CP1 would also include the potential to revise the operational rules for flood control at Shasta Dam and Reservoir, which could reduce the potential for flood damage, and benefit recreation. Although the volume of the flood control pool would remain the same as under existing operations (1.3 MAF), the bottom of the flood control pool elevation would likely be increased based on increased dam height and reservoir capacity. Because of reservoir geometry, this would decrease the depth of the flood control pool, allowing higher winter and spring water levels. Increased reservoir capacity could have further flood damage reduction benefits in years when water levels are below the new flood control pool elevation.

In some years, when the flood control requirements guides reservoir releases, potential also exists for changes in flood control rules to allow more operational flexibility in reservoir drawdown requirements in response to storms, resulting in a net increase in the rate of spring reservoir filling during some years.

In addition, higher spring water levels, reduced drawdown (distance to water) during the recreation season, and associated increases in reservoir surface area would benefit recreation.

Potential Benefits of CP1

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

Increase Anadromous Fish Survival Water temperature is one of the most important factors in achieving recovery goals for anadromous fish in the Sacramento River. CP1 would increase the ability of Shasta Dam to make cold-water releases and regulate water temperatures for fish in the upper Sacramento River, primarily in dry and critical water years. This would be accomplished by raising Shasta Dam 6.5 feet, thus increasing the depth of the cold-water pool in Shasta Reservoir and resulting in an increase in seasonal cold-water volume below the thermocline (layer of greatest water temperature and density change). Cold water released from Shasta Dam significantly influences water temperature conditions in the Sacramento River between

Keswick Dam and the RBPP. Hence, the most significant water temperature benefits to anadromous fish would occur upstream from the RBPP. It is estimated that under CP1, improved water temperature and flow conditions could result in an average annual increase in the salmon population of about 61,300 out-migrating juvenile Chinook salmon.

Increase Water Supply Reliability CP1 would increase water supply reliability by increasing firm water supplies for CVP and SWP irrigation and M&I deliveries. This action would contribute to replacement of supplies redirected to other purposes in the Central Valley Project Improvement Act (CVPIA). CP1 would help reduce estimated future water shortages by increasing firm yield for agricultural and M&I deliveries by at least 47,300 acre-feet per year and average annual yield by about 31,000 acre-feet per year. For this DEIS, firm yield is considered equivalent to the estimated increase in the reliability of supplies during dry and critical periods. The majority of increased firm yield (42,700 acre-feet) would be for south-of-Delta agricultural and M&I deliveries. In addition, water use efficiency could help reduce current and future water shortages by allowing a more effective use of existing supplies. As population and resulting water demands continue to grow and available supplies continue to remain relatively static, more effectively using these supplies could reduce potential critical impacts on agricultural and urban areas resulting from water shortages. Under CP1, approximately $1.6 million would be allocated over an initial 10-year period to fund agricultural and M&I water conservation programs, focused on agencies benefiting from increased reliability of project water supplies.

Develop Additional Hydropower Generation Higher water surface elevations in the reservoir would result in an increase in power generation of about 54 gigawatt-hours (GWh) per year. This generation value is the expected increased generation from Shasta Dam and other CVP/SWP facilities.

Maintain and Increase Recreation Opportunities CP1 includes features to at least maintain the existing recreation capacity at Shasta Lake. Although CP1 does not include specific features to further increase recreation capacity, benefits to the water-oriented recreation experience at Shasta Lake would likely occur because of the increase in average lake surface area, reduced drawdown during the recreation season, and modernization of recreation facilities. The maximum surface area of the lake would increase by about 1,110 acres (4 percent), from 29,700 acres to about 30,800 acres. The average surface area of the lake during the recreation season from May through September would increase by about 800 acres (3 percent), from 23,900 acres to 24,700 acres. There is also limited potential to provide additional benefits to recreation by allowing more reliable filling of the reservoir during the spring.

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

Construction for CP1

Construction activities associated with physical features under CP1 would include land-based construction activities associated with 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

Construction activities for CP1 are described in Section 2.3.8, “Comprehensive Plan Construction Activities.”

Operations and Maintenance for CP1

Shasta Dam is operated in conjunction with other CVP facilities and SWP facilities to manage floodwater, storage of surplus winter runoff for irrigation in the Sacramento and San Joaquin valleys, M&I use, maintenance of navigation flows, protection and conservation of fish in the Sacramento River and Delta, and generation of hydroelectric energy. Storage in Shasta Reservoir fluctuates greatly throughout the year; storage is typically highest in April and May, as the need for flood control reservation space in the reservoir decreases. Storage is typically at its lowest in September and October, after the irrigation season and before winter refill begins. Shasta Reservoir capacity is currently 4,552 TAF, with a maximum objective release capacity of 79,000 cubic feet per second (cfs). Storage levels are lowest by October to provide sufficient flood risk reduction and capture capacity during the following wet months. The storage target gradually increases beginning in October to full pool in May; storage is then withdrawn for high water demand (e.g., agricultural, M&I, fishery, and water quality uses) during summer.

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

- 2009 NMFS BO (NMFS 2009)
- 2008 USFWS BO (USFWS 2008)
- CVPIA Programmatic EIS (Reclamation 1999)
- CVP long-term water service contracts (see the Hydrology, Hydraulics, and Water Management Technical Report, Table 1-25, in the Physical Resources Appendix)
- Trinity River ROD (Reclamation 2000)
- Reclamation’s 2008 OCAP BA (Reclamation 2008)
- Flood management requirements in accordance with the Water Control Manual (USACE 1977)
- State Water Resources Control Board (SWRCB) Orders 90-05 and 91-01
- CDFG Reclamation Memorandum of Agreement (CDFG and Reclamation 1960)
- Water Quality Control Plan for the San Francisco Bay/San Joaquin Delta Estuary (SWRCB 1995)
- SWRCB Water Right Revised Decision 1641 (SWRCB 2000)
- CVP and SWP Coordinated Operations Agreement (Reclamation and DWR 1986)

In addition, Shasta Dam and Reservoir are operated according to the *Standing Operating Procedures for Shasta Dam and Reservoir*. However, due to sensitivity regarding this information, including security and public health and safety concerns, this document is not available to the general public.

Under CP1, the additional storage would be retained to increase water supply reliability and to expand the cold-water pool in Shasta Reservoir for fisheries benefits. Shasta Dam operational guidelines would continue unchanged, except during dry and critical years, when 70,000 acre-feet and 35,000 acre-feet, respectively, of the 256,000 acre-feet increased storage capacity in Shasta Reservoir would be operated primarily to increase M&I deliveries. Operations targeting increased M&I deliveries were based on existing and anticipated future demands, operational priorities, and facilities of the SWP, which provides M&I water to a majority of the State's population. For this DEIS, these operations were simulated in CalSim-II by using the reserved storage capacity to provide deliveries for previously unmet SWP demands during dry and critical years. For CP1, existing water quality and temperature requirements would typically be met in most years; therefore, additional water in storage would be released primarily for water supply purposes. Accordingly, minimal increases in flow would be expected in months when Delta exports were constrained, or when flow was not required for water supply purposes.

In comparison to current operations, CP1 would store some additional flows behind Shasta Dam during periods when downstream needs would have already been met, but flows would have been released because of storage limitations. The resulting increase in storage would be released downstream when there were opportunities for beneficial use of the water, either to meet water supply reliability demands or to improve Reclamation's abilities to meet its environmental objectives. The additional water in storage would also expand the cold-water pool and increase end-of-September carryover storage in Shasta Reservoir, increasing the ability of Shasta Dam to improve water temperatures for anadromous fish in the upper Sacramento River.

Conversely, if water in storage were insufficient to meet all of the project purposes, the first increment to be reduced would be deliveries to water service contractors. Releases from Shasta Dam under CP1 would typically increase in the summer months, corresponding with the periods of greatest agricultural demands. Similarly, releases would be reduced in the winter months, when the increased storage space could be used to capture additional runoff rather than releasing water to the downstream river, as would occur under Shasta Reservoir's current operations.

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

2.3.4 CP2 – 12.5-Foot Dam Raise, Anadromous Fish Survival and Water Supply Reliability

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

Major Components of CP2

CP2 includes the following major components:

- Raising Shasta Dam and appurtenant facilities by 12.5 feet.
- Implementing the set of eight common management measures previously described.
- Implementing the common environmental commitments previously described.

A dam raise of 12.5 feet was chosen because it represents a midpoint between the likely smallest dam raise considered and the largest practical dam raise that would not require relocating the Pit River Bridge. By raising Shasta Dam from a crest elevation of 1,077.5 feet to 1,090.0 feet (based on NGVD29), CP2 would increase the height of the reservoir's full pool by 14.5 feet. The additional 2-foot increase in the height of the full pool above the dam raise height would result from spillway modifications similar to the modifications proposed under CP1. This increase in full pool height would add approximately 443,000 acre-feet of storage to the reservoir's capacity. Accordingly, storage in the overall full pool would increase from 4.55 MAF to 5.0 MAF. Table 2-5 summarizes major physical features associated with CP2.

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. The existing TCD would also be extended for efficient use of the expanded cold-water pool. 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.

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

Potential Benefits of CP2

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

Increase Anadromous Fish Survival Water temperature is one of the most important factors in achieving recovery goals for anadromous fish in the Sacramento River. CP2 would increase the ability of Shasta Dam to make cold-water releases and regulate water temperatures for fish in the upper Sacramento River, primarily in dry and critical water years. This would be accomplished by raising Shasta Dam 12.5 feet, thus increasing the depth of the cold-water pool in Shasta Reservoir and resulting in an increase in seasonal cold-water volume below the thermocline (layer of greatest water temperature and density change). Cold water released from Shasta Dam significantly influences water temperature conditions in the Sacramento River between Keswick Dam and the RBPP. Hence, the most significant water temperature benefits to anadromous fish would occur upstream from the RBPP. It is estimated that improved water temperature and flow conditions under CP2 could result in an average annual increase in the salmon population of about 379,200 out-migrating juvenile Chinook salmon.

Increase Water Supply Reliability CP2 would increase water supply reliability by increasing firm water supplies for CVP and SWP irrigation and M&I deliveries. This action would contribute to replacement of supplies redirected to other purposes in the CVPIA. CP2 would help reduce estimated future water shortages by increasing the reliability of firm water supplies for agricultural and M&I deliveries by at least 77,800 acre-feet per year and average annual yield by about 51,300 acre-feet per year. For this DEIS, firm yield is considered equivalent to the estimated increase in the reliability of supplies during dry and critical periods. The majority of increased firm yield (67,100 acre-feet) would be for south-of-Delta agricultural and M&I deliveries. In addition, water use efficiency could help reduce current and future water shortages by allowing a more effective use of existing supplies. As population and resulting water demands continue to grow and available supplies continue to remain relatively static, more effectively using these supplies could reduce potential critical impacts on agricultural and urban areas resulting from water shortages. Under CP2, approximately $2.6 million would be allocated over an initial 10-year period to fund agricultural and M&I water conservation programs, focused on agencies benefiting from increased reliability of project water supplies.

Develop Additional Hydropower Generation Higher water surface elevations in the reservoir would result in a net increase in power generation of about 90 GWh per year. This generation value is the expected increased generation from Shasta Dam and other CVP/SWP facilities.

Maintain and Improve Recreation Opportunities CP2 includes features to, at minimum, maintain the existing recreation capacity at Shasta Lake. Although CP2 does not have specific features to further increase recreation capacity, benefits to the water-oriented recreation experience at Shasta Lake would likely occur because of the increase in average lake surface area, reduced drawdown during the recreation season, and modernization of recreation facilities. The maximum surface area of the lake would increase by about 1,900 acres (6 percent), from 29,700 acres to about 31,600 acres. The average surface area of the lake during the recreation season from May through September would increase by about 1,300 acres (5 percent), from 23,900 acres to 25,200 acres. There is also limited potential to provide additional benefits to recreation by allowing more reliable filling of the reservoir during the spring.

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

Construction for CP2

Construction activities associated with physical features under CP2 would include land-based construction activities associated with 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

Construction activities for CP2 are described in Section 2.3.8, "Comprehensive Plan Construction Activities."

Operations and Maintenance for CP2

Operations under CP2 are governed by the same regulatory constraints as described for CP1. Similar to CP1, the additional storage would be retained to increase water supply reliability and to expand the cold-water pool in Shasta Reservoir for fisheries benefits. Shasta Dam operational guidelines would continue unchanged, except during dry years and critical years, when 120,000 acre-feet and 60,000 acre-feet, respectively, of the 443,000 acre-feet increased storage capacity in Shasta Reservoir would be operated primarily to increase M&I deliveries. Operations targeting increased M&I deliveries were based on existing and anticipated future demands, operational priorities, and facilities of the SWP. For CP2, existing water quality and temperature requirements would typically be met in most years; therefore, additional water in storage would be released primarily for water supply purposes. Accordingly, minimal increases in flow would be expected in months when Delta exports were constrained, or when flow was not usable for water supply purposes.

In comparison to current operations, CP2 would store some additional flows behind Shasta Dam during periods when downstream needs would have already been met, but flows would have been released because of storage limitations. The resulting increase in storage would be released downstream when there were opportunities for beneficial use of the water, either to meet water supply reliability demands or to improve Reclamation's abilities to meet its environmental objectives. The additional water in storage would also expand the cold-water pool and increase end-of-September carryover storage in Shasta Reservoir, increasing the ability of Shasta Dam to improve water temperatures for anadromous fish in the upper Sacramento River.

Conversely, if water in storage were insufficient to meet all of the project purposes, the first increment to be reduced would be deliveries to water service contractors. Releases from Shasta Dam under CP2 would typically increase in the summer months, corresponding with the periods of greatest agricultural demands. Similarly, releases would be reduced in the winter months, when the increased storage space could be used to capture additional runoff rather than releasing water to the downstream river, as would occur with Shasta Reservoir's current operations.

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

2.3.5 CP3 – 18.5-Foot Dam Raise, Agricultural Water Supply Reliability and Anadromous Fish Survival

CP3 focuses on increasing agricultural water supply reliability and increasing anadromous fish survival by raising Shasta Dam 18.5 feet and enlarging Shasta Reservoir by 634,000 acre-feet.

Major Components of CP3

CP3 includes the following major components:

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

By raising Shasta Dam 18.5 feet, from a crest elevation of 1,077.5 feet to 1,096.0 feet (based on NGVD29), CP3 would increase the height of the reservoir full pool by 20.5 feet. The additional 2-foot increase in the height of the full pool above the dam raise height would result from spillway modifications similar to the modifications proposed under CP1. This increase in full pool height would add approximately 634,000 acre-feet of storage to the reservoir's capacity. Accordingly, storage in the overall full pool would increase from 4.55 MAF to 5.19 MAF. Although higher dam raises are technically and physically feasible, 18.5 feet is the largest dam raise that would not require extensive and costly reservoir area relocations, such as relocating the Pit River Bridge, Interstate 5 (I-5), and the Union Pacific Railroad (UPRR) tunnels. Table 2-5 summarizes major physical features associated with CP3.

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. The existing TCD would also be extended for efficient use of the expanded cold-water pool.

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

Potential Benefits of CP3

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

Increase Anadromous Fish Survival Water temperature is one of the most important factors in achieving recovery goals for anadromous fish in the Sacramento River. CP3 would increase the ability of Shasta Dam to make cold-water releases and regulate water temperatures for fish in the upper Sacramento River, primarily in dry and critical water years. This would be accomplished by raising Shasta Dam 18.5 feet, thus increasing the depth of the cold-water pool in Shasta Reservoir and resulting in an increase in seasonal cold-water volume below the thermocline (layer of greatest water temperature and density change). Cold water released from Shasta Dam significantly influences water temperature conditions in the Sacramento River between Keswick Dam and the RBPP. Hence, the most significant water temperature benefits to anadromous fish would occur upstream from the RBPP. It is estimated that improved water temperature and flow conditions under CP3 could result in an average annual increase in the Chinook salmon population of about 207,400 out-migrating juvenile fish.

Increase Water Supply Reliability CP3 would increase water supply reliability by increasing firm water supplies for CVP irrigation deliveries. This action would contribute to replacement of supplies redirected to other purposes in the CVPIA. CP3 would help reduce estimated future water shortages by increasing the reliability of firm water supplies for agricultural deliveries by at least 63,100 acre-feet per year and average annual yield by about 61,700 acre-feet per year. For this DEIS, firm yield is considered equivalent to the estimated increase in the reliability of supplies during dry and critical periods. Almost half of the increased firm yield (28,000 acre-feet) would be for south-of-Delta agricultural deliveries, with the remainder for north-of-Delta agricultural deliveries. In addition, water use efficiency could help reduce current and future water shortages by allowing a more effective use of existing supplies. As population and resulting water demands continue to grow and available supplies continue to remain relatively static, more effectively using these supplies could reduce potential critical impacts to agricultural and urban areas resulting from water shortages. Under CP3, approximately $3.1 million would be allocated over an initial 10-year period to fund agricultural water conservation programs, focused on agencies benefiting from increased reliability of project water supplies.

Develop Additional Hydropower Generation Higher water surface elevations in the reservoir would result in a net increase in power generation of about 90 GWh per year. This generation value is the expected increased generation from Shasta Dam and other CVP/SWP facilities.

Maintain and Increase Recreation Opportunities CP3 includes features to, at a minimum, maintain the existing recreation capacity at Shasta Lake. Although CP3 does not include specific features to further increase recreation capacity, benefits to the water-oriented recreation experience at Shasta Lake would likely occur because of the increase in average lake surface area, reduced drawdown during the recreation season, and modernization of recreation facilities. The maximum surface area of the lake would increase by about 2,600 acres (9 percent), from 29,700 acres to about 32,300 acres. The average surface area of the lake during the recreation season from May through September would increase by about 2,000 acres (8 percent), from 23,900 acres to 25,900 acres. There is also limited potential for reservoir reoperation to provide additional benefits to recreation by allowing more reliable filling of the reservoir during the spring.

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

Construction for CP3

Construction activities associated with physical features under CP3 would include land-based construction activities associated with 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

Construction activities for CP3 are described in Section 2.3.8, “Comprehensive Plan Construction Activities.”

Operations and Maintenance for CP3

Operations under CP3 are governed by the same regulatory constraints as described for CP1. Under CP3, Shasta Dam operational guidelines would continue unchanged, with the additional storage retained for agricultural water supply reliability and to expand the cold-water pool in Shasta Reservoir for fisheries benefits. Unlike CP1 and CP2, none of the increased storage space in Shasta Reservoir would be reserved for increasing M&I deliveries under CP3. Existing water quality and temperature requirements would be met in most years; therefore, additional water in storage would be released primarily for water supply purposes. Accordingly, minimal increases in flow would be expected in months when Delta exports were constrained, or when flow was not usable for water supply purposes.

In comparison to current operations, CP3 would store some additional flows behind Shasta Dam during periods when downstream needs would have already been met, but flows would have been released because of storage limitations. The resulting increase in storage would be released downstream when there were opportunities for beneficial use of the water, either to meet water supply reliability demands or to improve Reclamation's abilities to meet its environmental objectives. The additional water in storage would also expand the cold-water pool and increase end-of-September carryover storage in Shasta Reservoir, increasing the ability of Shasta Dam to improve water temperatures for anadromous fish in the upper Sacramento River.

Conversely, if water in storage were insufficient to meet all of the project purposes, the first increment to be reduced would be deliveries to water service contractors. Releases from Shasta Dam under CP3 would typically increase in the summer months, corresponding with the periods of greatest agricultural demands. Similarly, releases would be reduced in the winter months, when the increased storage space could be used to capture additional runoff rather than releasing water to the downstream river, as would occur with Shasta Reservoir's current operations.

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

2.3.6 CP4 – 18.5-Foot Dam Raise, Anadromous Fish Focus with Water Supply Reliability

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

Major Components of CP4

CP4 includes the following major components:

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

- Restoring riparian, floodplain, and side channel habitat in the upper Sacramento River
- Implementing the set of eight common management measures previously described
- Implementing the common environmental commitments previously described

By raising Shasta Dam 18.5 feet, from a crest elevation of 1,077.5 feet to 1,096.0 feet (based on NGVD29), CP4 would increase the height of the reservoir full pool by 20.5 feet. The additional 2-foot increase in the height of the full pool above the dam raise height would result from spillway modifications similar to the modifications proposed under CP1. This increase in full pool height would add approximately 634,000 acre-feet of storage to the reservoir's capacity. Accordingly, storage in the overall full pool would be increased from 4.55 MAF to 5.19 MAF.

The additional storage created by the 18.5-foot dam raise would be used to improve the ability to meet temperature objectives and habitat requirements for anadromous fish during drought years and increase water supply reliability. Of the increased reservoir storage space, about 378,000 acre-feet would be dedicated to increasing the supply of cold water for anadromous fish survival purposes. Table 2-5 summarizes major physical features associated with CP4.

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

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

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

Adaptive Management of Cold-Water Pool The adaptive management plan may include operational changes to the timing and magnitude of releases from Shasta Dam to benefit anadromous fish, as long as there are no conflicts with current operational guidelines or adverse impacts on water supply reliability. Adaptive management of the cold-water pool for anadromous fish is discussed further below under "Operations and Maintenance for CP4."

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

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

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

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

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

Restore Riparian, Floodplain, and Side Channel Habitat Under CP4, riparian, floodplain, and side channel habitat restoration would occur at one or a combination of potential locations along the upper Sacramento River. Restoration measures for six potential sites, referred to collectively as “upper Sacramento River restoration sites”, are described below. The sites under consideration for habitat restoration are shown in Figure 2-3.

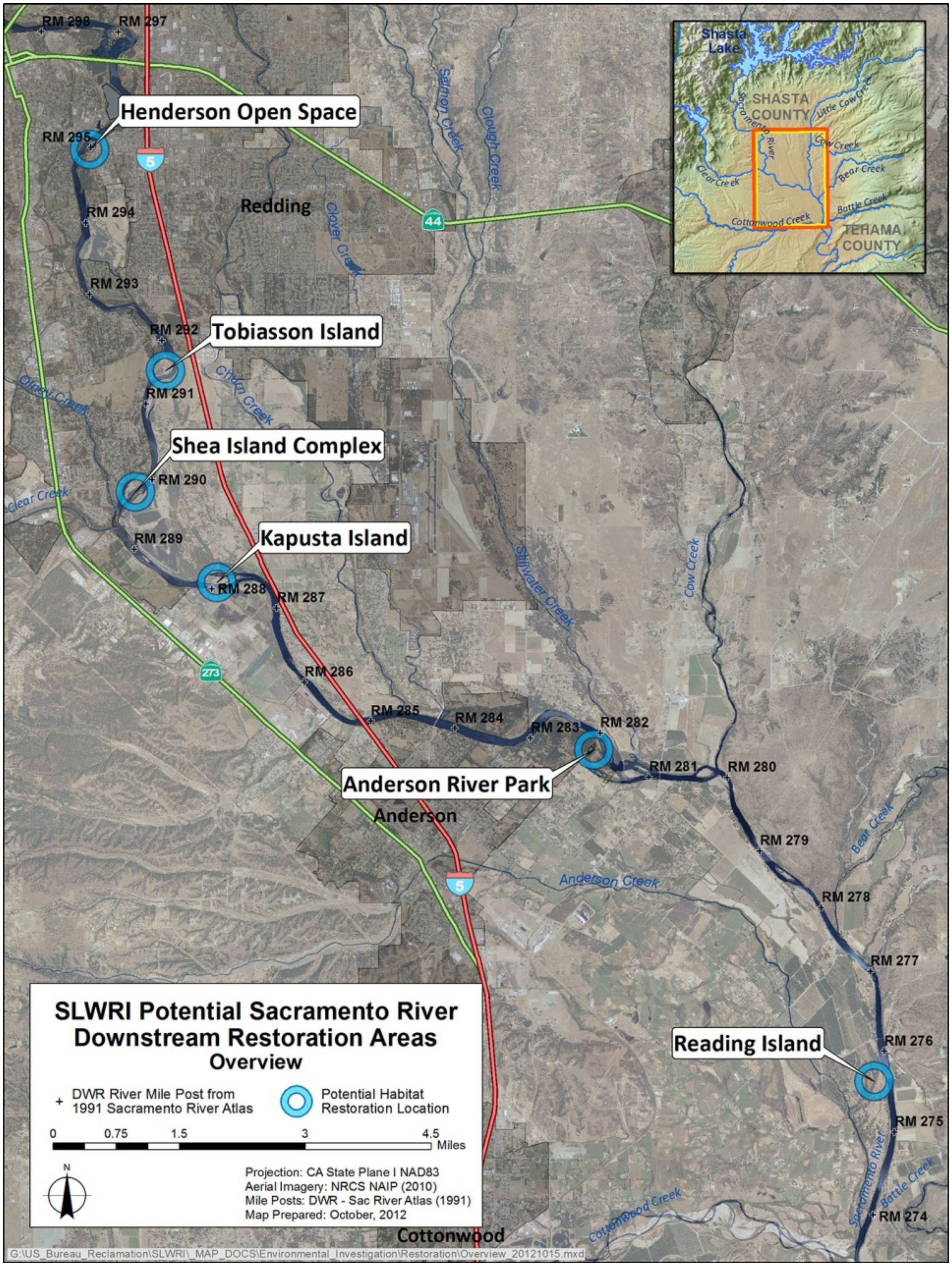

Figure 2-3. Potential Sacramento River Habitat Restoration Areas

Henderson Open Space The City of Redding Henderson Open Space area is located south of Cypress Bridge on the east side of the Sacramento River at River Mile (RM) 295. Riparian and side channel restoration at the Henderson Open Space site could consist of enhancing an existing side channel to activate the frequency and duration of flows for Chinook salmon spawning habitat throughout the side channel. This potential modification would create up to 2,000 more linear feet of spawning habitat near areas of the Sacramento River that are actively used by anadromous fish for spawning.

Tobiasson Island Tobiasson Island is located downstream from South Bonnyview Bridge in the center of the Sacramento River at RM 292. Riparian, floodplain, and side channel habitat enhancement at this site would involve creating a side channel through the island to be activated at Sacramento River flows for Chinook salmon spawning. Riparian vegetation would be established along the course of the new side channel, adding approximately 1,350 linear feet of spawning and floodplain habitat to this section of the Sacramento River.

Shea Island Complex The Shea Island Complex is located on the west side of the Sacramento River upstream from the river's confluence with Clear Creek at RM 291. Restoration at the Shea Island Complex to improve side channel, riparian, and floodplain habitat would involve enhancing a major side channel through the site to keep the side channel hydraulically connected with the main stem of the Sacramento River at a broader range of flows. Adding channel complexity and enhancing riparian vegetation throughout the length of the side channel would improve Chinook salmon habitat along an additional 1,930 feet of the Sacramento River.

Kapusta Island Kapusta Island is located adjacent to the Kapusta Open Space area upstream from the I-5 crossing of the Sacramento River at RM 288. Restoration of riparian, side channel and floodplain habitat at Kapusta Island would involve enhancing an existing side channel by allowing it to carry water at a broader range of flows specifically to increase spawning habitat for winter-run and spring-run Chinook salmon. Allowing flow through the island, and increasing floodplain habitat would increase potential spawning habitat in this area of the river by about 1,590 linear feet.

Anderson River Park Anderson River Park is an open space area on the south bank of the Sacramento River downstream from Churn Creek, and upstream from the Deschutes Road crossing at RM 283. Restoration at this site would involve hydraulically reconnecting a remnant Sacramento River side channel with the Sacramento River. Regularly flowing water throughout the length of this side channel would increase anadromous fish rearing habitat along 4,750 feet of side channel in this section of the river.

Reading Island Reading Island lies along the Sacramento River just north of Cottonwood Creek at RM 274. The channel for Anderson Creek, a remnant Sacramento River side channel, defines the western edge of Reading Island.

Construction of a levee on Anderson Creek has blocked the channel's connectivity with the Sacramento River and has created Anderson Slough, an area of still water. Riparian, floodplain, and side channel restoration on Reading Island would involve restoring flows in Anderson Creek and through Anderson Slough. These activities, alongside removal of invasive aquatic vegetation in the channel and reestablishment of riparian vegetation would aid in restoring rearing habitat for winter-run Chinook, and spawning habitat for steelhead along 4,225 feet of channel in this area of the river.

Potential Benefits of CP4

Major potential benefits of CP4, related to the project objectives, are described below.

Increase Anadromous Fish Survival Water temperature is one of the most important factors in achieving recovery goals for anadromous fish in the Sacramento River. CP4 would significantly increase the ability of Shasta Dam to make cold-water releases and regulate water temperature in the upper Sacramento River, primarily in dry and critical water years. This would be accomplished by raising Shasta Dam 18.5 feet, thus increasing the depth of the cold-water pool in Shasta Reservoir and resulting in an increase in seasonal cold-water volume below the thermocline (layer of greatest water temperature and density change). Cold water released from Shasta Dam significantly influences water temperature conditions in the Sacramento River between Keswick Dam and the RBPP. Hence, the most significant water temperature benefits to anadromous fish would occur upstream from the RBPP. It is estimated that improved water temperature and flow conditions under CP4 could result in an average annual increase in Chinook salmon population of nearly 812,600 out-migrating juvenile fish.

Under CP4, an increase in the cold-water pool would allow Reclamation to operate Shasta Reservoir to provide not only a more reliable source of water during dry and critical water years, but also to provide more cool water for release into the Sacramento River to improve conditions for anadromous fish. Of the increased storage space, about 378,000 acre-feet (60 percent) would be dedicated to increasing the cold-water supply for anadromous fish survival purposes.

In addition, CP4 includes a gravel augmentation program. Gravel augmentation would occur on average at one or more locations in the Sacramento River between Keswick Dam and the RBPP for a period of 10 years. On average, 5,000 to 10,000 tons of gravel would be placed each year, although the specific quantity of gravel placed in a given year may vary from that range. Spawning gravel augmentation is expected to positively influence anadromous fish populations in the Sacramento River.

Potential benefits to anadromous fish survival through conserving, restoring, and enhancing ecosystem resources are described below.

Increase Water Supply Reliability CP4 would increase water supply reliability by increasing firm water supplies for CVP and SWP irrigation and M&I deliveries. This action would contribute to replacement of supplies redirected to other purposes in the CVPIA. CP4 would help reduce estimated future water shortages by increasing the reliability of firm water supplies for agricultural and M&I deliveries by at least 47,300 acre-feet per year and average annual yield by about 31,000 acre-feet per year. For this DEIS, firm yield is considered equivalent to the estimated increase in the reliability of supplies during dry and critical periods. The majority of increased firm yield (42,700 acre-feet) would be for south-of-Delta agricultural and M&I deliveries. In addition, water use efficiency could help reduce current and future water shortages by allowing a more effective use of existing supplies. As population and resulting water demands continue to grow and available supplies continue to remain relatively static, more effectively using these supplies could reduce potential critical impacts to agricultural and urban areas resulting from water shortages. Under CP4, approximately $1.6 million would be allocated over an initial 10-year period to fund agricultural and M&I water conservation programs, focused on agencies benefiting from increased reliability of project water supplies.

Develop Additional Hydropower Generation Higher water surface elevations in the reservoir would result in a net increase in power generation of about 133 GWh per year. This generation value is the expected increased generation from Shasta Dam and other CVP/SWP facilities.

Conserve, Restore, and Enhance Ecosystem Resources In the upper Sacramento River, the addition of spawning gravel and the restoration of riparian, floodplain, and side channel habitat are expected to improve the complexity of aquatic habitat and its suitability for anadromous salmonid spawning and rearing habitat. Riparian areas provide habitat for a diverse array of plant and animal communities along the Sacramento River, including several threatened or endangered species. Riparian areas also provide shade and woody debris that increase the complexity of aquatic habitat and its suitability for spawning and rearing. Lower floodplain areas, river terraces, and gravel bars play an important role in the health and succession of riparian habitat. Restoration would support the goals of the Sacramento River Conservation Area Forum and other programs associated with riparian restoration along the Sacramento River. In addition, improved fisheries conditions as a result of cold-water carryover storage in CP4, as described above, and increased flexibility to meet flow and temperature requirements, could also enhance overall ecosystem resources in the Sacramento River. Side channels can support important habitat for anadromous salmonids, including rearing and spawning habitat. Side channel habitats also provide refuge from predators and productive foraging habitat for juvenile anadromous salmonids.

Maintain and Increase Recreation Opportunities CP4 includes features to, at a minimum, maintain the existing recreation capacity at Shasta Lake.

Potential recreation benefits would be as stated for CP3. Although CP4 does not include specific features to further increase recreation capacity, benefits to the water-oriented recreation experience at Shasta Lake would likely occur because of the increase in average lake surface area, reduced drawdown during the recreation season, and modernization of recreation facilities. The maximum surface area of the lake would increase by about 2,600 acres (9 percent), from 29,700 acres to about 32,300 acres. The average surface area of the lake during the recreation season from May through September would increase by about 2,600 acres (11 percent), from 23,900 acres to 26,500 acres. There is also limited potential to provide additional benefits to recreation by allowing more reliable filling of the reservoir during the spring.

Benefits Related to Other Project Objectives CP4 could also provide benefits related to flood damage reduction and water quality, similar to CP1.

Construction for CP4

Construction activities associated with physical features under CP4 would include land-based construction activities associated with 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
- Augmenting spawning gravel in the upper Sacramento River
- Restoring riparian, floodplain, and side channel habitat

Construction activities for CP4 are described in Section 2.3.8, “Comprehensive Plan Construction Activities.”

Operations and Maintenance for CP4

Operations under CP4 are governed by the same regulatory constraints as described for CP1. Under CP4, the additional storage would be retained to increase water supply reliability and to expand the cold-water pool in Shasta Reservoir for fisheries benefits. Of the 634,000 acre-feet of additional storage, 378,000 acre-feet of water (60 percent) would be dedicated to increasing the cold-water supply for anadromous fish survival purposes. This would be in addition to any storage targets set by regulations described in Chapter 6, “Hydrology, Hydraulics, and Water Management.” Similar to CP1, Shasta Dam operational guidelines would continue unchanged under CP4, except during dry and critical years, when 70,000 acre-feet and 35,000 acre-feet, respectively, of the increased storage capacity in Shasta Reservoir would be operated primarily to provide increased M&I deliveries. Operations targeting increased M&I

deliveries were based on existing and anticipated future demands, operational priorities, and facilities of the SWP.

As modeled, the 378,000 acre-feet of additional water would be the first increment of the reservoir filled after the reservoir was enlarged. This amount of water would be available as additional water for the cold-water pool each year regardless of water year type, unless Reclamation elected to use the additional water to augment flows protecting anadromous fish in the Sacramento River, as part of a proposed adaptive management plan, as explained below. An additional 256,000 acre-feet of the increased storage space would be used primarily to improve water supply reliability; operations of Shasta Dam related to the 256,000 acre-feet of storage would be similar to operations under CP1.

As stated above, of the total 634,000 acre-feet of additional storage, 378,000 acre-feet of water would be used to increase the cold-water pool for fisheries. Reclamation is currently working with NMFS, USFWS, and CDFW through the Sacramento River Temperature Task Group (SRTTG), a multiagency group established to adaptively manage flows and water temperatures in the Sacramento River to improve and stabilize Chinook salmon populations in the upper Sacramento River. The additional 378,000 acre-feet of cold-water pool would be managed by Reclamation in coordination with the SRTTG.

Current analysis indicates that the most beneficial use of the additional 378,000 acre-feet of storage for fisheries protection is as an expanded cold-water pool; however, Reclamation has agreed to adaptively manage the 378,000 acre-feet of water, as appropriate, to increase benefits to anadromous fish as part of CP4. Adaptive management is an approach allowing decision makers to take advantage of a variety of strategies and techniques that are adjusted, refined, and/or modified based on an improved understanding of system dynamics. Adaptive management, if applied appropriately, allows for flexible operations based on best available science and new information as it becomes available.

The adaptive management plan may include operational changes to the timing and magnitude of releases primarily to improve the quality and quantity of aquatic habitat. These changes may include increasing minimum flows, timing releases from Shasta Dam to mimic more natural seasonal flows, meeting flow targets for side channels, or retaining the additional 378,000 acre-feet of water in storage to meet temperature requirements. Reclamation would work cooperatively with the SRTTG to determine the best use of the cold-water pool each year under an adaptive management plan. Reclamation would manage the cold-water pool and operate Shasta Dam each year based on recommendations from the SRTTG. Because adaptive management is predicated on using best available science and new information to make decisions, a monitoring program would be implemented as part of the adaptive management plan. SRTTG members would conduct monitoring, develop monitoring protocols, and set performance standards to determine the success of adaptive management actions.

Under the currently proposed operations, the 378,000 acre-feet of additional storage would be the first increment of water in the reservoir to fill after dam enlargement. This water would be available each year independent of water year type if used exclusively to enlarge the cold-water pool. If the 378,000 acre-feet of stored water is used to augment flows based on recommendations from the SRTTG, this water would not be guaranteed to be available for use the following year because of uncertainty in hydrologic conditions. Once water was released to augment flows as part of the adaptive management plan, the 378,000 acre-feet of additional storage space would be refilled after the 256,000 acre-feet of additional storage space was filled for the primary purpose of increasing water supply reliability. Each year that the 378,000 acre-feet of additional water was held in storage as part of an increase in the cold-water pool, the allocated amount would be available as long as the cold-water pool continued to provide benefits to fisheries.

SALMOD modeling and related analysis indicate that in most cases, providing an increased cold-water pool benefits Chinook salmon populations in the Upper Sacramento River more than increasing flows. Therefore, the impacts and benefits of increasing flows under CP4 are not presented in this DEIS. Per recommendations in Title 43 of the CFR, Part 46, Section 46.145, substantive increases in flows associated with the adaptive management plan would be evaluated in subsequent NEPA analysis.

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

2.3.7 CP5 – 18.5-Foot Dam Raise, Combination Plan

CP5 primarily focuses on increased water supply reliability, anadromous fish survival, Shasta Lake area environmental resources, and increased recreation opportunities.

Major Components of CP5

CP5 includes the following major components:

- Raising Shasta Dam and appurtenant facilities by 18.5 feet
- Constructing additional resident fish habitat in Shasta Lake and along the lower reaches of its tributaries (Sacramento River, McCloud River, and Squaw Creek)
- Constructing shoreline fish habitat around Shasta Lake
- Augmenting spawning gravel in the upper Sacramento River
- Restoring riparian, floodplain, and side channel habitat in the upper Sacramento River

- Increasing recreation opportunities at Shasta Lake
- Implementing the set of eight common management measures previously described
- Implementing the common environmental commitments previously described

By raising Shasta Dam 18.5 feet, from a crest elevation of 1,077.5 feet to 1,096.0 feet (based on NGVD29), CP5 would increase the height of the reservoir full pool by 20.5 feet. The additional 2-foot increase in the height of the full pool above the dam raise height would result from spillway modifications similar to the modifications proposed under CP1. This increase in full pool height would add approximately 634,000 acre-feet of storage to the reservoir's capacity. Accordingly, storage in the overall full pool would be increased from 4.55 MAF to 5.19 MAF. Table 2-5 summarizes major physical features associated with CP5.

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. The existing TCD would be extended to achieve efficient use of the expanded cold-water pool. 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.

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

CP5 also involves (1) restoring resident fish habitat in Shasta Lake; (2) restoring fisheries and riparian habitat at several locations along the lower reaches of the tributaries to Shasta Lake; (3) augmenting spawning gravel in the upper Sacramento River; (4) restoring riparian, floodplain, and side channel habitat in the upper Sacramento River; and (5) increasing recreation opportunities at Shasta Lake.

Construct Reservoir Shoreline Enhancement The ecosystem enhancement goal for the shoreline environment of Shasta Lake is to improve warm-water fish habitat associated with the transition between the reservoir's aquatic and terrestrial habitats. Shoreline enhancement entails a range of enhancement opportunities along the Shasta Lake shoreline below the full pool elevation of

1,090 feet (based on the North American Vertical Datum of 1988 (NAVD88))[3] that would occur with an 18.5-foot dam raise. This area is typically between 0.1 mile and 1.5 miles upslope from the current full pool elevation of 1,070 feet (based on NAVD88). The shoreline is defined as the area encompassing nearshore aquatic habitat within the reservoir itself and vegetation and other habitat components adjacent to the reservoir.

Two categories of potential nearshore warm-water fish habitat enhancement activities are (1) structural enhancements, which entail placing artificial structures in the Shasta Lake littoral zone; and (2) vegetative enhancements, which entail planting and seeding to provide submerged and partly submerged vegetative cover when the reservoir is at full pool capacity during the winter/spring months.

Construction activities common to all action alternatives include stockpiling manzanita for fish habitat (see Section 2.3.2). CP5 would involve clearing additional manzanita from above the new full pool inundation zone to create further structural enhancements for fish habitat in the Shasta Lake littoral zone.

Vegetative enhancements associated with CP5 would include planting willows (*Salix*) to enhance nearshore fish habitat, and single-treatment aerial and hand seeding of annual cereal grains to treat shoreline areas at Shasta Lake. Treatment with cereal grains provides only short-term cover, but is cost-effective across large areas and can be implemented quickly and efficiently. The annual cereal grain grasses provide cover for young fish and also nutrients for plankton as the grasses decompose. The plankton in turn are a valuable food source for juvenile fish.

Construct Reservoir Tributary Aquatic Habitat Enhancement The primary goal for the enhancement of aquatic habitat in the watershed is to improve the connectivity for native fish species and other aquatic organisms between Shasta Lake and its tributaries. Two categories of potential aquatic habitat enhancement in tributaries are (1) fish passage enhancements, which entail identifying and correcting barriers to fish passage, particularly at culverts and other human-made barriers; and (2) aquatic habitat enhancements, which entail identifying and implementing feasible habitat improvements intended to conserve or restore degraded aquatic and riparian habitat in tributaries to Shasta Lake.

Fish passage enhancements associated with CP5 include opportunities to restore and/or enhance five perennial stream crossings. Barriers to fish passage in the watersheds above Shasta Lake are associated primarily with culverts or other types of stream crossings.

[3] Shasta Lake water surface elevations are based on NAVD88. 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 which was completed using NAVD88.

Aquatic habitat enhancements associated with CP5 involve enhancing aquatic connectivity and reducing sediment related to roads constructed across intermittent streams. The preliminary site survey identified opportunities to enhance 14 intermittent stream crossings. Based on the information obtained in the survey, these crossings provide opportunities for meeting the objectives of enhancing aquatic connectivity and/or reducing the potential for road-related sediment. Two sites have been identified in the Salt Creek watershed, two sites have been identified in the Sugarloaf Creek watershed, and 10 sites have been identified in the McCloud River Arm watershed.

Augment Spawning Gravel in Upper Sacramento River As described in CP4, spawning gravel would be added to the upper Sacramento River. This measure is identical to that proposed under CP4.

Restore Riparian, Floodplain, and Side Channel Habitat As described in CP4, riparian, floodplain, and side channel habitat restoration would occur at suitable locations along the Sacramento River. This measure is identical to that proposed under CP4.

Recreation Enhancements A total of 18 miles of new hiking trails and 6 trailheads would be constructed to enhance recreation under CP5.

Potential Benefits of CP5

Major potential benefits of CP5, related to the project objectives, are described below.

Increase Anadromous Fish Survival Water temperature is one of the most important factors in achieving recovery goals for anadromous fish in the Sacramento River. CP5 would increase the ability of Shasta Dam to make cold-water releases and regulate water temperature in the upper Sacramento River, primarily in dry and critical water years. This would be accomplished by raising Shasta Dam 18.5 feet, thus increasing the depth of the cold-water pool in Shasta Reservoir and resulting in an increase in seasonal cold-water volume below the thermocline (layer of greatest water temperature and density change). Cold water released from Shasta Dam significantly influences water temperature conditions in the Sacramento River between Keswick Dam and the RBPP. Hence, the most significant water temperature benefits to anadromous fish would occur upstream from the RBPP. It is estimated that improved water temperature and flow conditions under CP5 could result in an annual average increase in the Chinook salmon population of about 377,800 out-migrating juvenile fish.

Increase Water Supply Reliability CP5 would increase water supply reliability by increasing firm water supplies for CVP and SWP irrigation and M&I deliveries. This action would contribute to replacement of supplies redirected to other purposes in the CVPIA. CP5 would help reduce estimated future water shortages by increasing the reliability of firm water supplies for agricultural and M&I deliveries by at least 113,500 acre-feet per year, and average annual yield by about 75,900 acre-feet per year. For this DEIS, firm yield is considered equivalent to the estimated increase in the reliability of supplies during dry and critical periods. The majority of increased firm yield (88,300 acre-feet) would be for south-of-Delta agricultural and M&I deliveries. In addition, increased water use efficiency could help reduce current and future water shortages by allowing a more effective use of existing supplies. As population and resulting water demands continue to grow and available supplies continue to remain relatively static, more effective use of these supplies may reduce potential critical impacts to agricultural and urban areas resulting from water shortages. Under CP5, approximately $3.8 million would be allocated over an initial 10-year period to fund agricultural and M&I water conservation programs, focused on agencies benefiting from increased reliability of project water supplies.

Develop Additional Hydropower Generation Higher water surface elevations in the reservoir would result in a net increase in power generation of about 117 GWh per year. This generation value is the expected increased generation from Shasta Dam and other CVP/SWP facilities.

Conserve, Restore, and Enhance Ecosystem Resources CP5 would provide for habitat improvements both in the reservoir area and downstream from Shasta Dam on the upper Sacramento River.

Along the Shasta Lake shoreline, shallow warm-water fish habitat would be improved by using manzanita cleared from above the inundation zone to create structural enhancements, planting willows to enhance nearshore fish habitat, and seeding of cereal grains (native grasses) to treat shoreline areas. Once established, the willows and native grasses would provide submerged and partly submerged vegetative cover when the reservoir is at full pool during the winter/spring months. These improvements would help provide favorable spawning conditions, and juvenile fish leaving the tributaries would benefit from improved adjacent shoreline habitat. Placing manzanita brush structures near the shoreline would enhance the diversity of structural habitat available for the warm-water fish species that occupy Shasta Lake. Establishing vegetation also could benefit terrestrial species that inhabit the shoreline of Shasta Lake.

The lower reaches of perennial tributaries to Shasta Lake would be the focus for aquatic restoration under CP5 because they provide year-round fish habitat. Native fish species require connectivity to the full range of habitats offered by Shasta Lake and its tributaries. Improved fish passage addresses the requirement to provide access and/or modify barriers to improve ecological conditions that support these native fish assemblages. Aquatic habitat improvements include enhancing aquatic connectivity and reducing sediment related to roads constructed across intermittent streams.

In the upper Sacramento River, the addition of spawning gravel and the restoration of riparian, floodplain, and side channel habitat are expected to improve the complexity of aquatic habitat and its suitability for spawning and rearing. Riparian areas provide habitat for a diverse array of plant and animal communities along the Sacramento River, including numerous threatened or endangered species. Riparian areas also provide shade and woody debris that increase the complexity of aquatic habitat and its suitability for spawning and rearing. Lower floodplain areas, river terraces, and gravel bars play an important role in the health and succession of riparian habitat. Restoration would support the goals of the Sacramento River Conservation Area Forum and other programs associated with riparian restoration along the Sacramento River. Side channels can support important habitat for anadromous salmonids, including rearing and spawning habitat. Side channel habitats also provide refuge from predators and productive foraging habitat for juvenile anadromous salmonids.

Maintain and Increase Recreation Opportunities CP5 includes features to, at a minimum, maintain the existing recreation capacity at Shasta Lake. In addition, this alternative involves construction of 18 miles of new trails and 6 trailheads to enhance recreation opportunities at Shasta Lake. As with the other alternatives, benefits to the water-oriented recreation experience at Shasta Lake would likely occur because of the increase in average lake surface area, reduced drawdown during the recreation season, and modernization of recreation facilities. The maximum surface area of the lake would increase by about 2,600 acres (9 percent), from 29,700 acres to about 32,300 acres. The average surface area of the lake during the recreation season from May through September would increase by about 1,900 acres (8 percent), from 23,900 acres to 25,800 acres. There is also limited potential for reservoir reoperation to provide additional benefits to recreation by allowing more reliable filling of the reservoir during the spring.

Benefits Related to Other Project Objectives CP5 could also provide benefits related to flood damage reduction and water quality, similar to CP3.

Construction for CP5

Construction activities associated with physical features under CP5 would include land-based construction activities associated with 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
- Augmenting spawning gravel in the upper Sacramento River

- Restoring riparian, floodplain, and side channel habitat
- Enhancing Shasta Lake and tributary shoreline

Construction activities for CP5 are described in Section 2.3.8, “Comprehensive Plan Construction Activities.”

Operations and Maintenance for CP5

Operations under CP5 are governed by the same regulatory constraints as described for CP1. Similar to CP1, the additional storage would be retained to increase water supply reliability and to expand the cold-water pool in Shasta Reservoir for fisheries benefits. Similar to CP1, Shasta Dam operational guidelines would continue unchanged, except during dry and critical years, when 150,000 acre-feet and 75,000 acre-feet, respectively, of the 634,000 acre-feet increased storage capacity in Shasta Reservoir would be operated primarily to provide increased M&I deliveries. Operations targeting increased M&I deliveries were based on existing and anticipated future demands, operational priorities, and facilities of the SWP. For CP5, existing water quality and temperature requirements would typically be met in most years; therefore, additional water in storage would be released primarily for water supply purposes. Accordingly, minimal increases in flow would be expected in months when Delta exports were constrained, or when flow was not usable for water supply purposes.

In comparison to current operations, CP5 would store some additional flows behind Shasta Dam during periods when downstream needs would have already been met, but flows would have been released because of storage limitations. The resulting increase in storage would be released downstream when there were opportunities for beneficial use of the water, either to meet water supply reliability demands or to improve Reclamation’s abilities to meet its environmental objectives. The additional water in storage would also expand the cold-water pool and increase end-of-September carryover storage in Shasta Reservoir, increasing the ability of Shasta Dam to improve water temperatures for anadromous fish in the upper Sacramento River.

Conversely, if water in storage were insufficient to meet all of the project purposes, the first increment to be reduced would be deliveries to water service contractors. Releases from Shasta Dam under CP5 would typically increase in the summer months, corresponding with the periods of greatest agricultural demands. Similarly, releases would be reduced in the winter months, when the increased storage space could be used to capture additional runoff rather than releasing water to the downstream river, as would occur with Shasta Reservoir’s current operations.

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

2.3.8 Comprehensive Plan Construction Activities

Construction activities under all comprehensive plans would include land-based construction activities associated with the following:

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

CP4 and CP5 would also include construction activities associated with gravel augmentation and restoring riparian, floodplain, and side channel habitat. Additional construction activities associated with Shasta Lake and tributary shoreline enhancements are included under CP5. Construction activities under the proposed action alternatives are described below.

Clearing Portions of Inundated Reservoir Area

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

Fifteen vegetation management areas have been delineated to facilitate efficient removal of vegetation around the reservoir perimeter, including 11 areas of complete vegetation removal and 4 areas of overstory removal (see Figure 2-4). The acreages of each vegetation management area affected by identified reservoir clearing treatments are summarized in Table 2-6 below.

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

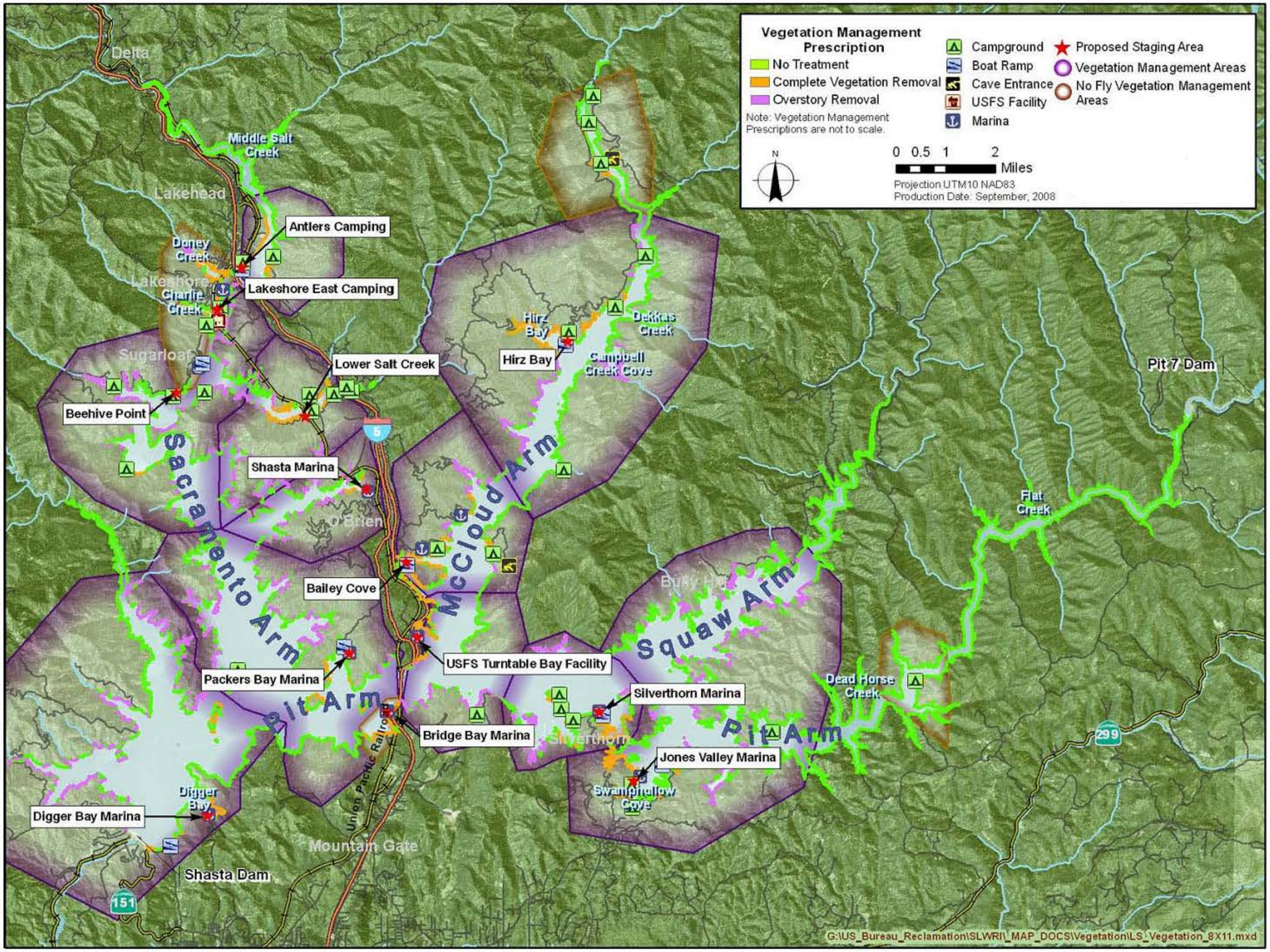

Figure 2-4. Vegetation Management Areas

Table 2-6. Reservoir Clearing Treatment Applied By Action Alternative

	CP1				CP2				CP3, CP4, and CP5			
Landing Location	**Complete Removal (acres)**	**Complete Removal Quantity (board feet)**	**Overstory Removal (acres)**	**Overstory Removal Quantity (board feet)**	**Complete Removal (acres)**	**Complete Removal Quantity (board feet)**	**Overstory Removal (acres)**	**Overstory Removal Quantity (board feet)**	**Complete Removal (acres)**	**Complete Removal Quantity (board feet)**	**Overstory Removal (acres)**	**Overstory Removal Quantity (board feet)**
Antlers	8	48,600	5	33,400	12	76,600	8	52,700	17	109,300	12	75,100
Bailey Cove	17	148,400	7	40,600	26	234,000	11	64,000	37	333,700	15	91,300
Beehive Point	3	5,400	24	102,300	4	8,500	38	161,300	6	12,100	54	230,100
Bridge Bay	9	51,800	0	0	14	81,600	0	0	20	116,400	0	0
Digger Bay	8	27,700	31	92,600	13	43,700	49	146,000	19	62,400	70	208,300
Hirz Bay	22	211,200	22	169,500	35	333,000	34	267,300	49	474,900	49	381,200
Jones Valley	17	81,700	51	328,000	26	128,800	81	517,100	38	183,700	116	737,500
Lakeshore East	17	58,800	2	12,500	27	92,800	4	19,700	39	132,300	5	28,100
Lower Salt Creek	14	96,300	15	62,700	22	151,800	24	98,900	31	216,500	35	141,100
McCloud Arm	4	14,900	0	0	7	23,500	0	0	10	33,500	0	0
Packers Bay	7	29,200	22	78,800	11	46,000	35	124,200	16	65,600	50	177,100
Pit Arm	2	22,400	0	0	3	35,300	0	0	4	50,400	0	0
Shasta Marina	1	17,900	13	89,400	2	28,200	21	141,000	2	40,200	30	201,100
Silverthorn	17	117,900	18	115,100	26	185,900	29	181,400	37	265,200	41	258,800
Turntable	5	33,100	8	88,700	8	52,200	13	139,900	11	74,400	19	199,500
Total	**150**	**965,300**	**220**	**1,213,600**	**236**	**1,521,900**	**347**	**1,913,500**	**337**	**2,170,600**	**495**	**2,729,200**

Key:
CP = comprehensive plan

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

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

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

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

Construction of Dam and Appurtenant Structures

This section summarizes major features associated with enlarging Shasta Dam and Reservoir and modifying its appurtenances for all comprehensive plans (action alternatives). Total surface area that would be required for work limits and permanent features, and an estimate of materials needed to modify Shasta Dam and its appurtenances under each comprehensive plan are shown in Table 2-7. For more detailed explanations of design considerations, please refer to the Engineering Summary Appendix.

Table 2-7. Physical Features for Proposed Modifications of Shasta Dam and Appurtenances for Action Alternatives

Physical Features	CP1	CP2	CP3, CP4, and CP5
Quantity of Concrete (cubic yards)	57,000	77,300	100,800
Quantity of Cement (tons)	128,600	170,500	213,000
Quantity of Metalwork (pounds)	19,654,400	20,435,900	21,751,200
Volume of Imported Fill Material (cubic yards)	61,200	94,400	130,500
Volume of Excavation to Waste Material (cubic yards)	1,600	1,600	1,600
Quantity of Demolished Material (cubic yards)	25,400	29,200	31,600
Area of Permanent Structures (square feet)	412,600	412,600	412,600
Area of Work Limits (square feet)	460,900	460,900	460,900

Key:
CP = comprehensive plan

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

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

Drain holes would be drilled from two different locations: from the existing dam crest to drain the surface contact and from the existing dam crest for surface drainage at the downstream overhang. A vertical shaft would be excavated through the concrete from the existing dam crest to the hoist gallery to install electrical conduit.

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

The spillway bridge and dam crest access road would be out of service for an extended period of time (over two years) during construction of the new spillway and dam crest raise. A detour route would be provided below the dam across an existing bridge. Modifications to the TCD would be performed to minimize impacts to reservoir operations to the extent possible, but supplemental cold water releases may be required through the river outlets during a portion of the construction period. Control equipment for the TCD would be removed, stored, and reinstalled for the higher dam crest. The elevator tower would be out of service for about 4 months for construction of the dam crest raise and for replacement of the elevator car and hoist equipment.

Main Gravity Dam and Wing Dams Enlargement of Shasta Dam under all action alternatives would require raising Shasta Dam (the main gravity dam) and its left and right wing dams as indicated in Table 2-8. Construction activities to raise the main gravity dam and the left and right wing dams are summarized below.

Table 2-8. Physical Features for Proposed Modifications of Shasta Dam and Appurtenances for Action Alternatives

Feature	Existing	CP1	CP2	CP3, CP4, CP5
Main Gravity Dam				
Crest Raise (feet)	0	6.5	12.5	18.5
Crest Elevation[1]	1077.5	1,084.0	1,090.0	1,096.0
Upstream Parapet Wall Elevation[1]	1079.1	1,087.5	1,093.5	1,099.5
Full Pool Elevation[2]	1069.7	1,078.2	1,084.2	1,090.2
Left Wing Dam				
Crest Raise (feet)	0	8.5	14.5	20.5
Crest Elevation[1]	1077.5	1,086.0	1,092.0	1,098.0
Upstream Parapet Wall Elevation[1]	1079.1	1,089.5	1,095.5	1,101.5
Right Wing Dam				
Crest Raise (feet)	0	6.5	12.5	18.5
Crest Elevation[1]	1077.5	1,084.0	1,090.0	1,096.0
Upstream Parapet Wall Elevation[1]	1079.1	1,087.5	1,093.5	1,099.5
Spillway				
Crest Raise (feet)	0	0.5	6.5	12.5
Crest Elevation[1]	1037.0	1,037.5	1,043.5	1,049.5

Notes:
[1] Main dam and wing 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

Shasta Dam would be raised by placing mass concrete corresponding in width to the existing dam monolith blocks on the existing dam crest (concrete gravity section and spillway crest section). Structural concrete would be placed for the top of the dam, including for the roadway, the upstream and downstream parapets, and the walkway. Reinforcing bars would be used around the utility gallery, and nominal temperature steel would be used for the exposed structural concrete surfaces. Steel top-of-dam drains would be furnished and installed in each block to drain to the upstream face. Surface area and features of the new dam crest would be similar to the existing dam crest, including gantry crane rails and surface drains. A new upstream parapet wall would provide flood protection. The dam raise would include a new utility gallery.

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

A building housing a visitor center and Reclamation offices, a parking lot, picnic areas, and vista points have been incorporated into the abutment design. The visitor center building would provide adequate space for visitors, storage, staff, and security functions, and feature a panoramic view of all facilities. The existing roadways, lawns, sidewalks, trees, and other features on the left wing dam crest would be restored to a configuration similar to existing conditions. Existing facilities would be removed from the site before construction, and replaced after the raise is completed.

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

Spillway Structural concrete would be used to raise the existing spillway crest and to shape the raised spillway crest as indicated in Table 2-8. The existing spillway bridge, two existing spillway piers, cantilever wall sections, and three existing drum gates and operating equipment would be removed. Five new spillway piers would be constructed at locations within the spillway, designed to avoid existing overflow block contraction joints, and a new concrete spillway crest would be constructed between them. The locations of the new piers would result in different widths of spillway gates. The three existing 110-foot by 28-

foot drum gates would be replaced with six sloping, fixed-wheel gates. The total spillway crest length would be reduced from 330 feet to 300 feet as a result. A new bridge would be required over the spillway to allow for vehicular traffic and for a gantry crane to travel from one end of the dam to the other.

Temperature Control Device Modifications to the TCD would be needed for all action alternatives. Modifications would primarily involve extending the main steel structure to the new full pool elevation; raising the TCD operating equipment, including gate hoists, electrical equipment, miscellaneous metalwork, and hoist platform above the new top of joint-use elevation; installation of additional cladding on the existing and raised sections of the TCD; and lengthening/replacing shutter operating cables.

Shasta Powerplant Penstock Intake and Penstock Modifications The centerline of the existing penstock intakes would remain at the current level, but the gate hoists would require relocation with a higher dam crest. The existing steel penstock pipes have been determined to be adequate for the higher reservoir loads and no penstock modifications are anticipated.

Pit 7 Dam Powerhouse The Pit 7 Dam and Powerhouse, which is owned and operated by Pacific Gas and Electric Company (PG&E), is located on the upper Pit River at the northeast end of Shasta Lake. The complex consists of three main features: a main dam with integral spillway, a two-unit hydroelectric powerhouse immediately downstream from the main dam, and an afterbay dam. The only expected modifications to the Pit 7 Powerhouse associated with any action alternative include installing a tailwater depression system. During high flows, a tailwater depression system would introduce compressed air into the turbine runner pit to depress the tailwater to a level that does not interfere with turbine operation, thereby allowing continued turbine operation.

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

Reservoir Area Dikes and Railroad Embankments

The physical features for the proposed dikes and railroad embankments under each comprehensive plan are shown in Table 2-9. The proposed dikes would be constructed using common earthmoving equipment and methods. Additional excavation to provide working surfaces and keys for the embankment fill would be required along the slope of the upstream foundation for some of the proposed dikes. Ground treatment and/or over-excavation may be necessary in some areas to remove and/or treat pervious material. Riprap would be placed on the upstream face of each dike to the crest of the dike to protect against wave run-up and erosion. Reservoir area dikes and railroad embankments are further described in the Engineering Summary Appendix.

Table 2-9. Physical Features for Proposed Dikes and Railroad Embankments by Action Alternative

Dike Features	CP1	CP2	CP3, CP4, and CP5
Lakeshore Dikes/Railroad Embankments			
Doney Creek Dike			
Volume of Fill Material (core, drain, filter) (cubic yards)	-	12,200	75,000
Volume of Riprap (cubic yards)	-	1,000	5,900
Volume of Excavated Material (cubic yards)	-	3,100	10,200
Site Clearing and Grubbing Below Dike (acres)	-	1.5	7.2
Antlers Dike			
Volume of Fill Material (core, drain, filter) (cubic yards)	-	-	4,900
Volume of Riprap (cubic yards)	-	-	400
Volume of Excavated Material (cubic yards)	-	-	300
Site Clearing and Grubbing Below Dike (acres)	-	-	0.9
North Railroad Embankment			
Volume of Fill Material (core, filter) (cubic yards)	17,100	17,100	17,100
Volume of Riprap (cubic yards)	400	400	400
Volume of Excavated Material (cubic yards)	1,500	1,500	1,500
Site Clearing and Grubbing Below Dike (acres)	1.2	1.2	1.2
Middle Railroad Embankment			
Volume of Fill Material (core, filter) (cubic yards)	13,400	13,400	13,400
Volume of Riprap (cubic yards)	300	300	300
Volume of Excavated Material (cubic yards)	4,000	4,000	4,000
Site Clearing and Grubbing Below Dike (acres)	2.9	2.9	2.9
South Railroad Embankment			
Volume of Fill Material (core, filter) (cubic yards)	101,900	101,900	101,900
Volume of Riprap (cubic yards)	2,500	2,500	2,500
Volume of Excavated Material (cubic yards)	8,500	8,500	8,500
Site Clearing and Grubbing Below Dike (acres)	6.2	6.2	6.2
Bridge Bay Dikes			
West Dike			
Volume of Fill Material (core, drain, filter) (cubic yards)	3,000	7,700	69,000
Volume of Riprap (cubic yards)	200	800	23,600
Volume of Excavated Material (cubic yards)	2,100	5,000	15,300
Site Clearing and Grubbing Below Dike (acres)	0.8	1.4	2.2
East Dike			
Volume of Fill Material (core, drain, filter) (cubic yards)	1,000	3,000	40,100
Volume of Riprap (cubic yards)	40	160	7,400
Volume of Excavated Material (cubic yards)	900	2,000	16,900
Site Clearing and Grubbing Below Dike (acres)	0.4	0.6	1.1

Key:
- = not applicable
CP = comprehensive plan

Relocations

As a result of the proposed Shasta Dam raise under the comprehensive plans, the following major features would be inundated by the increase in full pool elevation:

- Roadways
- Vehicle bridges
- Railroad bridges
- Recreation facilities
- Utilities and miscellaneous minor infrastructure

Existing infrastructure affected by enlarging Shasta Dam and Reservoir under any of the comprehensive plans would need to be removed and/or relocated.

Roadways Physical features associated with proposed road relocations under each comprehensive plan are shown by major focus area in Table 2-10. Road design criteria and construction characteristics are discussed in detail in the Engineering Summary Appendix.

Table 2-10. Physical Features for Proposed Road Relocations by Major Road Focus Area for Action Alternatives

Road Relocation Features	CP1	CP2	CP3, CP4, and CP5
Lakeshore Drive			
Number of Road Segments Affected	4	6	8
Length (linear feet)	8,100	13,100	13,700
Clearing and Grubbing (acres)	4	7	7
Excavation to Embankment (cubic yards)	46,100	55,100	55,500
Embankment Fill (cubic yards)	95,900	145,900	149,300
Closure Expected	No	No	No
Turntable Bay Area			
Number of Road Segments Affected	3	3	3
Length (linear feet)	6,200	6,200	6,200
Clearing and Grubbing (acres)	2	2	2
Excavation to Embankment (cubic yards)	19,000	19,100	19,000
Embankment Fill (cubic yards)	71,500	71,500	71,500
Closure Expected	Yes	Yes	Yes

Table 2-10. Physical Features for Proposed Road Relocations by Major Road Focus Area for Action Alternatives (contd.)

Road Relocation Features	CP1	CP2	CP3, CP4, and CP5
Gillman Road			
Number of Road Segments Affected	-	3	3
Length (linear feet)	-	1,200	1,200
Clearing and Grubbing (acres)	-	1	1
Excavation to Embankment (cubic yards)	-	0	0
Embankment Fill (cubic yards)	-	28,500	28,500
Closure Expected	-	Yes	Yes
Jones Valley and Silverthorn Area			
Number of Road Segments Affected	1	1	4
Length (linear feet)	2,000	2,000	3,600
Clearing and Grubbing (acres)	1	1	2
Excavation to Embankment (cubic yards)	0	0	1,500
Embankment Fill (cubic yards)	41,300	41,300	54,500
Closure Expected	Yes	Yes	Yes
Salt Creek Road			
Number of Road Segments Affected	-	4	5
Length (linear feet)	-	4,300	5,100
Clearing and Grubbing (acres)	-	1	1
Excavation to Embankment (cubic yards)	-	4,100	5,500
Embankment Fill (cubic yards)	-	34,600	34,600
Closure Expected	-	Yes	Yes
Remaining Road Relocations			
Number of Road Segments Affected	2	4	7
Length (linear feet)	230	2,300	3,900
Clearing and Grubbing (acres)	0.4	1	2
Excavation to Embankment (cubic yards)	15	120	600
Embankment Fill (cubic yards)	34,200	76,100	89,300
Closure Expected	No	No	No

Key:
- = not applicable
CP = comprehensive plan

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

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

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

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

- Charlie Creek Bridge
- Doney Creek Bridge
- McCloud River Bridge
- Didallas Creek Bridge

Criteria and assumptions considered in determining structure type and length for the replacement structures are included in the Engineering Summary Appendix. Based on the design criteria and assumptions, and considering preliminary horizontal alignments and profile grades developed for the relocated roadways, Table 2-11 summarizes proposed bridge characteristics for the four road bridges requiring replacement under all comprehensive plans.

Table 2-11. Physical Features of Proposed Vehicular Bridge Relocations Common to All Action Alternatives

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

Key:
N/A = not applicable
SLWRI = Shasta Lake Water Resources Investigation

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

Traffic would continue on the existing bridges during construction. It is likely that barges would be used extensively for vehicular bridge foundation construction, bridge assembly, transport of materials, workers, and equipment, and demolition of the existing bridges. Concrete would be poured from barges. A staging area would be required on the lakeshore, from which barges could be loaded and unloaded.

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

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

- Enlarging the existing reinforced concrete footing
- Enlarging and extending the existing reinforced concrete columns and pier wall
- Removing some of the lower portion of the eastern pier steel tower (based on location of existing cross bracing)
- Reusing the existing steel bearing assemblies

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

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

Railroad Bridges

Pit River Bridge Pier Modification The Pit River Bridge is a multipurpose structure, carrying both UPRR and I-5 traffic. The bridge is both a steel-through truss and a deck truss. UPRR and Caltrans have joint operation and maintenance responsibility. The new full pool elevations would inundate the existing bridge bearings and low-chord steel truss members. To prevent the existing steel bearings and lower portions of the steel truss members from being submerged, a watertight concrete tub structure (bearing protection structure) would be required. The reinforced concrete structure would be attached to the top of two existing concrete piers. The structure footprint would be rectangular, with the top of the structure above the full pool elevation. Elevations for the top of the bearing protection structure and material quantities for Pit River Bridge modifications under each comprehensive plan are shown in Table 2-12.

Table 2-12. Physical Features for Proposed Bearing Protection Structure for Action Alternatives

Item	CP1	CP2	CP3, CP4, and CP5
Top of Bearing Protection Structure Elevation (feet)[1]	1082.2	1088.2	1094.2
Concrete (cubic yards)	2,100	2,900	4,000
Reinforcing Steel (pounds)	618,000	876,000	1,200,000

Notes:
[1] Bearing protection structure elevations are based on the North American Vertical Datum of 1988 (NAVD88), which is 2.66 feet higher than the National Geodetic Vertical Datum of 1929. 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

Because the existing bridge superstructure and top-of-pier are exposed to the elements, a structure cover would not be required; however, two submersible sump pumps would be installed to keep the water level in the new concrete protective structure from rising near the bearings. Check valves and ball valves would prevent pumped water from draining out of the line back into the sump. Protective grates would prevent large objects from entering the sump area.

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

The proposed new bridge superstructures would be composite superstructures consisting of steel plate girders and a reinforced concrete deck. In general, the bridge superstructures would be designed to be continuous over the piers. However, with a requirement for 16 feet of vertical clearance between the two westernmost piers for the Sacramento River Second Crossing railroad bridge (with a minimum width of 30 feet), to allow for the passage of houseboats, this span is a simply supported span. No minimum clearance for houseboat traffic would be required for the Doney Creek railroad bridge; large-diameter concrete columns with drilled shafts would support the superstructure and be founded on bedrock. The Sacramento River Second Crossing railroad bridge would require nine spans, with a total length of 982 feet between concrete abutments. The Doney Creek railroad bridge would require five spans, with a total length of 537.5 feet between concrete abutments. Construction quantities for major items of work for these features under comprehensive plans are summarized in Table 2-13.

Table 2-13. Physical Features of Proposed Railroad Bridges Common to All Action Alternatives

Item	Sacramento River Second Crossing Bridge Quantities	Doney Creek Bridge Quantities
Steel Truss Bridge Removal (lb)	3,300,000	2,000,000
Concrete Removal (cubic yards)	15,310	4,570
Excavation (cubic yards)	2,100	630
Backfill (cubic yards)	1,900	2,200
Concrete, including Shafts (cubic yards)	11,700	7,080
Reinforcing Steel (lb)	3,420,000	1,760,000
Structural Steel in Girders (lb)	4,750,000	2,250,000

Key:
lb = pound
SLWRI = Shasta Lake Water Resources Investigation

The proposed relocation of the UPRR bridges would require that the railroad tracks be realigned between the two bridges. This realignment would parallel the existing tracks with a 25-foot offset to the east. Construction quantities for major items of work for the railroad realignment between the UPRR bridges are summarized in Table 2-14. Any required embankments for this realignment are described under the “Reservoir Area Dikes and Railroad Embankments” section above.

Table 2-14. Physical Features of Proposed Railroad Realignment Common to All Action Alternatives

Item	Railroad Realignment Between Bridges
Length of Track Realignment (linear feet)	8,400
Railroad Track Removal (tons)	370
Ballast Removal (tons)	6,400
Excavation (cubic yards)	35,000
Compacted Backfill (cubic yards)	7,500
Railroad Track (tons)	390
Ballast (tons)	26,500

Key:
SLWRI = Shasta Lake Water Resources Investigation

Recreation Facilities Any raise of Shasta Dam would have some effect on the many recreation features found along the reservoir shoreline. These features include marinas/boat ramps, resorts, campgrounds/day use areas, cabins, trails, and USFS facilities. Areas for potential recreation relocations (referred to as windows) and corresponding relocation plans for each window have been developed. Figure 2-5 details the location of these windows and existing recreation sites with proposed modification, expansion, or relocation activities.

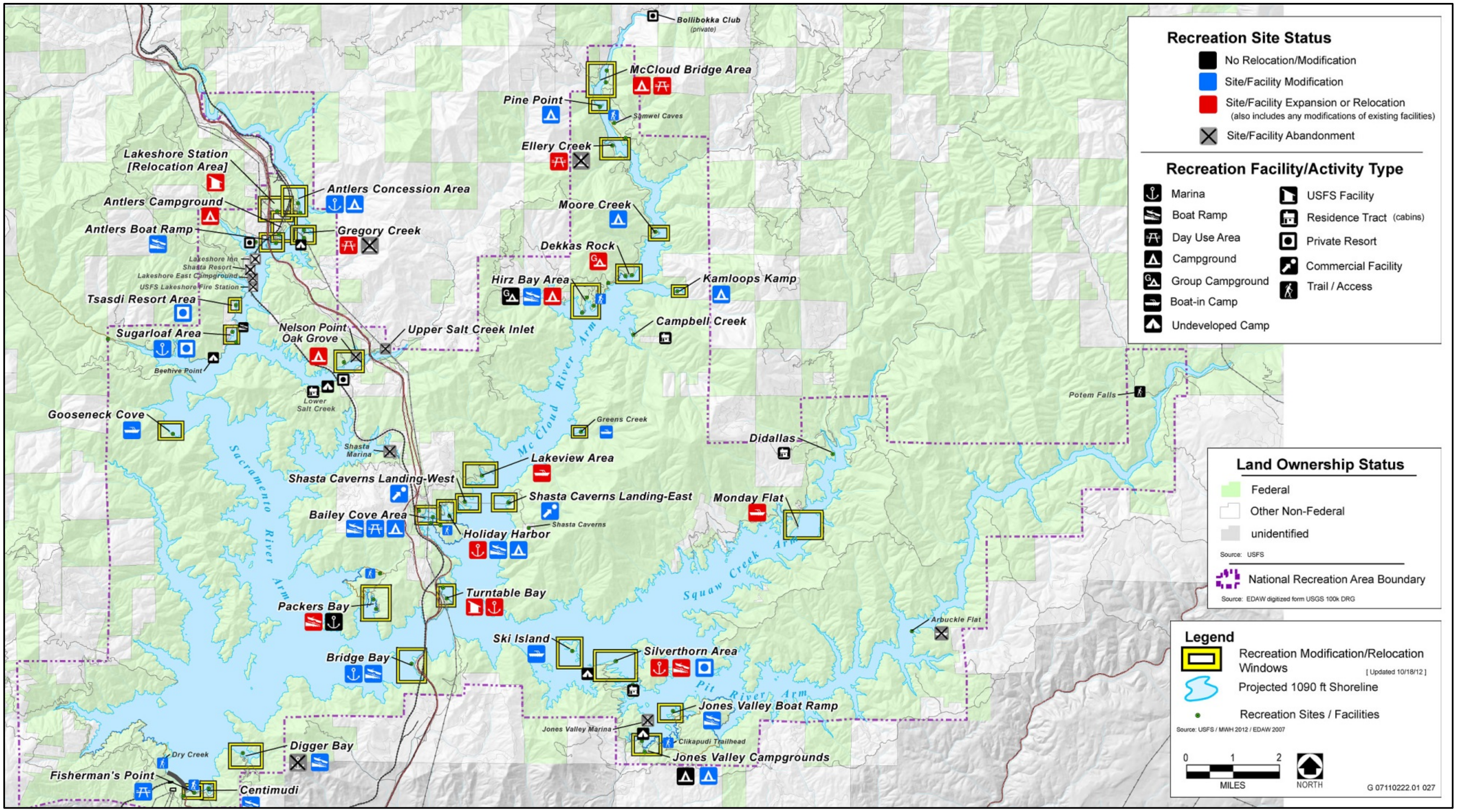

Figure 2-5. Recreation Study Windows

The primary goal of the relocation plans is to verify that with any dam raise, the existing recreation capacity could be maintained. Reclamation and USFS will continue to work together to refine recreation relocations and develop a recreation plan that is suitable for the NRA. For recreation facilities on Federal lands, the USFS will consider relevant laws, regulations, policy, special use permits and master development plans to develop and/or provide final approval for any proposed recreation facility relocations. Action alternatives would, at minimum, maintain the existing recreation capacity at Shasta Lake. Inundated recreation facilities and associated utilities would be relocated before demolition to the extent practicable. Scheduling and sequencing of recreation facility relocation construction activities will strive to minimize or avoid interruption to public recreation activities and access to recreation sites. Recreation facilities proposed for relocation are included below in the detailed description of each action alternative. Table 2-15 presents a summary of the recreation facilities to be modified or relocated under each comprehensive plan. Quantities of demolition and construction materials associated with modification and relocation of recreation facilities are listed in Table 2-16.

Table 2-15. Recreation Facilities to be Modified or Relocated Under Action Alternatives

Recreation Facilities	CP1	CP2	CP3 and CP4	CP5
Marinas/Public Boat Ramps				
Number of Affected Facilities (marinas/boat ramps)	9/6	9/6	9/6	9/6
Relocation Needed[1] (acres)	8.5	8.5	8.5	8.5
Replacement Structures (square feet)	49,900	49,900	49,900	49,900
Campsites and Day-Use Sites				
Number of Affected Facilities (resorts/campsites and day-use sites)	202	261	328	328
Relocation Needed[1] (acres)	32	34	39	39
Replacement Structures (square feet)	6,200	6,200	6,200	6,200
Resorts/USFS Facilities				
Number of Affected Facilities (resorts/USFS facilities)	6/2	6/2	6/2	6/2
Relocation Needed[1] (acres)	19	19	19	19
Replacement Structures (square feet)	41,000	52,800	68,900	68,900

Table 2-15. Recreation Facilities to be Modified or Relocated Under Action Alternatives (contd.)

Recreation Facilities	CP1	CP2	CP3 and CP4	CP5
Trailheads/Trails				
Number of Affected Facilities (trailheads/trails)	2/9	2/9	2/9	2/9
Relocation Needed[1] (miles)	8.1	9.9	11.6	11.6
Recreation Enhancement[3] (trailheads/trails[miles])	-	-	-	6/18

Note:
[1] Does not include on-site modification of facilities.
[2] For some trails, trailheads are integrated into other recreation facilities. Estimates for standalone trailheads only.
[3] Additional recreation facilities for Alternative CP5 only.
Key:
- = not applicable
CP = comprehensive plan
USFS = U.S. Department of Agriculture, Forest Service

Table 2-16. Recreation Demolition and Construction Material Quantities for Action Alternatives

Material	CP1	CP2	CP3, CP4, and CP5
Recreation Facilities			
Imported Fill (cubic yards)	236,200	384,200	552,800
Excavation to Waste (cubic yards)	592,300	430,600	315,400
Structure Demolition (square feet)	130,700	146,700	164,200
Demolition Waste (cubic yards)	99,200	102,100	105,200

Key:
CP = comprehensive plan

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

Marinas and public boat ramps that could not be modified in place would be relocated to adjacent areas that can provide the necessary grade and access for ramps. To maintain current recreation capacity of public boat ramps and/or marinas, the following potential new or expanded areas could be used:

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

Resort Modifications Raising Shasta Dam would affect approximately six resorts around the reservoir to some degree. Inundated structures and structures within 3 vertical feet of the new full pool would be demolished. Septic systems would also be demolished, and remaining structures would either be connected to new localized wastewater treatment facilities or be relocated to other septic systems. To maintain the current recreation capacity of the resorts, the Antlers Concession Area could be used.

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

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

The following potential new or expanded areas could be used to meet the need for boat-in campgrounds:

- Lakeview Marina Area
- Monday Flat Boat-In Camp

The following potential new or expanded areas could be used to meet the need for day-use areas:

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

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

Nonrecreation Structures Under all SLWRI comprehensive plans, nonrecreational residential and commercial structures affected by inundation would require demolition. These structures would be demolished by appropriately licensed contractors. All utilities would be disconnected, capped, and/or removed per permit requirements and governing utility standards. The structure and foundation would then be demolished. Asbestos material, if discovered, would be removed and taken to an approved landfill for disposal per permit requirements. General demolition waste would also be removed and trucked to an approved landfill. Table 2-17 shows the total volume of demolished material for nonrecreational structures by comprehensive plan.

Table 2-17. Nonrecreation Structures Demolition Quantities for Action Alternatives

Demolition	CP1	CP2	CP3, CP4, and CP5
Structure Demolition (square feet)	8,700	21,500	27,000
Total Volume of Material (cubic yards)	1,300	3,200	4,000

Key:
CP = comprehensive plan

Utilities and Miscellaneous Minor Infrastructure Gas/petroleum facilities, potable water facilities, power and telecommunications infrastructure, and wastewater facilities would be relocated if affected physically by inundation or if the facilities (such as septic systems) would no longer meet Shasta County

Development Standards. The relocation numbers or lengths of facility features to be relocated during proposed utility relocations are shown for each comprehensive plan in Table 2-18. New facilities would be designed and constructed in accordance with applicable Federal, State, and local codes and requirements. Relocated facilities would be of the same types, sizes, and materials as existing facilities where feasible. For relocation of wastewater treatment facilities, new septic systems may be constructed on the property if they meet Shasta County requirements for separating septic systems from the lake. Otherwise, the comprehensive plans include facilities for pressurized sewer collection systems to transport wastewater flows to centralized package wastewater treatment plants.

Demolished facilities would not be reused to construct relocated facilities. Demolished and relocated utilities are summarized as part of the detailed description of each action alternative. The approach and methodology for demolition, design, and relocation criteria for each category of utilities are discussed in greater detail in the Engineering Summary Appendix.

Table 2-18. Physical Features for Proposed Utilities Relocations for Action Alternatives

Utility Type	CP1	CP2	CP3, CP4, and CP5
Potable Water Facilities			
Length of Waterlines Relocated (linear feet)	7,200	8,500	11,000
Wells/Tanks Relocated (number)	12	13	10
Pump Stations Relocated (number)	2	2	3
Length of Waterline Demolished (linear feet)	8,900	11,200	14,800
Wells/Tanks Demolished (number)	16	28	25
Pump Stations Demolished (number)	2	2	3
Gas/Petroleum Facilities			
Tanks Relocated (number)	7	10	10
Tanks Demolished (number)	7	10	10
Wastewater Facilities			
Septic Systems Relocated[1] (number)	14	19	19
Vault/Pit Toilets Relocated (number)	2	2	2
Pump Stations Relocated (number)	1	1	1
Length of Wastewater Pipe Relocated (linear feet)	400	400	430
Septic Systems Demolished[2] (number)	211	239	266
Vault/Pit Toilets Demolished (number)	2	2	2
Pump Stations Demolished (number)	2	2	2
Length of Wastewater Pipe Demolished (linear feet)	2,300	2,300	2,400
Package Wastewater Treatment Plants[3] (number)	Up to 6	Up to 6	Up to 6

Table 2-18. Physical Features for Proposed Utilities Relocations for Action Alternatives (contd.)

Utility Type	CP1	CP2	CP3, CP4, and CP5
Power Distribution Facilities			
Power Lines Relocated (linear feet)	30,300	36,300	37,800
Power Towers Relocated (number)	6	6	6
Power Lines Demolished (linear feet)	26,400	33,700	36,200
Power Towers Demolished (number)	6	6	6
Telecommunications			
Copper Wire Relocated (linear feet)	27,900	30,200	33,400
Fiber-Optic Cable Relocated (linear feet)	4,300	5,800	5,800
Copper Wire Demolished (linear feet)	23,600	27,800	31,200
Fiber-Optic Cable Demolished (linear feet)	3,600	5,200	5,200

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

Spawning Gravel Augmentation Under CP4 and CP5

Under CP4 and CP5, gravel augmentation would occur at one to three locations between Keswick Dam and the RBPP every year for a period of 10 years, unless unusual conditions or agency requests precluded placement during a single year. Construction activities would vary significantly by location, but generally would include clearing, grubbing, and some grading of new access routes to allow construction vehicles to access the river. At several locations, clearing and grubbing of the riverbank would be required to allow gravel to be placed on the bank for recruitment. Gravel would be delivered to the locations by dump trucks. In most cases, gravel would be stockpiled in a staging area and moved with bulldozers, loaders, and/or excavators. Dust control trucks would be present during all construction activities.

Several locations would require in-water construction work. Generally, this involves building gravel out into the river channel “step-wise,” meaning that gravel is dumped and leveled, and the leveled area serves as a working platform for the next step of construction. This practice is common for spawning gravel placement, and minimizes the extent to which construction vehicles drive directly through an active river channel. One or two locations, however, would require construction activity in the active river channel, where construction vehicles would deposit gravel and raise the grade of the river near existing riffles.

Riparian, Floodplain, and Side Channel Habitat Restoration Under CP4 and CP5

Under CP4 and CP5, riparian, floodplain, and side channel habitat restoration would be constructed at one or more suitable locations along the upper Sacramento River to benefit anadromous fish and other aquatic and riparian species. Several potential sites exist along the upper Sacramento River between Keswick Dam and RBPP that would be suitable for these restoration measures. Construction activities for riparian, floodplain, and side channel habitat restoration would vary depending on the location or locations selected and type of restoration measure to be implemented at the site. In general, construction activities would include earth moving activities with bulldozers, loaders, excavators, and/or compactors. Vegetation removal may also be necessary at some sites, either for channel deepening/widening, or where water with aquatic vegetation is present in a channel pending modification.

Special precautions for restoration at these sites will primarily involve:

- Maintaining the active spawning areas in proximity to the site
- Avoiding the creation of habitat for predacious fish
- Minimal disruptions to navigability of the river
- Preventing the spread of invasive, non-native plant species
- Ensuring the safety of homes located along the Sacramento River downstream of the sites

The following are examples of construction measures proposed for restoration of riparian, floodplain, and side channel habitat at each of the potential restoration sites.

Henderson Open Space An existing side channel to the main stem of the Sacramento River would be enhanced to activate the frequency and duration of flows for Chinook salmon spawning habitat throughout a portion of Henderson Open Space Park. The enhancement would involve modifying the northern opening to the existing side channel to restore connectivity with the river at flows greater than 8,000 cfs. Minor grading and channel slope modification would be necessary to rework the existing (sometimes inundated) channel to a point at which flows may be activated for spawning habitat.

The existing Henderson Open Space side channel is heavily vegetated. Floodplain terraces and adjacent riparian areas would be replanted with native vegetation after the completion of earth-moving activities. A more detailed site analysis would determine the mix, composition, and density of the riparian vegetation plantings. To varying degrees, temporary fencing and irrigation would be necessary to protect and sustain newly established riparian vegetation.

Tobiasson Island A regularly flowing side channel would be created to increase spawning habitat for all runs of Chinook salmon at Tobiasson Island. Creating this side channel would involve excavating a trapezoidal-shaped channel, the base of which would correspond to an elevation that would allow flows of 5,000 cfs or greater to enter the side channel, hence hydraulically connecting it to the Sacramento River. If created, this new side channel would add approximately 1,350 linear feet of salmonid spawning habitat to this section of the Sacramento River.

The potential site for the channel to be cut does not currently have flowing water or riparian vegetation: therefore, vegetation removal would not be necessary. However, upon completion of earth-moving activities, it would be necessary to establish native vegetation throughout the side channel on the newly created floodplain terraces. A more detailed site analysis would determine the mix, composition, and density of the riparian vegetation plantings. Temporary irrigation and fencing for vegetation planting at this site is not feasible because the site lacks water supply and electricity.

Shea Island Complex Restoration at the Shea Island Complex would involve lowering a section of the upstream end of the major side channel through the site. The objective would be to keep water moving through the channel when the Sacramento River reaches flows of 10,000 cfs or greater, thus enhancing salmonid spawning habitat.

Additionally, removal of vegetation and debris would be necessary in both the excavated portion of the channel and other portions of the channel to insure the connectivity of flows. Minor grading activity could increase channel complexity along the length of the corridor. Upon completion of earth-moving activities, it would be necessary to establish native vegetation throughout the side channel on the newly created floodplain terraces. A more detailed site analysis would determine the mix, composition, and density of the riparian vegetation plantings. Temporary irrigation and fencing for vegetation planting at this site is because the site lacks a water supply and electricity.

Kapusta Island An existing side channel on Kapusta Island would be enhanced to increase spawning habitat for winter-run and spring-run Chinook salmon in the Sacramento River. This enhancement would involve lowering the channel bed so that the channel may be hydraulically connected to the Sacramento River when the river is flowing in excess of 10,000 cfs.

A trapezoidal cut would need to occur along the course of the side channel, which is inundated only infrequently; in addition, vegetation and debris would need to be removed. Upon completion of earth-moving activities, establishing vegetation on new floodplain terraces and adjacent riparian areas with native plants would be necessary. A more detailed site analysis would determine the mix, composition, and density of the riparian vegetation plantings. Temporary fencing or irrigation at this site for newly established riparian vegetation is highly infeasible and a planting mix would need to be selected with this limitation in mind.

Anderson River Park Restoring floodplain, riparian and side channel habitat at Anderson River Park would involve altering a relic Sacramento River side channel located in the southeastern portion of the park at river flows of, or above 8,000 cfs or more. The side channel rearing habitat would be created by altering the upstream end of the side channel to capture flows. At present, the side channel is seasonally inundated, but likely by way of seepage from the river through alluvial material. Riparian vegetation and appurtenant biota are at this site; therefore, removal of vegetation to lower the channel bed would be necessary, followed by post excavation replanting of native riparian vegetation.

Reading Island Restoring floodplain, riparian, and side channel habitat at Reading Island would involve hydraulically reconnecting Anderson Creek with the Sacramento River at flows ranging between 4,000 cfs and 6,000 cfs. To restore Sacramento River flows through Anderson Creek, it would first be necessary to breach the levee that creates Anderson Slough. Additionally, clearing and excavation of the side channel would be necessary to ensure flows through the channel. This would involve removing vegetation and debris and deepening the existing channel.

After excavation, floodplain terraces and adjacent riparian areas would need to be vegetated with native plants. This would require temporary irrigation and fencing to sustain plantings and keep livestock off site. A more detailed site analysis would determine the mix, composition, and density of the riparian vegetation plantings.

Shasta Lake Tributary and Shoreline Enhancement Under CP5

Structural enhancements associated with CP5 include placing brush structures constructed from whiteleaf manzanita (*Arctostaphylos manzanita*) in the Shasta Lake littoral zone. Because of manzanita's density, installation would not require using anchor or cabling techniques that could result in ancillary negative impacts (e.g., maintenance, hazards to boaters). The brush structures would be assembled in the drawdown zone of the reservoir in an area that would be inundated as the reservoir surface elevation rises in fall. The brush structures are expected to be about 1,800 cubic feet in size. The establishment period would be the first year after construction; life span of the brush structures is projected to be 10 years.

Table 2-19 identifies the general area, number, and size of proposed structural enhancement locations for the main body of Shasta Lake, and the Pit, Sacramento, McCloud, Big Backbone, and Squaw arms. Selection of specific locations has been deferred so that enhancement locations are consistent with other project objectives. The level of proposed treatment is based on the proportion of available manzanita surrounding Shasta Lake. In general terms, these locations would incorporate available material at locations with preferred topographic features; preferred locations are coves that offer steep drawdown areas during the primary use period (spring, early summer).

Table 2-19. Proposed Structural Enhancement of Shasta Lake's Main Body and by Arms Under CP5

Area	Area Treated (acres)	Number of Locations
Main Body	17	595
Pit	12	420
Sacramento	43	1,505
McCloud	8	280
Big Backbone	3	105
Squaw	17	595
Total	**100**	**3,500**

Vegetative enhancements associated with CP5 include planting willows to enhance nearshore fish habitat, and aerial and hand seeding of annual cereal grains to treat shoreline areas at Shasta Lake.

More than 30 acres could be available to enhance the willow recruitment adjacent to Shasta Lake. Rooted willows would be planted in draws and other moist sites, such as springs, to provide long-term live cover. The establishment period for willows would be the first year after construction; life span is projected to be 5 to 50 years. The establishment period for cereal grains would also be the first year of construction, with the life span projected to be 1 to 3 years. This approach would require native seed and nursery stock; several years of advanced preparation would be needed before planting could take place.

Table 2-20 summarizes proposed enhanced treatment with native willows and grasses for the main body of Shasta Lake and by the lake's arms.

Table 2-20. Proposed Vegetative Enhancement Treatment of Shasta Lake's Main Body and Arms under CP5

Area	Willow Planting (acres)	Native Grass Seeding (acres)
Main Body	1	2
Pit Arm	1	4
Sacramento Arm	7	4
McCloud Arm	1	2
Big Backbone Arm	3	2
Squaw Arm	1	2
Total	**14**	**16**

Construction Staging

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

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

Construction Schedule, Equipment, and Workforce

The total duration of construction for major facilities is estimated to range from 4.5 to 5 years for all comprehensive plans. An overlap is expected in the timing of some of the construction components. Construction would be phased, when feasible, to avoid environmental impacts.

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

Daily highway truck trips would be required to bring construction material to the site, and carry construction debris and waste material to a suitable landfill. Estimated daily highway truck trips for each comprehensive plan are shown in Table 2-21. Table 2-21 also shows the estimated construction period and annual construction labor force for each comprehensive plan.

Table 2-21. Estimated Construction Period, Truck Trips, and Construction Labor Force for Action Alternatives

Construction Item	CP1	CP2	CP3	CP4	CP5
Construction Period (years)	4.5	5	5	5	5
Construction Labor Force (number/year)	300	300	350	350	360
Daily Truck Trips for Materials (trips/day)	95	118	168	175	177
Daily Truck Trips for Waste (trips/day)	75	56	52	53	54
Total Daily Truck Trips (trips/day)	170	173	220	228	230

Key:
CP = comprehensive plan

Borrow Sources

Multiple borrow sources are available to meet project needs for concrete, sand and gravel, core and homogenous fill, shell fill, riprap, and filter and drain materials for reservoir area embankments. Potential borrow sources were examined at a preliminary level and would need further sampling and testing to determine suitability and refine quantity estimates. Potential borrow sources include areas of the dike construction sites, areas located below the reservoir's inundation zone, and commercial sources. Commercial sources are located within approximately 2 to 30 miles of the Bridge Bay site, and within approximately 15 to 43 miles of the Lakeshore sites. Potential borrow sources are identified in Figure 2-6. Available fill material from potential borrow sources are described in the Engineering Summary Appendix.

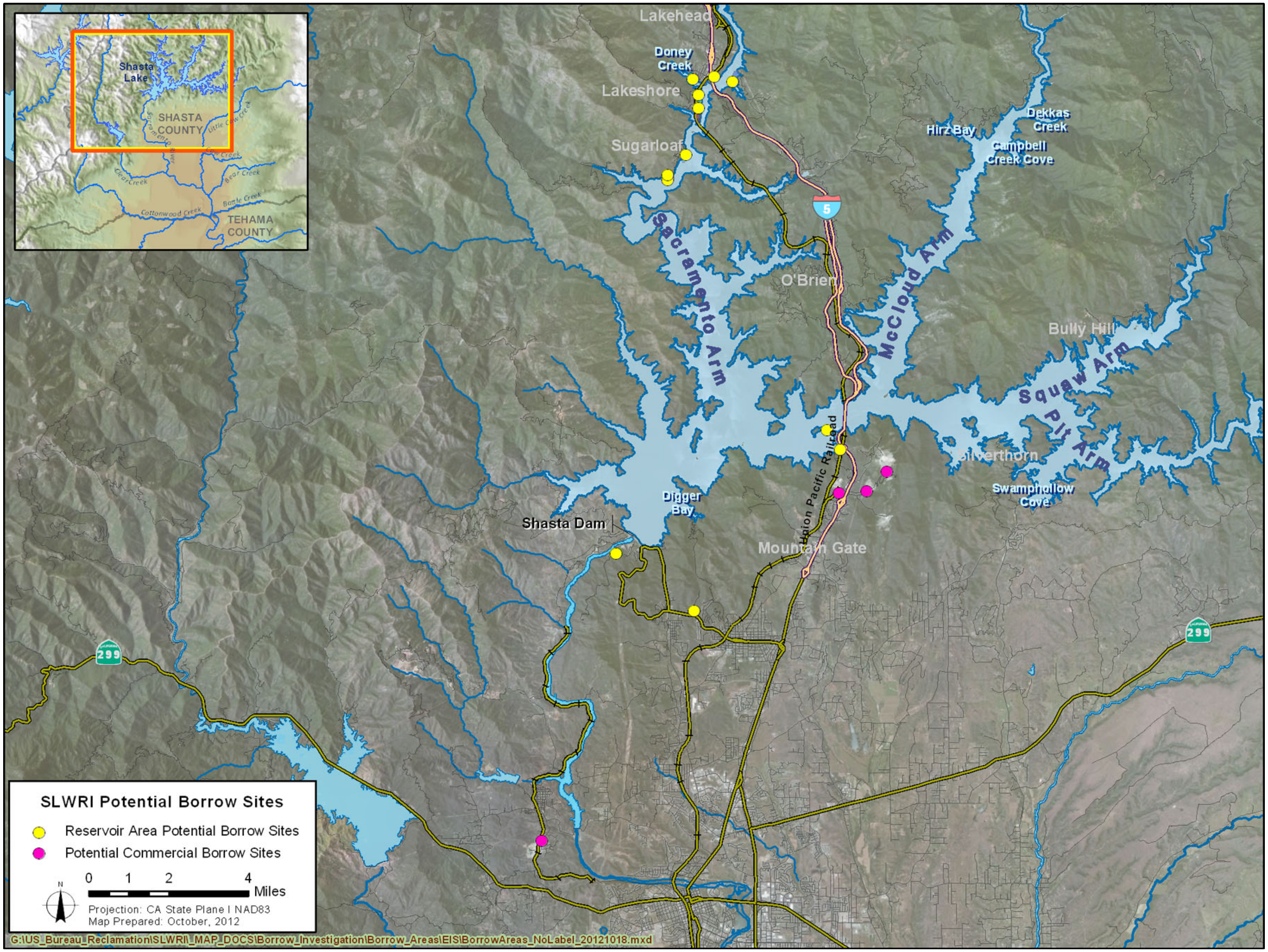

Figure 2-6. Potential Borrow Sources

2.4 Alternatives Considered and Eliminated from Further Analysis

Alternatives considered but eliminated from further analysis are described below. The plans described were developed during the initial plans phase, and the comprehensive plans phase, consistent with the alternatives development process discussed previously.

In addition to the alternatives described below, more than 60 potential management measures, shown in Table 2-1, were identified, evaluated, and screened as part of the SLWRI plan formulation process to address the primary and secondary planning objectives and satisfy the other applicable planning constraints, considerations, and criteria. These management measures included constructing new reservoirs in other locations, such as on the Sacramento River upstream from Shasta Reservoir, on tributaries downstream from Shasta Dam (e.g., Cottonwood Creek and Auburn Dam Projects), and offstream near the Sacramento River downstream from Shasta Dam (e.g., Sites Reservoir). Management measures deleted from further consideration were summarized previously and are described in detail in the Plan Formulation Appendix, along with reasons for deleting measures from further consideration and development.

2.4.1 Initial Alternatives Phase

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

- **AFS-1 – Increase Cold Water Assets with Shasta Operating Pool Raise (6.5 feet).** AFS-1 focused on maintaining cooler water temperatures in the upper Sacramento River by increasing the minimum end-of-October carryover storage target. This would allow additional cold water to be stored for use in the following year. No changes would be made to the existing seasonal temperature targets for anadromous fish on the upper Sacramento River, but the ability to meet these targets would be improved.

  It was found that AFS-1 had a significant potential to benefit anadromous fish in the upper Sacramento River, but there would be no additional increase in water supply reliability. This plan had two major components: (1) Raising Shasta Dam by 6.5 feet for the primary purpose of enlarging the cold-water pool and regulating water temperature in the upper Sacramento River: and (2) increasing the size of the minimum operating pool to 880,000 acre-feet.

  AFS-1 was not retained for further development as a stand-alone plan because, although it had considerable benefits for anadromous fish survival, it did not meet the primary planning objective of increasing water supply reliability.

- **AFS-2 – Increase Minimum Anadromous Fish Flow with Shasta Enlargement (6.5 feet).** AFS-2 focused on the primary planning objective of anadromous fish survival by using the additional reservoir storage to increase minimum seasonal flows in the upper Sacramento River from the current 3,250 cfs to about 4,200 cfs. The primary component of AFS-2 included raising Shasta Dam by 6.5 feet for the primary purpose of enlarging the volume of water available to meet minimum flows for winter-run Chinook salmon on the upper Sacramento River. No changes would be made to the carryover target volume or minimum operating pool.

  Subsequent evaluation indicated that although increasing minimum flows would be beneficial for fish at various stages of development, it would be detrimental at other life stages. Accordingly, this plan was deleted from further development.

- **AFS-3 – Increase Minimum Anadromous Fish Flow with Shasta Enlargement (6.5 feet) and Restore Aquatic Habitat.** AFS-3 was similar to AFS-2, except that it also involved acquiring, restoring, and reclaiming one or more inactive gravel mines along the upper Sacramento River to restore about 150 acres of aquatic and floodplain habitat. AFS-3 had two major plan components: (1) Raising Shasta Dam by 6.5 feet for the primary purpose of enlarging the volume of water available to meet minimum flows for winter-run Chinook salmon on the upper Sacramento River: and (2) acquiring, restoring, and reclaiming one or more inactive gravel mining operations along the upper Sacramento River to restore about 150 acres of aquatic and floodplain habitat.

  Increasing minimum flows was not found to significantly benefit to anadromous fish, and concerns were expressed regarding significant uncertainties about offstream areas being able to successfully support viable fish spawning and rearing. Further, during public scoping activities in late 2005, little to no interest was demonstrated for restoring inactive gravel mines along the Sacramento River above the current location of the RBPP. Accordingly, this plan element was deleted from further consideration at this time.

- **WSR-3 – Increase Water Supply Reliability with Shasta Enlargement (High Level).** WSR-3 focused on water supply reliability by increasing the volume of water stored in Shasta Lake by the maximum amount technically feasible. WSR-3 had two major components: (1) Raising Shasta Dam by about 202.5 feet for the primary purpose of creating 9.3 MAF of additional storage available for water supply: and (2) major modifications to or replacing, dam appurtenances, including hydropower facilities and the TCD.

Raising the dam to this level would require extensive and very costly reservoir area relocations such as moving the Pit River Bridge, I-5, and UPRR tracks, and would require modifying Keswick Dam and its powerplant. This plan would provide a major increase in water supply reliability, anadromous fish, hydropower, flood damage reduction, and recreation resources. However, the plan is not financially feasible because the construction cost is estimated at more than $6 billion (at October 2008 price levels). Accordingly, WSR-3 was deleted from further development.

- **WSR-4 – Increase Water Supply Reliability with Shasta Enlargement (18.5 feet) and Conjunctive Water Management.** WSR-4 focused on the primary objective of water supply reliability by raising Shasta Dam 18.5 feet in combination with conjunctive water management. WSR-4 had two major components: (1) Raising Shasta Dam by 18.5 feet for the primary purpose of creating 636,000 acre-feet of additional storage available for water supply and (2) implementing a conjunctive water management program, consisting largely of contracts between Reclamation and certain Sacramento River basin water users. The conjunctive water management component included downstream facilities, such as additional river diversions and transmission and groundwater pumping facilities, to facilitate exchanges. Reclamation would provide additional surface supplies to participating CVP users in wet and normal water years, in exchange for reducing deliveries in dry and critical years, when users would rely more on groundwater supplies.

  Preliminary estimates of the conjunctive water management component associated with this alternative indicated that water supply yield could be increased by between 10 and 20 percent. However, few to no fishery benefits would result and no strong indication of non-Federal participation in a conjunctive water management component was identified. Accordingly, WSR-4 was deleted from further consideration.

- **CO-1 and CO-2 – Increase Anadromous Fish Habitat and Water Supply Reliability with Shasta Enlargement (6.5 feet and 18.5 feet).** CO-1 and CO-2 addressed both primary objectives by restoring anadromous fish habitat and raising Shasta Dam. Both CO-1 and CO-2 would dedicate some of the added reservoir space from the dam raise to increasing the minimum carryover storage in Shasta Reservoir to make more cold-water releases for regulating water temperature in the upper Sacramento River. CO-1 and CO-2 had three major components: (1) Raising Shasta Dam by 6.5 feet (CO-1) or 18.5 feet (CO-2), for the purposes of expanding the cold-water pool and creating 260,000 acre-feet (CO-1) or 630,000 acre-feet (CO-2) of additional storage available for water supply; (2) acquiring, restoring, and reclaiming one or more inactive gravel mining operations along the upper Sacramento River to create about 150 acres of aquatic and floodplain habitat, and (3) revising flood control operations to benefit water supply reliability by managing floods more efficiently.

For reasons similar to those described for AFS-3, both CO-1 and CO-2 were eliminated as stand-alone plans, and the gravel mine restoration components of both plans were deleted from further consideration.

- **CO-3 –** Increase Anadromous Fish Flow/Habitat and Water Supply Reliability with Shasta Enlargement (18.5 feet). CO-3 is similar to CO-2, except that a portion of the additional storage would be dedicated to managing flows for winter-run Chinook salmon on the upper Sacramento River. Under this preliminary plan, approximately 320,000 acre-feet would be dedicated to increasing minimum flows from approximately 3,250 cfs to about 4,200 cfs between October 1 and April 30.

  Subsequent evaluation indicated that although increasing minimum flows would be beneficial for fish at various stages of development, it would be detrimental at other life stages. Accordingly, CO-3 was deleted from further development.

- **CO-4 – Multipurpose with Shasta Enlargement (6.5 feet).** This plan addressed both the primary and secondary objectives through a combination of measures, raising Shasta Dam, restoring habitat, and adding recreation facilities in the Shasta Lake area. Enlargement of the reservoir and limited reservoir reoperation would also help improve operations for flood management and recreation. Major components of CO-4 involved increasing water supply reliability with a 6.5-foot dam raise, increasing anadromous fish survival by increasing cold-water pool depth and volume in Shasta Reservoir, and restoring inactive gravel mines and floodplain habitat along the Sacramento River. CO-4 involved further investigation of and potential modifications to the existing TCD at Shasta Dam for enhanced temperature management, and increasing the operational efficiencies of Shasta Dam and Reservoir for water supply reliability and flood control. Finally, the plan involved implementing conjunctive water management, as in WSR-4, constructing shoreline and tributary fish habitat improvements in the Shasta Lake area, and restoring one or more riparian habitat areas between Redding and the current location of the RBPP on the Sacramento River.

CO-4 was eliminated from further consideration primarily because of its low effectiveness and efficiency and redundancies with WSR-1 and CO-5, both of which were recommended for further development.

2.4.2 Comprehensive Plans Phase

The scenarios presented in Tables 2-22 and 2-23, related to the formulation of the anadromous fish survival focus plan (CP4), were eliminated from further consideration during the comprehensive plans phase.

Table 2-22. Eliminated Scenarios Considered to Augment Flows – Anadromous Fish Survival Focus Plan

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

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

Table 2-23. Eliminated Scenarios Considered for Cold-Water Storage – Anadromous Fish Survival Focus Plan

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

Further information about the SLWRI plan formulation process, including detailed descriptions of deleted and retained measures, initial plans, and scenarios used to formulate CP4, are presented in the Plan Formulation Appendix.

2.5 Summary of Potential Benefits of Action Alternatives

Table 2-24 summarizes the overall potential benefits of all comprehensive plans. The quantified benefits were based on modeling efforts that are described in several parts of the DEIS: Chapter 6, “Hydrology, Hydraulics, and Water Management”; Chapter 11, “Fisheries and Aquatic Resources”; Chapter 23, “Power and Energy”; and the Modeling Appendix.

Table 2-24. Summary of Major Benefits of Action Alternatives

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

Notes:
[1] Average annual increase in juvenile Chinook salmon surviving to migrate downstream from the RBPP. Numbers were derived from SALMOD.
[2] Average amount per year for 10-year period.
[3] Total drought period reliability for Central Valley Project and State Water Project deliveries. Does not reflect benefits related to water use efficiency actions included in all comprehensive plans.
[4] Tributary aquatic enhancement provides for the connectivity of native fish species and other aquatic organisms between Shasta Lake and its tributaries. Estimates of benefits reflect only connectivity with perennial streams and do not reflect additional miles of connectivity with intermittent streams.
[5] Annual recreation visitor user days were estimated using two methodologies. The maximum value is reported to capture the largest potential effects from increased visitation. These values do not account for increased visitation due to modernization of recreation facilities associated with all comprehensive plans. Annual visitation for National Economic Development analysis may be refined for the Draft Feasibility Report.

Key:
- = not applicable
CP = comprehensive plan
Delta = Sacramento-San Joaquin Delta
GWh/year = gigawatt-hours per year
NOD = north of Delta
SOD = south of Delta
SLWRI = Shasta Lake Water Resources Investigation
RBPP = Red Bluff Pumping Plant
TAF = thousand acre feet

2.6 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. The basis for selecting the recommended plan/preferred alternative is to be fully reported and documented, including the criteria and considerations used in selecting a recommended course of action by the Federal Government. It is recognized that most of the activities pursued by the Federal Government will require assessing trade-offs by decision makers and that in many cases, the final decision will require judgment regarding the appropriate extent of monetized and nonmonetized effects.

The needed rationale to support Federal investment in water resources projects is described in the 2009 Council on Environmental Quality's Draft *Proposed National Objectives, Principles, and Standards for Water and Related Resources Implementation Studies (CEQ 2009)*:

> *The presentations shall summarize and explain the decision rationale leading from the identification of need through the recommendation of a specific alternative. This shall include the steps, basic assumptions, analysis methods and results, criteria and results of various screenings and selections of alternatives, peer review proceedings and results, and the supporting reasons for other decisions necessary to execute the planning process. The information shall enable the public to understand the decision rationale, confirm the supporting analyses and findings, and develop their own fully-informed opinions and/or decisions regarding the validity of the study and its recommendations.*
>
> *Opportunities shall be provided for public reaction and input prior to key study decisions, particularly the tentative and final selection of recommended plans. The above information shall be presented in a decision document or documents, and made available to the public in draft and final forms. The document(s) shall demonstrate compliance with the National Environmental Policy Act (NEPA) and other pertinent Federal statutes and authorities.*

Consistent with the above CEQ guidance and NEPA guidelines, the preferred alternative for implementation will be identified in the Final EIS. The preferred alternative is not identified in this DEIS. Because the preferred alternative has not been determined at this time, the potential effects of all alternatives are described at a similar level of detail.

The preferred alternative will be identified in the Final EIS in consideration of public, stakeholder, and agency comments on this DEIS. Ultimately, the alternative that best meets the stated objectives and maximizes net public benefits will be identified with supporting rationale and documentation. The alternative recommended for implementation may or may not be identified as the "Environmentally Preferable Alternative" consistent with NEPA, the "National Economic Development (NED) Plan" consistent with the Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies, the "Least Environmentally Damaging Practicable Alternative" consistent with the CWA, and the "Environmentally Superior Alternative" consistent with CEQA.

Chapter 3 Considerations for Describing Affected Environment and Environmental Consequences

3.1 Introduction

Chapters 4–25 of this DEIS are organized by environmental resource area. Each chapter discusses the affected environment and potential environmental consequences (short- and long-term impacts, direct and indirect impacts, and mitigation measures, and cumulative impacts) that could result from implementing the proposed action alternatives. Additional details about the affected environment are available for some resource areas in the technical reports; see the appendices to this DEIS.

3.2 Chapter Contents and Definition of Terms

Chapters 4–25 are organized into the following resource and issue areas:

- **Chapter 4 –** Geology, Geomorphology, Minerals, and Soils
- **Chapter 5 –** Air Quality and Climate
- **Chapter 6 –** Hydrology, Hydraulics, and Water Management
- **Chapter 7 –** Water Quality
- **Chapter 8 –** Noise and Vibration
- **Chapter 9 –** Hazards and Hazardous Materials and Waste
- **Chapter 10 –** Agriculture and Important Farmlands
- **Chapter 11 –** Fisheries and Aquatic Ecosystems
- **Chapter 12 –** Botanical Resources and Wetlands
- **Chapter 13 –** Wildlife Resources

- **Chapter 14 –** Cultural Resources
- **Chapter 15 –** Indian Trust Assets
- **Chapter 16 –** Socioeconomics, Population, and Housing
- **Chapter 17 –** Land Use and Planning
- **Chapter 18 –** Recreation and Public Access
- **Chapter 19 –** Aesthetics and Visual Resources
- **Chapter 20 –** Transportation and Traffic
- **Chapter 21 –** Utilities and Service Systems
- **Chapter 22 –** Public Services
- **Chapter 23 –** Power and Energy
- **Chapter 24 –** Environmental Justice
- **Chapter 25 –** Wild and Scenic River Considerations for McCloud River

For some of these resource and issue areas, there is also an appendix containing a technical report of the same name. The technical reports describe the affected environment in more detail than the summarized information presented in the main body of this DEIS. Related modeling results are presented, where appropriate, in the Modeling Appendix.

3.2.1 NEPA Requirements

Council on Environmental Quality (CEQ) regulations for implementing NEPA include the following requirements for an EIS (Title 40, Section 1502.15 of the Code of Federal Regulations (40 CFR 1502.15)):

> *[An] EIS shall succinctly describe the environment of the area(s) to be affected or created by the alternatives under consideration. The descriptions shall be no longer than is necessary to understand the effects of the alternatives. Data and analyses in a statement shall be commensurate with the importance of the impact, with less important material summarized, consolidated, or simply referenced.*

On February 18, 2010, CEQ issued guidance on including greenhouse gas (GHG) emissions and climate change impacts in environmental review documents under NEPA. CEQ guidance suggests that Federal agencies consider opportunities to reduce GHG emissions caused by proposed Federal actions, adapt their actions to climate change impacts throughout the NEPA process, and address these issues in the agencies' NEPA procedures. The following are the two main factors to consider when addressing climate change in environmental documentation:

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

CEQ notes that "significant" national policy decisions with "substantial" GHG impacts require analysis of their GHG effects. That is, the GHG effects of a Federal agency's proposed action must be analyzed if the action would cause "substantial" annual direct emissions; would implicate energy conservation or reduced energy use or GHG emissions; or would promote cleaner, more efficient renewable-energy technologies.

3.2.2 Approach to Affected Environment

Chapters 4–25 provide an overview of the existing physical environment and socioeconomic conditions that could be affected by the five action alternatives and the No-Action alternative considered in this DEIS. This information was obtained from technical studies prepared by Reclamation for some resource and issue areas; those studies are attached to this DEIS. Additional information was obtained from published environmental and planning documents, books, Web sites, journal articles, field surveys, and communications with technical experts. Descriptions of the affected environment are organized by geographic region. Conditions in the primary study area – Shasta Lake and vicinity and the upper Sacramento River (Shasta Dam to Red Bluff) – are described first. These discussions are followed by descriptions of conditions in the extended study area, which consists of the lower Sacramento River and Delta and CVP/SWP facilities and water service areas.

In certain resource areas, the geographic regions are organized slightly differently than how they are defined in Chapter 1. For example, when effects would occur solely because of operational changes, the Trinity, American, and Feather rivers may all be discussed with the geography for CVP/SWP facilities and service areas, because the impacts would be similar in nature.

3.2.3 Methods and Assumptions

Chapters 4–25 analyze the direct and indirect effects of the No-Action Alternative and comprehensive plans (i.e., action alternatives) for each environmental resource area. Direct effects are those that would be caused by the action and would occur at the same time and place. Indirect effects are reasonably foreseeable consequences that may occur at a later time or at a distance from the project area. Examples of indirect effects are growth inducement or other effects related to changes in land use patterns, population density, or growth rate, and related effects on the physical environment.

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

An environmental document prepared to comply with NEPA must consider the context and intensity of the environmental effects that would be caused by, or result from, the proposed action. Under NEPA, the significance of an effect is a determining factor in whether an environmental impact statement must be prepared. An environmental document prepared to comply with CEQA must identify the significance of the environmental effects of a proposed project. As stated in Section 15382 of the State CEQA Guidelines, a "[s]significant 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."

CVP and SWP Operational Assumptions

Reclamation and DWR use CalSim-II, a specific application of the Water Resources Integrated Modeling System (WRIMS) to Central Valley water operations, to study operations, benefits, and effects of new facilities and operational parameters for the CVP and SWP. In this DEIS, the quantitative assessment of actions related to water resources relied primarily on two CalSim-II baselines for CEQA and NEPA:

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

Operational assumptions for refinement, modeling, and evaluation of potential effects of the No-Action Alternative and action alternatives included in this DEIS were derived from the:

- The Reclamation 2008 *Biological Assessment on the Continued Long-Term Operations of the CVP and SWP* (2008 OCAP BA) (Reclamation 2008)
- The USFWS 2008 *Formal ESA Consultation on the Proposed Coordinated Operations of the CVP and SWP* (2008 USFWS BO) (USFWS 2008)

- The NMFS 2009 *BO and Conference Opinion on the Long-Term Operations of the CVP and SWP* (2009 NMFS BO) (NMFS 2009)
- Coordinated Operations Agreement between Reclamation and DWR for the CVP and SWP, as ratified by Congress (Reclamation and DWR 1986)

As Reclamation has advanced the SLWRI, the environmental, hydrologic, and regulatory conditions in the Sacramento River basin and Delta have changed considerably. Among these changes have been substantial declines in the populations of key fish species that use the basin's waterways and the Delta, such as the delta smelt and Chinook salmon. These changes have led to a series of documents and decisions that have affected CVP and SWP operations. This section describes historical decisions related to CVP and SWP operations and the ways in which they have influenced the SLWRI.

In June 2004, Reclamation prepared the 2004 Operations Criteria and Plan (OCAP) to provide a description of facilities and the operating environment of the CVP and SWP. Using operational information presented in the 2004 OCAP, Reclamation and DWR developed the 2004 OCAP Biological Assessment (BA), prepared as part of the consultation process required by Section 7 of the Federal Endangered Species Act (ESA).

Reclamation consulted with NMFS and USFWS on the 2004 OCAP, and the two agencies issued the 2004 NMFS Biological Opinion (BO) (NMFS 2004) and 2005 USFWS BO (USFWS 2005), respectively. In 2007, the District Court for the Eastern District of California (District Court), in *Natural Resources Defense Council v. Kempthorne*, found the 2005 USFWS BO to be unlawful and inadequate. In May 2008, in *Pacific Coast Federation of Fishermen's Associations v. Gutierrez*, the District Court found the 2004 NMFS BO to be unlawful and inadequate. The District Court remanded both BOs to the fishery agencies.

In August 2008, Reclamation reinitiated consultation with the fishery agencies based on the 2008 OCAP BA. USFWS issued the 2008 USFWS BO, finding that the long-term operations of the CVP and SWP would jeopardize the continued existence of the delta smelt (USFWS 2008). In June 2009, NMFS issued the 2009 NMFS BO (NMFS 2009), finding that the same operations would jeopardize populations of listed salmonids, steelhead, green sturgeon, and orcas. Because both agencies made jeopardy determinations, both agencies included a Reasonable and Prudent Alternative (RPA) in their BOs.

Several lawsuits were filed challenging the 2008 USFWS BO, the 2009 NMFS BO, and Reclamation's acceptance of the RPA included with each BO (*Consolidated Salmonid Cases*, *Delta Smelt Consolidated Cases*). On November 13, 2009, and March 5, 2010, the District Court concluded that

Reclamation had violated NEPA by failing to perform any NEPA analysis before provisionally adopting the 2008 USFWS RPA and 2009 NMFS RPA. On December 14, 2010, and September 20, 2011, the District Court remanded the 2008 USFWS BO and the 2009 NMFS BO, respectively, to the fishery agencies. The District Court ordered USFWS and Reclamation to prepare a final BO and associated final NEPA document by December 1, 2013. Similarly, the District Court ordered NMFS and Reclamation to prepare a final BO and associated final NEPA document by February 1, 2016.

These legal challenges have resulted in uncertainty with regard to operational constraints for the CVP and SWP. As a result, evaluations of potential effects of the alternatives in the Preliminary DEIS were based on available modeling analysis at that time, which reflected operations described in the 2004 OCAP BA and the Coordinated Operations Agreement between Reclamation and DWR for the CVP and SWP. These analyses were suitable for comparison purposes, and reflected expected variation among the alternatives, including the type and relative magnitude of anticipated impacts and benefits.

In 2012 Reclamation updated the operational assumptions and modeling for the SLWRI to reflect operations described in the 2008 OCAP BA, the 2008 USFWS BO, and the 2009 NMFS BO. These assumptions were used to guide refinement, modeling, and evaluation of alternatives and were used as the basis of analysis in this DEIS. Despite the uncertainty resulting from the ongoing reconsultation process, the 2008 OCAP 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. Furthermore, it is currently anticipated that the final BOs issued by the resource agencies will contain similar RPAs. If ongoing reconsultation results change operational conditions that deviate substantially from the 2008 OCAP BA and the 2008 and 2009 BOs, these changes may be considered in future SLWRI documents.

3.2.4 Significance Criteria

Significance criteria for each resource area are provided in each resource chapter of this DEIS. These criteria are based on the checklist presented in Appendix G of the State CEQA Guidelines; factual or scientific information and data; and regulatory standards of Federal, State, and local agencies. These criteria also encompass the factors taken into account under NEPA to determine the significance of an action in terms of the context and the intensity of its effects.

3.2.5 Impact Comparisons and Definitions

Mechanisms that could cause impacts are discussed for each issue area. General categories of impact mechanisms are construction and activities related to future operation and maintenance, as described in Chapter 2, “Alternatives.” Project-related impacts are categorized as follows, to describe the intensity or duration of the impact:

- A **temporary** impact would last less than 3–4 years and typically would occur only during construction.

- A **short-term** impact could occur during construction and could last from the time construction ceases to within 3–5 years after construction.

- A **long-term** impact would last longer than 5 years after the completion of construction. In some cases, a long-term impact could be a permanent impact.

- A **direct** impact is an impact that would be caused by an action and would occur at the same time and place as the action.

- An **indirect** impact is an impact that would be caused by an action but would occur later in time or at another location, yet is reasonably foreseeable in the future.

- A **cumulative** impact is a project's impacts combined with impacts from other past, present, and reasonably foreseeable future projects. A project's incremental impacts are not "cumulatively considerable" solely because other projects would have a significant cumulative impact; rather, the project would also need to contribute considerably to a significant cumulative impact (State CEQA Guidelines, Section 15064(h)(1)).

3.2.6 Impact Levels

The terminology listed below is used to denote the significance of environmental impacts of the No-Action Alternative and action alternatives. This section is intended to allow the use of this DEIS for CEQA purposes.

- **No impact** would occur if the construction, operation, and maintenance of the alternative under consideration would not have any direct or indirect effects on the environment. "No impact" means no change from existing conditions. This impact level does not need mitigation.

- An impact that would not result in a substantial and adverse change in the environment would be **less than significant**. This impact level does not require mitigation under CEQA, even if applicable measures are available.

- A **significant** impact is defined by California Public Resources Code (PRC) Section 21068 as "a substantial, or potentially substantial, adverse change in the environment." Levels of significance can vary by project, based on the change in the existing physical condition. This DEIS uses the CEQA definition of "significant impact."

- A **potentially significant** impact is one that, if it were to occur, would be considered a significant impact as described above; however, the occurrence of the impact cannot be immediately determined with certainty. For CEQA purposes, a potentially significant impact is treated as if it were a significant impact. Therefore, under CEQA, feasible mitigation measures or alternatives to the proposed action must be identified, where applicable, to reduce the magnitude of potentially significant impacts.

- A **significant and unavoidable** impact is a substantial or potentially substantial adverse effect on the environment that cannot be reduced to a less-than-significant level even with any feasible mitigation. Under CEQA, a project with significant and unavoidable impacts could proceed, but the lead agency would be required to do the following:

  - Conclude in findings that there are no feasible means of substantially lessening or avoiding the significant impact in accordance with Section 15091(a)(3) of the State CEQA Guidelines (i.e., California Code of Regulations (CCR) Title 14, Section 15091(a)(3)).

  - Prepare a statement of overriding considerations, in accordance with Section 15093 of the State CEQA Guidelines, explaining why the lead agency would proceed with a project in spite of the potential for significant impacts.

- A **significant cumulative** impact would occur when the project would make a “cumulatively considerable incremental contribution” to an overall significant cumulative impact. If an overall cumulative impact would not be significant, even when the project would make a cumulatively considerable incremental contribution to the cumulative impact, then it is determined that the project would not cause a significant cumulative impact.

- A **beneficial** impact is a positive change or improvement in the environment and for which no mitigation measures are required.

- An impact may have a level of significance that is too uncertain to be reasonably determined. Such an impact would be designated **too speculative for meaningful evaluation**, in accordance with Section 15145 of the State CEQA Guidelines. Where some degree of evidence points to the reasonable potential for a significant effect, the EIS may explain that a determination of significance is uncertain, but is still assumed to be “potentially significant,” as described above. In other circumstances, after thorough investigation, the determination of significance may still be too speculative to be meaningful. This is an effect for which the degree of significance cannot be determined for specific reasons. For example, aspects of the impact itself may be unpredictable or the severity of consequences cannot be known at this time.

3.2.7 Mitigation Development Process and Objectives

Mitigation measures are presented where feasible to avoid, minimize, rectify, reduce, or compensate for significant and potentially significant impacts of the proposed action and alternatives, in accordance with Section 15126.4 of the State CEQA Guidelines and NEPA regulations (40 CFR 1508.20). Each mitigation measure is identified numerically to correspond with the number of the impact being mitigated by the measure. No mitigation measures are needed when an impact is determined to be "less than significant" or "beneficial," or where no impact would occur. Where sufficient feasible mitigation is not available to reduce an impact to a less-than-significant level, the impact is identified as "significant and unavoidable."

3.2.8 Significance After Mitigation

For every impact that would be significant or potentially significant, mitigation is applied, if feasible, to avoid or reduce the impact to a less-than-significant level and one of two conclusions is reached:

- The mitigation would reduce the impact to a less-than-significant level.

OR

- No feasible mitigation exists to reduce the impact to a less-than-significant level, and thus the impact would be significant and unavoidable.

Impact significance is reevaluated after application of mitigation in this DEIS.

3.2.9 Cumulative Effects

This section provides an analysis of overall cumulative effects of the project alternatives and the No-Action Alternative. Cumulative effects are determined by analyzing the potential for project impacts to combine with the impacts of other past, present, and reasonably foreseeable future projects to produce project-related impacts (as defined above). This analysis follows applicable guidance provided by CEQ in *Considering Cumulative Effects under the National Environmental Policy Act* (CEQ 1997) and *Guidance on the Consideration of Past Actions in Cumulative Effects Analysis* (CEQ 2005).

Definitions of Cumulative Effects

The CEQ regulations that implement NEPA provisions define a cumulative effect as "the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (federal or nonfederal) or person undertakes such other actions" (40 CFR 1508.7).

Cumulative impacts can result from individually minor but collectively significant actions over time, and they differ from indirect impacts (40 CFR 1508.8). They are caused by the incremental increase in total environmental effects that occurs when the evaluated project is added to other past, present, and reasonably foreseeable future actions. Cumulative effects can thus arise from causes that are totally unrelated to the project being evaluated, and the analysis of cumulative effects looks at the life cycle of the effects, not the project at issue. These effects can be either adverse or beneficial.

Cumulative impacts are defined in the State CEQA Guidelines (14 CCR Section 15355) as "two or more individual effects which, when considered together, are considerable or which compound or increase other environmental impacts." A cumulative impact occurs from "the change in the environment which results from the incremental impact of the project when added to other closely related past, present, and reasonably foreseeable future projects. Cumulative impacts can result from individually minor but collectively significant projects taking place over a period of time" (14 CCR Section 15355(b)).

Consistent with the State CEQA Guidelines (14 CCR Section 15130(a)), the discussion of cumulative impacts in Chapters 4–25 focuses on significant and potentially significant cumulative impacts. The State CEQA Guidelines (14 CCR Section 15130(b)) state that:

> *The discussion of cumulative impacts shall reflect the severity of the impacts and their likelihood of occurrence, but the discussion need not provide as great detail as is provided for the effects attributable to the project alone. The discussion should be guided by the standards of practicality and reasonableness, and should focus on the cumulative impact to which the identified other projects contribute rather than the attributes of other projects which do not contribute to the cumulative impact.*

Effects of Project Implementation with Climate Change

Each resource area evaluates the effects of SLWRI actions combined with predicted effects of climate change. The ways that the SLWRI could affect GHG production are described in Chapter 5, "Air Quality and Climate." The Climate Change Projection Appendix provides a summary of global climate forecasts and a discussion of the implications of climate change for California water resources. This appendix also includes quantitative analyses of climate change for selected comprehensive plans on resource areas. The discussion of climate change implications provided in the Climate Change Projection Appendix provides context for consideration of cumulative conditions.

Relationship to CALFED Programmatic Cumulative Impacts Analysis

The analysis of cumulative effects in this DEIS considers but does not tier from the cumulative effects assessment in the CALFED Bay-Delta Program (CALFED) Programmatic EIS/EIR. The "Shasta Lake Enlargement" project was included in the cumulative impacts analysis of the CALFED Programmatic EIS/EIR as a project in CALFED's Storage Program (CALFED 2000).

This project-specific analysis considers, but stands alone from and refines, the analysis of cumulative effects in the CALFED Programmatic EIS/EIR (CALFED 2000). This analysis focuses on issues resulting from the effects of the SLWRI combined with other reasonably foreseeable future projects. This DEIS considers CALFED projects that have been implemented, are being implemented, or are reasonably foreseeable future projects. The projects that have been implemented are considered as part of existing conditions; reasonably foreseeable future projects are considered as part of future conditions.

Methods and Assumptions

For purposes of this DEIS, cumulative impacts of an action alternative would be significant if implementing the alternative would make a considerable incremental contribution to a significant cumulative effect. The alternative's contribution is evaluated in combination with the effects of other past, present, and reasonably foreseeable future projects to determine whether (1) the overall cumulative effect would be significant and (2) the alternative's contribution would be considerable. Cumulatively significant impacts would do any of the following:

- Cause a significant adverse effect on a resource (using the criteria for significance described in the "Environmental Consequences and Mitigation Measures" sections of Chapters 4–25 of this DEIS)
- Adversely affect a resource that already has a degraded or declining condition because of substantial adverse effects that have already occurred
- Cause effects that initially were not significant, but would be part of an irreversible degrading or declining trend

Following CEQ guidance, Reclamation has identified associated actions (past, present, or future) that, when viewed with the proposed or alternative actions, may have significant cumulative impacts. Table 3-1 lists the plans, projects, and programs that were considered for each resource area.

The State CEQA Guidelines identify two basic methods for establishing the cumulative environment in which the project is to be considered: using a list of past, present, and probable future projects (the "list approach") or using adopted projections from a general plan, other regional planning document, or certified EIR for such a planning document (the "plan approach"). For this analysis of cumulative impacts, the list approach and the plan approach have been combined in quantitative and qualitative assessments to generate the most comprehensive future projections possible. The methodology for each of these assessments is described following Table 3-1.

Table 3-1. Present and Reasonably Foreseeable Future Actions Included in the Analysis of Cumulative Impacts, by Resource Area

Cumulative Projects
Quantitative
Forecasted 2030 Level of Demands for Water Supplies
Freeport Regional Water Project
Delta Water Supply Project
DWR South Bay Aqueduct Improvement and Enlargement Project
Vernalis Adaptive Management Plan
San Joaquin River Restoration Program – Full Restoration Flows
Grassland Bypass Project
Qualitative Assessment of Actions Related to Water/ Natural Resource Management and Restoration
Central Valley Project Improvement Act
Clear Creek Actions of the CVPIA Anadromous Fish Restoration Program
CALFED Ecosystem Restoration Program
Qualitative Assessment of Actions Related to the 2009 NMFS Biological Opinion
Clear Creek Actions: -Spawning Gravel Augmentation -Spring Creek Temperature Control Curtain -Adaptively Manage to Habitat Suitability/IFIM Study
Fish Passage Program (Action V) at Shasta and Folsom Dams
Sacramento River Basin Salmonid Rearing Habitat Improvements: -Restoration of Floodplain Rearing Habitat -Near Term Actions at Liberty Island/Lower Cache Slough and Lower Yolo Bypass -Lower Putah Creek Enhancements
Giant Garter Snake Recovery Plan
The Water Quality Control Plan for the California Regional Water Quality Control Board: Central Valley Region, the Sacramento River Basin and San Joaquin River Basin
The California Air Resources Board Climate Change Scoping Plan: A Framework for Change
Bay Delta Conservation Plan
San Joaquin River Restoration Program
Trinity River Mainstem Fishery Restoration Program
Sacramento River Conservation Area Forum Program
Iron Mountain Mine Restoration Plan
Draft Invasive Non-Native Plant (Weed) Management Plan for the Mouth of Cottonwood Creek Wildlife Area
Deer Creek Flow Enhancement Program
Lower Deer Creek Falls Fish Passage Improvement Project
Battle Creek Salmon and Steelhead Restoration Project
Butte Regional Conservation Plan
North-of-Delta Offstream Storage Investigation

Table 3-1. Present and Reasonably Foreseeable Future Actions Included in the Analysis of Cumulative Impacts, by Resource Area (contd.)

Cumulative Projects
Fremont Landing Conservation Bank
Yuba Salmon Forum Fish Passage Studies (Upper Yuba River Studies Program)
Davis-Woodland Water Supply Project
North Bay Aqueduct Alternative Intake Project
Lower Clear Creek Anadromous Fish Restoration and Management Project
North Delta Flood Control and Ecosystem Restoration Project
Two-Gates Fish Protection Demonstration Project
Franks Tract Project
Dutch Slough Tidal Marsh Restoration Project
Suisun Marsh Management, Preservation, and Restoration Plan
In-Delta Storage Program (Delta Wetlands Project)
Los Vaqueros Reservoir Expansion Project
East Bay Municipal Utility District Water Supply Management Program 2040
Bay Area Regional Desalination Project
Upper San Joaquin River Basin Storage Investigation (Temperance Flat Reservoir)
San Luis Drainage Reevaluation Program
Central Valley Salinity Alternatives for Long-Term Sustainability Initiative
San Joaquin River Salinity at Vernalis Salt and Boron TMDL and Basin Plan Amendment
B.F. Sisk Dam Corrective Action Project
San Luis Reservoir Low Point Improvement Project
Qualitative Assessment of Actions Related to Flood Management
Central Valley Flood Protection Plan
CALFED Levee System Integrity Program
Sacramento River Bank Protection Project
Folsom Dam Joint Federal Project
Natomas Levee Improvement Program Landslide Improvement Project
West Sacramento Levee Improvement Program
Delta Islands and Levees Feasibility Study

Table 3-1. Present and Reasonably Foreseeable Future Actions Included in the Analysis of Cumulative Impacts, by Resource Area (contd.)

Cumulative Projects
Qualitative Assessment of Actions Related to Energy
Increased Hydropower Generation Capacity at Lewiston Dam
Pacific Gas & Electric Company Pit River 3, 4 & 5 Hydroelectric Projects License Implementation
Pacific Gas & Electric Company McCloud and Pit Rivers 6 and 7 FERC Relicensing
California Department of Water Resources Oroville Facilities FERC Relicensing
Sacramento Municipal Utility District Upper American River Project
Qualitative Assessment of Actions Related to Land Use Planning and Infrastructure
Antlers Bridge Replacement
Jellys Ferry Bridge Replacement

Key:
CALFED = CALFED Bay-Delta Program
CVPIA = Central Valley Project Improvement Act
FERC = Federal Energy Regulatory Commission
IFIM = Instream Flow Incremental Methodology
NMFS = National Marine Fishery Service
TMDL = total maximum daily load

Quantitative Assessments Quantitative assessments were completed for each of the resource areas in this DEIS, where feasible. The effects of actions related to water resources and effects of development projects were assessed quantitatively. Quantitative changes to water resources and air quality were considered qualitatively in the consideration of cumulative impacts on related resources. The methodologies for the quantitative assessments are described below.

Quantitative Assessment of Actions Related to Water Resources In this DEIS, the quantitative assessment of actions related to water resources relied primarily on CalSim-II modeling of hydrologic conditions that could affect the environment. The model was run using two different baselines:

- “Existing conditions,” based on 2005 facilities and demands (a 2005 baseline)
- “Future conditions,” based on forecasted 2030 demands and reasonably foreseeable future projects and facilities (a 2030 baseline)

The 2030 baseline does not account for potential changes in water demands resulting from the effects of climate change. Potential changes in water demand due to climate change are described qualitatively in the “Qualitative Assessments” section. The 2030 baseline includes the following reasonably foreseeable future projects and conditions, described separately below:

- Forecasted 2030 level of demands for water supplies
- Freeport Regional Water Project
- Delta Water Supply Project
- DWR South Bay Aqueduct Improvement and Enlargement Project
- Vernalis Adaptive Management Plan (VAMP)
- San Joaquin River Restoration Program (SJRRP) – Full Restoration Flows
- Grassland Bypass Project

Forecasted 2030 Level of Demands for Water Supplies Reclamation and DWR developed assumptions for evaluating systemwide hydrologic and water supply conditions with CalSim-II under existing and future conditions. Detailed descriptions of the CalSim-II model, the modeling methodology used in evaluations, and key assumptions (including forecasted 2030 facilities and demands) are provided in the Modeling Appendix. For a summary of the analysis and modeling results, see the Hydrology, Hydraulics, and Water Management Technical Report (in the Physical Resources Appendix).

To quantify cumulative effects on hydrologic conditions, modeling runs with No-Action Alternative (2030) conditions were compared to modeling runs with existing (2005) conditions. For example, the No-Action Alternative (2030 baseline) was compared to existing conditions (2005 baseline) to identify the cumulative impacts of reasonably foreseeable future projects and conditions on hydrologic conditions. Similarly, project alternatives were compared to existing conditions (thus satisfying CEQA requirements) and to the No-Action Alternative (2030) (satisfying NEPA requirements) to identify the combined cumulative effect of project alternatives and other foreseeable projects and facilities. The No-Action Alternative (2030) includes forecasted year-2030 demands for water. These forecasted demands are considered to be reasonably foreseeable for determining cumulative impacts.

Freeport Regional Water Project The Freeport Regional Water Project is intended to provide water for East Bay Municipal Utility District (EBMUD) customers in dry years and needed water for the Sacramento region by drawing water from the Sacramento River near the town of Freeport. The project consists of a new 185-million-gallon-per-day water intake structure and pumping plant on the Sacramento River, a new large-diameter pipeline to transport water eastward from the intake to a new Sacramento County Water Agency water treatment plant and to the existing Folsom South Canal. The Freeport Regional Water Project is included only in future conditions for the SLWRI.

Delta Water Supply Project The Delta Water Supply Project provides a new supplemental high-quality water supply for the Stockton metropolitan area. The completed project is intended to replace declining surface water resources, protect groundwater supplies, and provide for current and future water needs in the Stockton metropolitan area. The project includes a new intake and pump station that will divert water from the San Joaquin River through miles of underground pipeline to a new 30-million-gallon-per-day water treatment plant. The project will help meet Stockton's water needs, as detailed in the City of Stockton's general plan, through 2025. The Delta Water Supply Project is included only in future conditions for the SLWRI.

DWR South Bay Aqueduct Improvement and Enlargement Project The South Bay Aqueduct conveys water from the Delta through more than 40 miles of pipelines and canals to the Zone 7 Water Agency and the Alameda County and Santa Clara Valley water districts. Those three water districts, in turn, serve the cities of Livermore, Dublin, Pleasanton, San Ramon, Fremont, Newark, Union City, Milpitas, Santa Clara, and San Jose.

The first conveyance facility constructed for the SWP, the South Bay Aqueduct was designed for a capacity of 300 cfs. Recent flow tests and studies have shown that the actual capacity is 270 cfs. The purpose of the South Bay Aqueduct Enlargement Project is to increase the aqueduct's capacity to 430 cfs to meet the Zone 7 Water Agency's future needs and provide operational flexibility to reduce the SWP's peak power consumption.

The following are the principal features of this project:

- Add four 45 cfs pumps to the South Bay Pumping Plant, and expand the existing plant structure and add a new service bay and switchyard.
- Construct a third (Stage 3) Brushy Creek pipeline and surge tank parallel to the existing two barrels.
- Construct a 500-acre-foot reservoir (425 acre-feet of active storage) to be served by the Stage 3 Brushy Creek Pipeline.
- Raise the height of the canal embankments, canal lining, and canal overcrossing structures and bridges along the Dyer, Livermore, and Alameda canals and at the Patterson Reservoir.
- Modify check structures and siphons along the Dyer, Livermore, and Alameda canals.
- Construct new drainage overcrossing structures to eliminate drainage into the canals.

Construction is proceeding on enlargement of the South Bay Pumping Plant to make room for the four new pump units (DWR 2011a). The South Bay Aqueduct Improvement and Enlargement Project is included only in future conditions for the SLWRI.

Vernalis Adaptive Management Plan The VAMP was proposed under the 1998 San Joaquin River Agreement, which was adopted by the State Water Resources Control Board (SWRCB) in Water Right Decision 1641 (December 1999).

The 12-year VAMP provided for additional flows in the lower San Joaquin River during a 31-day pulse-flow period during April and May. The predicted April 15 San Joaquin River flows at Vernalis were increased by 1 to 2 predefined "steps," ranging from 1,200 cubic feet per second (cfs) to 1,300 cfs between each step. If the average of water-year conditions for the current year and the previous year was a below-normal, dry, or critical condition, then the flows would only be increased to the next step. However, if the average of water-year conditions for the current year and the previous year was a wet, above-normal, or average (i.e. between above normal and below normal) condition, then the flows would be increased by two steps. During a multiple year drought, when the current and previous two water years were comprised of either (1) three critical years or (2) two critical years and one dry year, there would be no required flow increases under VAMP. VAMP flow requirements typically were met either through additional releases or through reductions in demands from the Merced Irrigation District, Oakdale Irrigation District, Mendota Pool Exchange Contractors, Modesto Irrigation District, and Turlock Irrigation District.

Although the VAMP and San Joaquin River Agreement expired in 2011, Reclamation intends to continue implementing actions similar to the VAMP for the foreseeable future, or until the SWRCB adopts new, permanent objectives for San Joaquin River flows that replace the current program. Reclamation is currently implementing a “single-step” VAMP, in which flows are increased by only one step in all water year types. As an interim solution, all flow increases to meet single-step VAMP flow targets are being provided by Merced Irrigation District under a 2-year agreement with Reclamation (covering spring 2012 and spring 2013).

Single-step VAMP operations are reflected in the SLWRI’s modeling of existing conditions. Based on the SWRCB’s October 2011 Technical Report, it is anticipated that new flow objectives will require that a certain percentage of unimpaired inflow (e.g., 20–60 percent) be dedicated for fishery purposes in the February through June time frame on the Stanislaus, Tuolumne, and Merced rivers to accomplish a narrative fish doubling goal consistent with the Central Valley Project Improvement Act (CVPIA) (SWRCB 2011). (See the discussion of the CVPIA in “Qualitative Assessment of Actions Related to Water Resources,” later in this chapter.)

Future SWRCB objectives will likely be as protective as the original VAMP requirements and are anticipated to remain in place through 2030. Accordingly, the SLWRI’s modeling of future conditions has incorporated full VAMP flow requirements.

San Joaquin River Restoration Program – Full Restoration Flows The SJRRP was established in 2006 to implement the Stipulation of Settlement in *NRDC, et al., v. Kirk Rodgers, et al.* (Settlement) (See also the discussion of the SJRRP in “Qualitative Assessment of Actions Related to Water Resources,” later in this chapter.) Federal authorization for implementing the Settlement is provided in the San Joaquin River Restoration Settlement Act, included in Public Law 111-11.

The Settlement calls for releases of water from Friant Dam to the confluence of the Merced River, referred to as Interim and Restoration flows; a combination of channel-related and structural modifications along the San Joaquin River below Friant Dam; and reintroduction of Chinook salmon. Restoration Flows are specific volumes of water to be released from Friant Dam during different year types, according to Exhibit B of the Settlement. Interim Flows are experimental flows that will continue until full Restoration Flows begin, and will collect relevant data about flows, temperatures, fish needs, seepage losses, recirculation, recapture, and reuse.

The release of Interim Flows began in October 2009; however, the release of Interim Flows is limited by channel capacity constraints between Friant Dam and the Merced River confluence. Interim Flows will continue as SJRRP actions are implemented to increase channel capacity, until full Restoration Flows begin (anticipated January 1, 2014), as constrained by then-existing channel capacity (Reclamation 2012). Restoration Flows will include releases from Friant Dam of up to 840 thousand acre-feet, depending on year type. In some years, peak releases from Friant Dam could reach as much as 8,000 cfs for several hours, within the constraints of channel capacity. For the SLWRI, existing conditions include Interim Flows and future conditions include full Restoration Flows.

Grassland Bypass Project The Grassland Bypass Project is a stakeholder initiative designed to improve water quality in the channels used to deliver water to the San Joaquin River and wetland areas in the Grassland watershed. Irrigation of soils containing high levels of salt and selenium has caused high levels of selenium to leach into the subsurface drainage water in the 97,000-acre Grassland Drainage Area. Before the Grassland Bypass Project began, this agricultural drainage water ultimately discharged into the San Joaquin River through Salt Slough, Mud Slough, and other channels used to deliver water to wetland areas in the Grassland watershed. The San Joaquin River is included on the Clean Water Act (CWA) Section 303(d) list of impaired waters as impaired for 18 different pollutants, with total maximum daily load (TMDL) set for 6 of these pollutants within the watershed (selenium, dissolved oxygen, diazinon, chlorpyrifos, salt, and boron). Approximately 8,200 acres of Grasslands watershed marshes, a portion of the lower San Joaquin River (from the confluence with Mud Slough to the Merced River confluence), and Mud Slough are listed on the CWA Section 303(d) list of impaired waters for exceeding water quality objectives for selenium.

The Grassland Bypass Project has been implementing agricultural best management practices and measures to reroute drainage water to reduce total selenium loading to impaired waters. The objectives of the project have been to achieve short-term load reductions by 2010 (partial implementation) and to prohibit all discharges exceeding selenium objectives by 2019 (full implementation). Between 1998 and 2009, best management practices implemented by Grassland area farmers prevented the discharge of more than 22,000 pounds of selenium to listed waters. As a result, Salt Slough and a portion of the lower San Joaquin River have been removed from the 303(d) list of impaired waters. In 2012, the volume of agricultural drainage water discharged from the Grassland Drainage Area into the San Luis Drain was reduced by 12,000 acre-feet through displacement across the San Joaquin River Water Quality Improvement Project reuse area.

For the SLWRI, the water operations models for existing conditions and future conditions include partial implementation and full implementation, respectively, of the Grassland Bypass Project.

Quantitative Assessment of Effects on Air Quality   For this analysis of cumulative impacts, regional impacts on air quality are analyzed quantitatively using the plan approach. As described in Chapter 5, "Air Quality and Climate," significance thresholds for the Shasta County Air Quality Management District (SCAQMD) are defined in the *Shasta County General Plan* (SCAQMD 2004). The analysis of local cumulative impacts is based on both the plan approach, which defines impact thresholds, and the list approach, which identifies projects that may emit pollutants in the same area as the SLWRI. SCAQMD standards for criteria pollutants have been established to limit the emissions of individual projects when considering the cumulative effect of all projects on regional pollutant concentrations. Therefore, a significant direct project impact would also be a cumulatively considerable incremental contribution to a significant cumulative impact.

The 2007 Urban Emissions model (URBEMIS) was used to estimate emissions of pollutants from construction activities. Among the inputs to the model for construction analysis were the types and quantities of construction equipment to be used, along with the hours of use; areas of land to be graded; number of truck trips and trip distances for export of spoils and import of materials; volumes of buildings to be demolished; areas of buildings to be built; and areas of land to be paved. For postconstruction activities, the principal inputs were the number of vehicle trips and average trip distances. The methods and results of this analysis are described in greater detail in Chapter 5, "Air Quality and Climate."

Qualitative Assessments   Past, present, and reasonably foreseeable future actions were assessed qualitatively. Information on current and historical conditions was used to evaluate the combined effects of past actions on resource areas and issues. For present and reasonably foreseeable future actions, a list of related actions was compiled. The combined effects of past, present, and reasonably foreseeable future actions were then evaluated with effects of the project.

A large number of past actions have occurred in the study area. These past actions have strongly influenced existing conditions, and some past actions created "legacies" that are still affecting resources. Among the legacies is the sediment released by hydraulic mining and the metal contamination that is still being generated by abandoned mines. The following are the most important combined effects of these past actions:

- Population growth and associated development of socioeconomic resources and infrastructure

- Conversion of natural vegetation to agricultural and developed land uses
- Introduction of nonnative plant and animal species
- Resource extraction (e.g., mining, grazing, and timber harvests)
- Development of water supply, particularly the construction and operation of Shasta Dam, the rest of the CVP, and the SWP

Present projects and reasonably foreseeable future projects include projects that are currently under construction, approved for construction, or in the final stages of formal planning. The present and reasonably foreseeable future actions considered in this analysis of cumulative impacts are those actions located within the primary or extended study area that have been identified as potentially affecting resources that also may be affected by the SLWRI.

A preliminary list of actions was compiled by reviewing available information regarding planned projects (including agency Web sites). Actions were then reviewed for inclusion in the cumulative impacts analysis based on three criteria:

- The action has an identified sponsor actively pursuing project development; the sponsor has completed or issued NEPA and/or CEQA compliance documents such as a DEIS or DEIR; and the action appears to be “reasonably foreseeable,” given other considerations such as public and stakeholder controversy.
- Available information defines the action in sufficient detail to allow meaningful analysis.
- The action could affect resources that would be potentially affected by action alternatives.

Any action that could affect resources that would be potentially affected by action alternatives and is under construction was also considered “reasonably foreseeable.”

Based on this review, the effects of the actions described below were considered qualitatively in the assessment of cumulative effects of action alternatives. This list is organized into four categories of actions: water resources, resource management and restoration, levee, and development actions. Some unknown subset of the following projects, though not strictly meeting the criteria above, would likely be implemented, such as the Bay Delta Conservation Plan (and associated alternative Delta conveyance facilities), the North-of-Delta Offstream Storage Facility (Sites Reservoir), and the Upper San Joaquin River Basin Storage Investigation (Temperance Flat Reservoir). It would be speculative to consider these projects at any more than a conceptual level because these projects and their effects are not defined in sufficient detail to allow meaningful analysis.

The combined effects of past actions and the list of related present and reasonably foreseeable future projects are described further below.

Qualitative Assessment of Actions Related to Water/Natural Resource Management and Restoration In addition to the water resources actions described above in the section "Quantitative Assessment of Actions Related to Water Resources," the water/natural resources–related management and restoration actions described below were identified as present or reasonably foreseeable.

Central Valley Project Improvement Act The CVPIA (Title 34, Sections 3401 through 3408(h) of Public Law 102-575) is concerned with restoring anadromous fish populations, providing water supplies for Federal and State refuges, mitigating effects of the CVP on other fish and wildlife, and retiring drainage-impaired farmlands. To fulfill these provisions, the CVPIA established an ongoing program creating a fund for restoration actions. The program is financed by the CVP's water and power users and administered by Reclamation. Funds are contributed to multiple restoration actions annually to finance restoration of aquatic, riparian, and other habitats and modify CVP operations.

The CVPIA directs the Secretary of the Interior to develop and implement a program that makes all reasonable efforts to double natural production of anadromous fish in Central Valley streams (Section 3406(b)(1)). The general objectives of the CVPIA Anadromous Fish Restoration Program are as follows:

- Improve anadromous fish habitat through physical habitat parameters as well as suitable flow parameters.
- Reduce the entrainment of juvenile fish at diversions.
- Collect fisheries data in a way that provides for the evaluation of restoration actions.
- Integrate restoration efforts with harvest and hatchery management.
- Involve stakeholders in the implementation and evaluation of restoration actions.

The Clear Creek Actions of the CVPIA Anadromous Fish Restoration Program involve modifying flow releases and replenishing gravels in the river downstream from Whiskeytown Dam to enhance spawning, egg incubation, and emigration by spring-, fall-, and late fall–run Chinook salmon. These actions also include gravel restoration, spring flushing, temperature control, and channel maintenance. Additionally, requirements of the Clear Creek Actions – all implemented to benefit anadromous fish habitat – include restoring habitat damaged by gravel mining in the area, decommissioning McCormick-Saeltzer Dam, developing a stream corridor protection program to prevent habitat degradation caused by sedimentation and urbanization, and developing a watershed management and analysis plan.

CALFED Ecosystem Restoration Program USFWS and NMFS implement CALFED's Ecosystem Restoration Program (ERP) with guidance from the Delta Stewardship Council and the Delta Plan, and in coordination with the Sacramento–San Joaquin Delta Conservancy. The ERP works to improve the ecological health of the Bay-Delta watershed by restoring and protecting habitats, ecosystem functions, and native species. Since the program's inception, ERP agencies have identified more than 600 programmatic actions and 119 milestones throughout the Bay-Delta watershed. The program includes all projects authorized, funded, and permitted (even if not constructed) to date, particularly in the Delta, that aim to do any of the following:

- Recover at-risk native species dependent on the Delta, Suisun Bay, and San Francisco Bay
- Minimize the downward population trends of native species that are not listed
- Protect and restore functional habitat types in the Bay-Delta estuary and its watershed for ecological and public values
- Prevent the establishment of additional nonnative invasive species and reduce the negative ecological and economic impacts of established nonnative species in the Bay-Delta estuary
- Improve and/or maintain water and sediment quality conditions that fully support healthy and diverse aquatic ecosystems in the Bay-Delta estuary and watershed

2009 NMFS Biological Opinion Sacramento River Habitat Restoration and Enhancement and Fish Passage Actions The 2009 NMFS BO included Reasonable and Prudent Alternatives to improve conditions for anadromous fish in the Sacramento River basin. These RPAs included revised water operations, habitat restoration and enhancement actions, and fish passage actions. Water operations defined in RPAs were included in the modeling evaluations for both existing and future conditions, and therefore were included in cumulative effects analyses. However, the following restoration and enhancement actions and fish passage actions for the Sacramento River and its tributaries were not included in existing or future conditions operations modeling. The actions related to the 2009 NMFS BO described below were identified as present or reasonably foreseeable actions.

Clear Creek Actions

Clear Creek RPAs were designed to prevent spring-run Chinook salmon from hybridizing with fall-run Chinook salmon in the Sacramento River. To prevent this hybridization, the following projects have been developed to attract early spring-run adults far upstream in Clear Creek where reservoir holding has maintained cooler water temperatures throughout the summer:

- **Spawning Gravel Augmentation –** This effort includes the continued augmentation of spawning gravels in Clear Creek to enhance spawning habitat for fall-run, late fall-run, and spring-run Chinook salmon as well as steelhead.

- **Spring Creek Temperature Control Curtain –** This project is the replacement of the Spring Creek Temperature Control Curtain in Whiskeytown Lake, in an effort to maintain the Spring Creek Tunnel's releases of cold water to Keswick Reservoir for winter-run Chinook salmon spawning and incubation.

- **Adaptively Manage to Habitat Suitability/ Instream Flow Incremental Methodology Study Results –** This action is to develop a state-of-the-art scientific analysis of habitat suitability to enable the continuation of flows adequate for anadromous fish migration and the maintenance of spawning gravels and suitable water temperatures for anadromous fish survival.

Fish Passage Program (Action V) at Shasta and Folsom Dams

The elements identified in the Fish Passage Program are near-term and long-term goals to provide passage for Sacramento River winter-run, spring-run, and Central Valley steelhead above Shasta and Folsom dams. Substantial areas of high-quality habitat exist above these dams, with colder water in high-elevation areas that represents a suitable refuge for cold-water fish in the face of climate change. The assessment will develop information necessary for consideration and development of fish passage options for the Basalt and Porous Lava Groups of Central Valley steelhead and spring-run Chinook salmon and Sacramento River winter-run Chinook salmon.

Sacramento River Basin Salmonid Rearing Habitat Improvements

This suite of actions consists of near-term and long-term actions to restore floodplain rearing habitat for juvenile winter-run, spring-run, and Central Valley steelhead in the lower Sacramento River basin. These actions are consistent with Reclamation's broad authorities in the CVPIA. The objective may be achieved at the Yolo Bypass, as part of the Bay Delta Conservation Plan (BDCP), or among other actions. The following actions in this suite were not included in modeling analyses for existing conditions, the No-Action Alternative, and proposed action alternatives:

- **Restoration of Floodplain Rearing Habitat –** The intent of this action is to restore floodplain rearing habitat for juvenile winter-run, spring-run, and Central Valley steelhead through a substantial increase in acreage of seasonal floodplain rearing habitat.

- **Near-Term Actions at Liberty Island/Lower Cache Slough and Lower Yolo Bypass –** These actions include the steps necessary to enhance the use of Liberty Island/Lower Cache Slough by juvenile salmonids.

- **Lower Putah Creek Enhancements –** These enhancements, to be completed by the end of 2015, include stream realignment and floodplain restoration for fish passage improvement and multispecies habitat development on existing public lands.

Reduction of Migratory Delays and Loss of Salmon, Steelhead, and Sturgeon at Fremont Weir and Other Structures in the Yolo Bypass Actions

This action involves the completion of planning-related and physical modifications that will provide high-quality, reliable migratory passage through the Yolo Bypass for Sacramento River basin adult and juvenile anadromous fishes. These actions may include steps to provide fish passage by altering Fremont Weir and/or other facility-related or operational requirements of the Sacramento River Flood Control Project or Yolo Bypass facility.

Giant Garter Snake Recovery Plan USFWS is required by Section 4(c)(2) of the ESA to conduct a status review of each listed species at least once every 5 years. A draft recovery plan for the giant garter snake was produced in 1999 (USFWS 1999). The known range of giant garter snake has changed little since the time of its listing (USFWS 2006).

The Water Quality Control Plan for the California Regional Water Quality Control Board: Central Valley Region, the Sacramento River Basin and San Joaquin River Basin The preparation and adoption of water quality control plans (basin plans) is required by the California Water Code (Section 13240) and supported by the Federal CWA. State law also requires that basin plans conform to the policies set forth in the California Water Code, beginning with Section 13000, and any State policy for water quality control. Because beneficial uses, together with their corresponding water quality objectives, can be defined per Federal regulations as water quality standards, the basin plans are regulatory references for meeting the State and Federal requirements for water quality control (40 CFR 131.20). The *Water Quality Control Plan for the California Regional Water Quality Control Board: Central Valley Region, the Sacramento River Basin and San Joaquin River Basin* (Basin Plan) covers the entire Sacramento and San Joaquin River basins. The Basin Plan was first adopted in 1975. In 1989, a second edition was published. The third edition, published in 1994, incorporated all amendments approved between 1989 and 1994, included new State policies and programs, edited and restructured the

Basin Plan to make it consistent with other regional and State plans, and substantively amended sections dealing with beneficial uses, objectives, and implementation programs. The Basin Plan was last revised in October 2011 (CVRWQCB 2011).

The California Air Resources Board Climate Change Scoping Plan: A Framework for Change The Global Warming Solutions Act of 2006 (Assembly Bill 32) required the California Air Resources Board to prepare a scoping plan to achieve reductions in California's GHG emissions. The scoping plan was originally approved in 2008. In 2011, the Functional Equivalent Document for the scoping plan was amended. The scoping plan, including the final supplement to the Functional Equivalent Document, was reapproved by the California Air Resources Board on August 24, 2011. The scoping plan provides the outline for actions to reduce California's GHG emissions (ARB 2008).

Bay Delta Conservation Plan (and Alternative Delta Conveyance Facilities) The BDCP is currently being developed. The BDCP consists of conservation measures that include components for water conveyance facilities combined with water conveyance operations; conservation components including land acquisition for major habitat restoration efforts in the Delta; and components related to reducing other stressors on the San Francisco Bay/Sacramento–San Joaquin Delta (Bay-Delta) ecosystem. The BDCP conservation measures are specific actions that would be implemented to achieve the biological goals and objectives of the proposed plan, and are a component of the BDCP conservation strategy. The conservation measures and effects assessment related to achieving the BDCP's overall planning goals are incorporated by reference into the EIR/EIS, which is expected to be publicly released in spring 2013. The BDCP conservation strategy consists of multiple components that are designed to collectively achieve the overall BDCP planning goals of ecosystem conservation and water supply reliability. The conservation strategy includes biological goals and objectives; conservation measures; avoidance and minimization measures; and a monitoring, research, and adaptive management program.

Four broad concepts have been studied to address urban water quality, water supply reliability, and environmental concerns in the Delta: physical barriers, hydraulic barriers, through-Delta facilities, and isolated facilities. Several alternative Delta conveyance facilities are being evaluated as part of the plan. Depending on the alternative, the water conveyance facility components would create a new conveyance mechanism to divert water from the north Delta to existing SWP and CVP export facilities in the south Delta, interacting with operational guidelines to achieve the planning goal outlined above. Among these alternatives is an isolated facility that would convey water around the Delta for local supply and export through a hydraulically isolated channel. This isolated facility could improve water quality for urban and agricultural water users, while eliminating reverse flow in the Delta and improving Delta water quality and flow by releasing water to south Delta channels. Because the intake gate for this facility would be upstream from much of the Delta along the Sacramento River, it would substantially reduce effects of bromide and agricultural drainage on water delivered to urban water purveyors.

Trinity River Mainstem Fishery Restoration Program The Trinity River Mainstem Fishery Restoration Program is located in the CVP service area at Lewiston Dam on the Trinity River. This program is designed to benefit anadromous salmonids and their habitat by developing a properly functioning, diverse floodplain and riverine habitat. The program's plan has two restoration goals: reestablish the natural physical processes that create and maintain high-quality aquatic habitat; and create spawning and rearing conditions downstream from the dams, including adequate water temperatures to best compensate for lost habitat upstream.

The plan includes direct in-channel actions, continued watershed restoration activities, replacement of bridges and structures within the floodplain, and a program to monitor and improve restoration activities. Some of the actions and activities have been implemented and are operational. The pending phases of the projects incorporated into the DEIR encompass work at 29 rehabilitation sites in Trinity County along the 40-mile reach of the mainstem Trinity River from Lewiston Dam to the North Fork Trinity River. The remaining 6 Phase 1 sites are concentrated between Lewiston and Douglas City (about a 16-mile reach) and the 23 Phase 2 sites are located between Rush Creek and the North Fork Trinity River near Helena, California.

San Joaquin River Restoration Program As described previously (see the discussion of full SJRRP Restoration Flows in "Quantitative Assessment of Actions Related to Water Resources," above), the SJRRP was established based on the 2006 Settlement of the *Natural Resources Defense Council et al., v. Rodgers, et al.* lawsuit. The program would restore and maintain fish populations in "good condition" in the mainstem San Joaquin River below Friant Dam to the confluence of the Merced River, including naturally reproducing and self-sustaining populations of salmon and other fish; and reduce or avoid adverse water supply impacts on all of the Friant Division long-term contractors that may result from the Interim Flows and Restoration Flows provided for in the Settlement.

The Settlement followed an 18-year lawsuit that involved the U.S. Departments of the Interior and Commerce, the Natural Resources Defense Council, and the Friant Water Users Authority. The Settlement received Federal court approval in October 2006. Federal legislation was passed in March 2009 authorizing Federal agencies to implement the Settlement. The SJRRP consists of releases of water from Friant Dam to the confluence of the Merced River (Interim and Restoration flows), a combination of channel and structural modifications along the San Joaquin River below Friant Dam, and reintroduction of Chinook salmon. The SJRRP's channel and structural modifications include modifications to channel and flow-control structures and habitat along the San Joaquin River and Lower San Joaquin Flood Control Project between Friant Dam and the Merced River confluence. They also involve constructing and operating new infrastructure to facilitate the recapture of Interim and Restoration flows on the San Joaquin River below the confluence of the Merced River.

Sacramento River Conservation Area Forum Program The nonprofit Sacramento River Conservation Area Forum works to protect, restore, and enhance the fisheries and riparian habitat along the Sacramento River in the primary and extended study areas, from Keswick Dam downriver to Verona. This is a cooperative effort to ensure that habitat restoration and management addresses not only the dynamics of riparian ecosystems, but also the realities of local agricultural and recreational issues associated with land use changes occurring along the river. The program (Resources Agency 2003) has goals to protect, restore, and enhance fisheries and riparian habitat along the Sacramento River and its tributaries. The Sacramento River Conservation Area Forum develops and implements site-specific and subreach plans for areas within the conservation area.

Iron Mountain Mine Restoration Plan The Iron Mountain Mine Restoration Plan identifies restoration actions to address injuries to or lost use of natural resources caused by acid mine drainage from the Iron Mountain Mine complex, located west of the upper Sacramento River in the primary study area. The plan involves restoring salmonid populations, riparian habitat, and instream ecological functions, as well as implementing restoration projects to compensate for the lost use of public areas and public services. The aquatic and riparian habitats affected by releases of hazardous substances at or from the Iron Mountain Mine site include the site’s creeks (Boulder, Slickrock, Flat, and Spring) and the mainstem and tributaries of the Sacramento River from Keswick Reservoir to Red Bluff. As additional compensation for damage to natural resources, this project includes an option for the Federal government to acquire approximately 1,250 acres to be transferred into public ownership and administered by the U.S. Department of the Interior, Bureau of Land Management (BLM) (IMMTC 2002; NOAA 2009). The Iron Mountain Mine Trustee Council has allocated funds to several projects designed to meet the goals of the *Iron Mountain Mine Restoration Plan*.

Draft Invasive Non-Native Plant (Weed) Management Plan for the Mouth of Cottonwood Creek Wildlife Area The Mouth of Cottonwood Creek Wildlife Area is located in south-central Shasta County. CDFW acquired lands in this wildlife area to protect, restore, and enhance riparian and wetland habitats. The *Invasive Non-Native Plant (Weed) Management Plan for the Mouth of Cottonwood Creek Wildlife Area* provides a preliminary strategy for managing the highest priority invasive nonnative plants on lands in the Mouth of Cottonwood Creek Wildlife Area.

Deer Creek Flow Enhancement Program The Deer Creek Irrigation District is located in southeastern Tehama County, approximately 20 miles north of Chico in Butte County and 22 miles south of Red Bluff and 2 miles east of the community of Vina in Tehama County. Deer Creek drains portions of the Sierra Nevada and is a tributary to the Sacramento River. Deer Creek is one of California's largest undammed watersheds in the Sacramento River basin. Several unique habitat features within Deer Creek make it an important resource for anadromous fish in the Sacramento Valley, particularly spring-run Chinook salmon and steelhead trout.

The Deer Creek Flow Enhancement Program is a component of the conceptual framework for the Deer Creek Flow Enhancement Program. The project is the implementation of Phase One of the Memorandum of Agreement between Deer Creek Irrigation District, DWR's Northern Region, and CDFW for the construction, operation, maintenance and monitoring of a flow enhancement program on Deer Creek. Phase One of DWR's conceptual framework for the Deer Creek Flow Enhancement Program is a water exchange project intended to provide salmonid passage flows for adult spawners and outmigrant young in Deer Creek. Specifically, Phase One includes the following components:

- The bypassing of 10 cfs of surface water from Deer Creek during critical migration periods
- Installation of two water supply wells or retrofit of two existing wells for irrigation purposes
- Deer Creek Annual Monitoring Program

The Memorandum of Agreement provides for the installation of two new groundwater wells for agricultural water supply and/or the refurbishment of two existing wells to extract up to 10 cfs of groundwater for irrigation purposes during critical migration periods. The installation of the wells would enable irrigators to switch from using stream flow to groundwater, thus leaving, or "bypassing," water in Deer Creek during critical spring (April–June) and fall (October–November) migration periods. Maintaining instream flows during these critical periods would allow fish to reach areas upstream from the Stanford Vina Diversion Dam in Deer Creek. Ultimately, the 10-year Memorandum of Agreement and flow enhancement program would improve access by salmonids to and from approximately 25 miles of Deer Creek upstream from the diversion dam.

The proposed project also includes a Deer Creek Annual Monitoring Program. This monitoring program provides groundwater level criteria, water quality criteria, and reporting requirements. The Deer Creek Annual Monitoring Program also monitors fish passage conditions over a range of water year types to determine the timing and effectiveness of the Deer Creek Flow Enhancement

Program's operations and to determine the need for pulse flows, riffle modifications, water temperature standards, and reporting requirements.

Lower Deer Creek Falls Fish Passage Improvement Project The Lower Deer Creek Falls Fish Passage Improvement Project will improve access to 5.75 stream miles for fall-run, late fall–run, and spring-run Chinook salmon as well as steelhead. Work is under way by Deer Creek Irrigation District, DWR, and CDFW to develop an environmental flow enhancement program in lower Deer Creek. The goal of the program is to increase fish transportation flows downstream from Deer Creek Irrigation District. More than 25 miles of prime spawning habitat are available upstream from the Deer Creek Irrigation District diversion dam. Detailed topographic surveys of the area and preliminary engineering investigations have been suspended until additional funding becomes available.

Battle Creek Salmon and Steelhead Restoration Project The intent of the Battle Creek Salmon and Steelhead Restoration Project is to create habitat that can sustain additional populations of winter-run Chinook salmon to minimize the species' high risk of extinction. Upon its completion, the project will have reestablished approximately 42 miles of prime salmon and steelhead habitat on Battle Creek, plus an additional 6 miles on its tributaries; removed several hydroelectric dams; and developed and implemented a long-term adaptive management plan with dedicated funding sources to ensure the continued success of restoration efforts. The project is to be completed no later than 2019.

Butte Regional Conservation Plan The Butte Regional Conservation Plan (BRCP) is both a Federal habitat conservation plan and a State natural communities conservation plan. The BRCP, a voluntary plan coordinated by the Butte County Association of Governments, covers approximately the western half of Butte County, including the all of the county's vernal pool landscapes. The BRCP will provide streamlined ESA permitting for transportation projects, land development, and other covered activities over the 30- to 50-year term of the permits. It will also provide comprehensive species, wetlands, and ecosystem conservation and contribute to the recovery of endangered species within the plan area.

The development of the BRCP is a complex multiyear effort that will replace the existing environmental permitting process. The plan has been broken down into five phases. Phase Four tasks are currently under way and consist of a second administrative draft of the BRCP, an administrative draft EIS/EIR, and public workshops. Phase Five is scheduled for 2013 and will include the development of a final plan, a final EIS/EIR, public workshops, and adoption of the plan.

North-of-Delta Offstream Storage Investigation The North-of-Delta Offstream Storage Investigation is a feasibility study being performed by Reclamation and DWR, in partnership with local interests. Pursuant to the

CALFED solution principles, storage locations that would not add a new dam on a major stream were considered and evaluated. As its name indicates, the North-of-Delta Offstream Storage Investigation focuses on offstream storage north of the Delta – specifically, potential projects for offstream storage of surface water at Sites Reservoir in the upper Sacramento River basin.

Offstream storage located north-of-the-Delta would require conveying water from the Sacramento River or one of its major tributaries to the new storage location. An offstream storage conveyance system could use either existing diversions and canals or new diversions and conveyance. Water would be diverted during periods of relatively higher flow through the conveyance system, into the new offstream storage reservoir, and stored until it is needed to meet the planning objectives.

Such storage could increase water supply reliability for all beneficial uses (agricultural, urban, and environmental). The Sites Reservoir Project could contribute to cumulative effects on water supplies and associated resources. The project could increase water supplies available for export in years when export supplies otherwise would be limited. This project also could modify the timing and magnitude of upstream reservoir releases in wet years.

A notice of intent/notice of preparation for this project was issued in November 2001 and public scoping for the environmental document occurred in January 2002. The complete plan formulation report was published in September 2008 and the Final EIS/EIR/Feasibility Report is scheduled to be completed in 2013.

Fremont Landing Conservation Bank The 100-acre Fremont Landing Conservation Bank in Yolo County functions as a mitigation bank providing credits for riparian floodplain forest or shaded riverine aquatic habitat. The mitigation bank serves portions of Tehama, Shasta, Glenn, Butte, Colusa, Sutter, Yuba, Yolo, Placer, Solano, Sacramento, Amador, Contra Costa, San Joaquin, Calaveras, Alameda, Stanislaus, Tuolumne, Merced, and Mariposa counties. Credits may be designated to provide habitat for special-status anadromous salmonids – Sacramento River winter-run, Central Valley spring-run, and Central Valley fall/late fall–run Chinook salmon as well as Central Valley steelhead. NMFS approved the site as part of an umbrella agreement that covers several Central Valley mitigation banking sites (Conservation Fund 2010). A mitigated negative declaration was issued in 2009 (BDCP 2012).

Yuba Salmon Forum Fish Passage Studies (Upper Yuba River Studies Program) The purpose of the Yuba Salmon Forum Fish Passage Studies is to take two sets of actions concurrently: (1) identify, evaluate, recommend, and seek to achieve implementation of effective near-term and long-term actions to achieve viable salmonid populations in the Yuba River watershed to contribute to recovery goals; and (2) consider other beneficial uses of water resources and habitat values in neighboring watersheds, as part of Central Valley salmonid recovery actions. The Yuba Salmon Forum adopted the *Draft Yuba River*

Salmon Forum Studies on June 24, 2011. These six studies provide information to Yuba Salmon Forum members that they may find useful in making decisions about the introduction of anadromous salmonids (Chinook salmon (*Oncorhynchus tshawytscha*) and central Valley steelhead (*O. mykiss*)) into the Yuba River basin upstream from USACE's Englebright Dam.

Davis-Woodland Water Supply Project The Davis-Woodland Water Supply Project will replace deteriorating groundwater supplies with safer, more reliable surface water supplies from the Sacramento River. The three primary objectives of the project are to provide a reliable water supply to meet existing and future needs, to improve water quality for drinking water supplies, and to improve the quality of treated wastewater effluent discharged by the project partners (the Cities of Woodland and Davis and the University of California, Davis) through 2040. Once complete, the project will serve more than two-thirds of the urban population of Yolo County.

Project plans include a jointly owned and operated intake on the Sacramento River, raw-water pipelines connecting the intake to a new regional water treatment plant, and separate pipelines delivering treated water to the project partners. Improvements to existing water supply systems will vary for Woodland and Davis and will include facilities such as distribution pipelines, water storage tanks, and booster pump stations.

The project will divert up to 45,000 acre-feet of water per year from the Sacramento River. Water rights were granted in March 2011 and will be subject to conditions imposed by the State. Water diversions will be limited during summer and other dry periods. A more senior water right for 10,000 acre-feet was purchased to provide summer water supply. Groundwater will continue to be used by Woodland and Davis when demand for water cannot be met by surface water supplies alone. The regional water supply project is currently under design, with construction planned between 2013 and 2015 and operations beginning in 2016.

North Bay Aqueduct Alternative Intake Project DWR proposes to implement the North Bay Aqueduct Alternative Intake Project to improve water quality and to provide reliable deliveries of SWP supplies to its contractors, the Solano County Water Agency and the Napa County Flood Control and Water Conservation District. This proposed project would include the construction and operation of an alternative intake on the Sacramento River, generally upstream from the Sacramento Regional Wastewater Treatment Plant, and connect it to the existing North Bay Aqueduct system by a new segment of pipe. The proposed alternative intake would be operated in conjunction with the existing North Bay Aqueduct intake at Barker Slough. The North Bay Aqueduct Alternative Intake Project would include the following facilities:

- A new alternative intake structure and pump station on the Sacramento River with state-of-the-art, positive-barrier fish screens

- A new pipeline segment to convey the water from the alternative intake to a point of connection with the existing North Bay Aqueduct near the North Bay Regional Water Treatment Plant
- Other project-related support facilities such as surge tanks

The notice of preparation for the North Bay Aqueduct Alternative Intake Project EIR was published in November 2009 (DWR 2009). A scoping report was released in February 2010 (ESA 2010). It is anticipated that the public review draft EIR will be available in early 2013.

Lower Clear Creek Anadromous Fish Restoration and Management Project The anadromous fish restoration and management actions of the Lower Clear Creek Anadromous Fish Restoration and Management Project will occur on public and private lands in the lower Clear Creek watershed, located west of Redding in Shasta County. The CVPIA funds most of the actions proposed in the environmental assessments produced for these efforts.

Beginning in the early 1990s, multiple Federal, State, and local agencies and private stakeholder groups concerned about lower Clear Creek began to plan and implement watershed restoration activities to reverse the effects of Whiskeytown Dam, Saeltzer Dam, placer and dredger gold mining, instream aggregate mining, road-related erosion, and decades of fire suppression. Since that time, the groups that formed the Clear Creek Restoration Team have implemented multiple resource inventories and restoration projects, including dam removal, gravel augmentation, flow augmentation, channel and floodplain restoration, erosion control, fuels reduction, and control of nonnative vegetation.

North Delta Flood Control and Ecosystem Restoration Project DWR certified the EIR for the North Delta Flood Control and Ecosystem Restoration Project in 2010 and filed a notice of determination with the Governor's Office of Planning and Research on November 9, 2010. This project will implement flood control improvements in the north Delta, principally on and around McCormack-Williamson Tract, Dead Horse Island, and Grizzly Slough, in a manner that benefits aquatic and terrestrial habitats, species, and ecological processes. Flood control improvements are needed to reduce damage to land uses, infrastructure, and the Bay-Delta ecosystem caused by catastrophic levee failures in the Delta.

Two-Gates Fish Protection Demonstration Project Reclamation is currently studying the proposed Two-Gates Demonstration Project, a 5-year experiment to validate a new behavioral model for delta smelt and study the effects of modifying Delta flows to protect delta smelt and other sensitive aquatic species from entrainment in CVP and SWP export pumps. Research suggests that the pre-spawning migration of adult delta smelt is tied to sediment and suspended particles in the water (turbidity). Temporary gates would be placed across Old River and Connection Slough in the central Delta. These gates would operate at two times of year: from December to March, to keep turbid water away from the CVP and SWP export pumps, thus keeping adult delta smelt away from the pumps; and in March and June, to prevent entrainment of larvae and juvenile delta smelt by the export pumps.

Franks Tract Project Reclamation and DWR propose to implement the Franks Tract Project to improve water quality and fisheries conditions in the Delta. Reclamation and DWR are evaluating installing operable gates to control the flow of water at key locations (Threemile Slough and/or West False River) to limit the entry of fish species of concern and higher salinity water into Franks Tract and other areas of the Delta with high fish mortalities. In addition to improving water quality, the gates would limit migration of delta smelt into the central and south Delta, where their survival rates are reduced. By protecting fish resources, this project also would improve the operational reliability of the CVP and SWP because curtailments (pumping restrictions) in project operations would likely be less frequent.

A plan of study for the Franks Tract Project was completed in August 2007. The notice of intent was published September 22, 2008, and the Initial Alternatives Information Report was completed in February 2010, and the Plan Formulation Report was completed in 2013. The project is still under consideration by Reclamation and DWR.

Dutch Slough Tidal Marsh Restoration Project This proposed project is a cooperative partnership between DWR, CALFED, the California Coastal Conservancy, landowners, the Natural Heritage Institute, the City of Oakley, Ironhouse Sanitary District, and private consultants. The project entails restoring wetlands and uplands and providing public access to the 1,166-acre Dutch Slough property owned by DWR. The property comprises three parcels, separated by narrow human-made sloughs, that were historically used for agricultural uses and grazing.

The primary goal of the Dutch Slough Tidal Marsh Restoration Project is to provide ecosystem benefits, including habitats for sensitive aquatic species. The project will be designed to maximize opportunities to assess the development of those habitats and measure ecosystem responses so that future Delta restoration projects will be more successful. This proposed project also provides an important opportunity to improve planners' understanding of restoration science in tidal marsh wetland ecosystems in the region (DWR 2010). Construction is scheduled to begin in summer 2013 with levee breaching anticipated in 2014.

Suisun Marsh Management, Preservation, and Restoration Plan Federal and State agencies jointly developed this comprehensive 30-year regional plan to address the use of resources on about 52,000 acres of wetland and upland habitats in Suisun Marsh near Fairfield. The focus of the *Suisun Marsh Management, Preservation, and Restoration Plan* is to achieve an acceptable multiple-stakeholder approach to the restoration of tidal wetlands and the enhancement of managed wetlands and their functions. The plan balances implementation of the CALFED Program, the Suisun Marsh Preservation Agreement, and other management and restoration programs for Suisun Marsh and is based on voluntary participation by private landowners.

DWR and Reclamation have collaboratively prepared the environmental documents with NMFS, CDFW, and the Suisun Resource Conservation District. The notice of intent/notice of preparation was published in November 2003. The Final EIS/EIR was made available in December 2011 (DOI et al. 2011).

In-Delta Storage Program (Delta Wetlands Project) DWR, in coordination with the California Bay-Delta Authority and with technical assistance from Reclamation, completed the State feasibility study for the In-Delta Storage Program in the south Delta, within the extended study area. The In-Delta Storage Project would provide capacity to store approximately 217 thousand acre-feet of water in the south Delta for a wide array of water supply, water quality, and ecosystem benefits. The project would consist of two storage islands (Webb Tract and Bacon Island) and two habitat islands (Holland Tract and Bouldin Island), an embankment design, consolidated inlet and outlet structures, project operations, and habitat management plans. The objectives of the project are to enhance water supply reliability and the operational flexibility of the CVP/SWP system, contribute to ecosystem restoration, and provide water for the Environmental Water Account (DWR 2011b). Detailed planning work by the State on the In-Delta Storage Project has been suspended since July 2006 when State funding was cut (DWR 2011b); however, a final EIR was certified in 2012 by Semitropic Water Storage District and other environmental documentation is under way.

Los Vaqueros Reservoir Expansion Project Los Vaqueros Reservoir was completed in 1997 to provide 100,000 acre-feet of offstream water storage to improve water quality and provide emergency storage for Contra Costa Water District (CCWD) customers. The purpose of this project is to enhance the Delta environment and improve the Bay Area’s water supply reliability and water quality by developing water supplies for environmental water management and helping to meet municipal and industrial water demands during drought and emergency periods, by expanding the existing reservoir.

To date, the project has consisted of an expansion of Los Vaqueros Reservoir from 100,000 acre-feet to 160,000 acre-feet, which required a dam raise, the relocation of recreation facilities, and an upgrade of the pumps at the Transfer Pump Station. The dam raise to 160,000 acre-feet was completed in 2012 and mitigation activities are scheduled for completion in 2013. Los Vaqueros Reservoir could be further expanded up to a total of 500,000 acre-feet. New Delta intakes, pumps, and pipelines would be required to fill the additional reservoir capacity, and water deliveries would be made from the expanded reservoir to Bay Area beneficiaries through new conveyance facilities.

Completion of the Draft Federal Feasibility Report is planned for 2014 and a final report is to be completed in 2015. A final decision on further expansion of the reservoir beyond 160,000 acre-feet is expected to occur in 2016, depending on the level of participation by other Bay Area water agencies, Reclamation, and DWR. Project implementation will also consider the CCWD Board Principles and the additional assurances, commitments, and requirements adopted by the CCWD Board on June 25, 2003.

East Bay Municipal Utility District Water Supply Management Program 2040 The Water Supply Management Program 2040 (WSMP 2040) is a program-level effort that estimates EBMUD's water supply needs over a 30-year planning horizon and proposes a diverse portfolio of policy initiatives and potential projects to ensure that those needs can be met in dry years. On October 13, 2009, the EBMUD Board of Directors approved the WSMP 2040. The CEQA analysis was challenged in court, and in a ruling issued on April 11, 2011, EBMUD was directed to analyze certain plan components in more detail. On May 24, 2011, the EBMUD Board set aside certification of the WSMP 2040 Program EIR and directed staff members to revise the program. That revision effort has since been completed, and on April 24, 2012, the EBMUD Board of Directors certified the revised program EIR and adopted the revised final plan for the WSMP 2040 (EBMUD 2012).

Bay Area Regional Desalination Project The Bay Area's largest water agencies (CCWD, EBMUD, the San Francisco Public Utilities Commission, the Santa Clara Valley Water District, and the Alameda County Flood Control and Water Conservation District – Zone 7) are working together to develop a regional desalination project to serve the needs of more than 5.6 million residents and businesses in the region. The project under consideration would use water from the Delta withdrawn at CCWD's Mallard Slough Pump Station, located in eastern Contra Costa County, to produce 20 million gallons per day of desalinated water for delivery to residential and business customers in the region. Water produced by this project could be blended with supplies from CCWD, EBMUD (Mokelumne Aqueduct), or both. Other parties would receive project water through transfers or wheeling. The water from the Bay Area Regional Desalination Project could be fully treated (two-pass reverse osmosis) or require further treatment (one-pass reverse osmosis), depending on the delivery point into either the CCWD or EBMUD system. The project would operate continuously in all water year types, with the possibility of storing water (including by exchange or transfer) in CCWD's Los Vaqueros Reservoir when demand is less than plant capacity.

Upper San Joaquin River Basin Storage Investigation (Temperance Flat Reservoir) The Upper San Joaquin River Basin Storage Investigation is a feasibility study being performed by Reclamation and DWR. The purpose of the Upper San Joaquin River Basin Storage Investigation is to determine the type and extent of Federal, State, and regional interests in a potential project in the upper San Joaquin River watershed with the following goals: expand water storage capacity; improve water supply reliability and flexibility for agricultural, urban, and environmental uses; and enhance San Joaquin River water temperature and flow conditions to support efforts for anadromous fish restoration. This investigation is one of five surface water storage studies recommended in the record of decision for the CALFED final programmatic EIS/EIR (August 2000). A plan formulation report for the project was released in October 2008 (Reclamation and DWR 2008). A public draft feasibility report is anticipated in September 2013.

San Luis Drainage Reevaluation Program The San Luis Unit (drainage study area) was authorized by Congress in Public Law 86-488 (74 Statutes 156), June 3, 1960, and amended by Section 101(e) of the Act of October 18, 1986, Public Law 99-500. The project purpose is to provide agricultural drainage service to the San Luis Unit to achieve a long-term, sustainable salt and water balance in the root zone of irrigated lands in the San Luis Unit and adjacent areas. Of the 730,000 acres in the drainage study area, about 379,000 acres are drainage-impaired and constitute the drainage service area. Reclamation estimates that installing subsurface drainage systems in two-thirds of this area by the end of the 50-year planning horizon would maintain the arability of the root zone throughout the entire 379,000 acres. The alternatives are the In-Valley/Drainage-Impaired Area Land Retirement Alternative and the In-Valley/Water Needs Land Retirement Alternative. Common features proposed for both alternatives are a drainage collection system, regional drainage reuse facility, conveyance system, selenium biotreatment, evaporation ponds, mitigation facilities, and land retirement.

Central Valley Salinity Alternatives for Long-Term Sustainability (CV-SALTS) The CV-SALTS initiative is a collaborative effort among 26 stakeholder groups to realize reductions in salt accumulation in the Central Valley. These groups represent a broad coalition of agriculture, municipalities, industry, and regulatory agencies. Represented by the Central Valley Salinity Coalition, they are working with the Central Valley Regional Water Quality Control Board (CVRWQCB) to address the valley's salinity problems. The goal of the CV-SALTS initiative is to adopt long-term solutions to salt management that will enhance water quality and economic sustainability in the valley. The CV-SALTS initiative has completed pilot studies on the sources and effects of salts in 13 percent of the affected areas; working in partnership with Reclamation, it will complete salts studies for the east and west sides of the San Joaquin River.

San Joaquin River at Vernalis Salt and Boron TMDL and Basin Plan Amendment The CV-SALTS stakeholder initiative was created to develop new approaches to protect soils and water from salt that has been slowly and steadily accumulating in the San Joaquin River watershed. The CV-SALTS stakeholder initiative will initiate a research effort that will review and determine the appropriate salinity concentration for the San Joaquin River in order to maintain all of the beneficial uses of the river. Reclamation is currently collaborating with CV-SALTS and the Regional Water Board to implement a real-time salinity management system that will satisfy the TMDL requirement for San Joaquin River salinity concentration.

B. F. Sisk Dam Corrective Action Project B.F. Sisk Dam (also known as San Luis Dam) is a 300-foot-high, compacted earthfill embankment located on the west side of the Central Valley approximately 12 miles west of Los Banos. Owned by Reclamation and operated by DWR, the dam is more than 3.5 miles long. B.F. Sisk Dam impounds San Luis Reservoir, which has a total capacity of more than 2 million acre-feet. The dam was built between 1963 and 1967 to provide supplemental storage of irrigation water for the CVP and municipal and industrial water for the SWP. The Gianelli Pumping-Generating Plant lifts water from both the California Aqueduct and the Delta-Mendota Canal (via O'Neill Forebay) into San Luis Reservoir for storage.

The dam and reservoir are located in an area of high potential for severe earthquakes on active faults, primarily the Ortigalita Fault, which crosses the reservoir. A series of studies and analyses that culminated in a seismic-risk analysis completed in 2006 found justification to act to reduce the risk to the downstream public of seismic damage to the dam. The current phase of the Safety of Dams project is referred to as a corrective action study and is expected to be complete in 2013. The study will include feasibility-level designs, environmental documentation, selection of a preferred alternative, and a modification report to the Federal Office of Management and Budget and the U.S. Congress.

San Luis Reservoir Low Point Improvement Project Reclamation is investigating 3 alternatives to address water quality problems within the CVP's San Felipe Division (Santa Clara and San Benito counties) that arise when San Luis Reservoir levels drop below 300 thousand acre-feet during late summer in dry water years, resulting in large algal blooms. Santa Clara Valley Water District has proposed the San Luis Reservoir Low Point Improvement Project to maintain a high-quality, reliable, and cost-effective water supply for the water district and other contractors of the San Felipe Division. Santa Clara Valley Water District wants to ensure that it and other San Felipe Division contractors receive their annual CVP contract allocations at the time and the level of quality needed to meet water supply commitments. The project objectives are as follows:

- Avoid supply interruptions when water is needed by increasing the certainty of meeting the requested delivery schedule throughout the year to south-of-Delta contractors dependent on San Luis Reservoir.

- Increase the reliability and quantity of yearly allocations to south-of-Delta contractors dependent on San Luis Reservoir.

- Minimize the downward population trends of native species that are not listed.

- Announce higher allocations earlier in the season to south-of-Delta contractors dependent on San Luis Reservoir without sacrificing accuracy of the allocation forecasts.

Qualitative Assessment of Actions Related to Flood Management The actions related to flood management described below were identified as present or reasonably foreseeable.

Central Valley Flood Protection Plan Legislation passed in 2007 directs DWR to develop three documents that will guide improvement of integrated flood management:

- *State Plan of Flood Control Descriptive Document* to inventory and describe the flood management facilities, land, programs, conditions, and mode of operations and maintenance for the State/Federal flood protection system in the Central Valley.

- *Flood Control System Status Report* to assess the status of the facilities included in the State Plan of Flood Control Descriptive Document, identify deficiencies, and make recommendations.

- *Central Valley Flood Protection Plan* (CVFPP) to describe a sustainable, integrated flood management plan that reflects a systemwide approach for protecting areas of the Central Valley that currently receive protection from flooding by existing facilities of the State Plan of Flood Control. It is supported by the *State Plan of Flood Control Descriptive Document*, the *Flood Control System Status Report*, and the *CVFPP Final Program Environmental Impact Report*.

The CVFPP is a sustainable, integrated flood management plan that describes the existing flood risk in the Central Valley and recommends actions to reduce the probability and consequences of flooding. Produced in partnership with Federal, tribal, local, and regional partners and other interested parties, the CVFPP also identifies the mutual goals, objectives, and constraints important in the planning process; distinguishes plan elements that address mutual flood risks; and recommends improvements to the State/Federal flood protection system. The 2012 CVFPP was completed by DWR and adopted by the Central Valley Flood Protection Board in July 2012 (DWR 2012). It is currently being implemented through two basinwide feasibility studies for the Sacramento and San Joaquin river basins, respectively.

CALFED Levee System Integrity Program DWR, CDFW, and USACE implement the CALFED Levee System Integrity Program, which maintains and improves the integrity of the Bay-Delta estuary's levee system. The goal of the

Levee System Integrity Program is to reduce risks to land use and associated economic activities, water supply, agricultural and residential uses, infrastructure, and the ecosystem from the effects of catastrophic breaching of Delta levees. Resources protected by the program include water quality, ecosystem health, infrastructure such as utilities and transportation corridors, agriculture, and recreational industries.

Protection and maintenance of nearly 700 miles of Delta levees has increased since 2000. Maintenance has been ongoing along more than 600 miles of eligible project and nonproject levees, and levee stability has been improved for more than 45 additional miles of levees. Large levee rehabilitation projects have been undertaken on numerous islands. Projects have also been implemented to grow native vegetation, reuse more than 2 million cubic yards of dredged material for levee stability and habitat development, and develop approximately 50 acres of riparian and wetland habitat and 3,000 linear feet of shaded riverine aquatic habitat (CALFED 2011).

Sacramento River Bank Protection Project The Sacramento River Bank Protection Project is a continuing construction project authorized by Section 203 of the Flood Control Act of 1960. USACE is responsible for implementation of this project in conjunction with its non-Federal partner, the Central Valley Flood Protection Board. The project's purpose is to provide protection to the existing levee and flood control facilities of the Sacramento River Flood Control Project. The project is to be completed in three phases. To date, a total of about 820,000 feet of riverbank has been stabilized under the project. During Phase III, USACE and the Central Valley Flood Protection Board will consider multiple objectives – not only controlling bank erosion, but also addressing other threats to the flood risk management system such as through-seepage, underseepage, and levee height deficiencies, while providing ecosystem restoration. Implementing Phase III will be critical to ensure that project levees seriously threatened by erosion will continue to receive corrective measures to prevent levee failure, catastrophic damage, and possible loss of life. Planning and development of Phase III began recently and will include a comprehensive sediment study, a thorough economic analysis, continued biological studies, a comprehensive cultural resources survey, a detailed real estate plan, and an updated mitigation site inventory. Phase III is expected to be completed in 2013.

Folsom Dam Joint Federal Project Folsom Dam regulates flows in the American River for flood control, and releases from Folsom Reservoir are used for irrigation, power, municipal and industrial, fish and wildlife, water quality, and other purposes. The "Folsom Facility" comprises Folsom Dam and Reservoir, left and right earthfill wing dams, Mormon Island Auxiliary Dam, and eight earthfill dikes that protect the surrounding communities, Folsom and Granite Bay.

The Folsom Joint Federal Project is a collaborative effort by Reclamation and USACE to address the hydrologic risk related to dam safety at the Folsom Facility, and to improve flood protection. This project includes construction of a new auxiliary spillway southwest of the existing main concrete dam. When completed in 2017, the auxiliary spillway will include a 1,000-foot-long approach channel beginning in Folsom Reservoir, a concrete control structure with 6 gates, a 2,100-foot-long auxiliary spillway chute, and a stilling basin that will act as an energy dissipation structure as water discharges enter the American River below the main concrete Folsom Dam. The new facility will allow Reclamation's dam operators to better manage large floods by safely releasing more water from Folsom Reservoir earlier during a large storm through both the spillway gates on Folsom Dam and the new control structure's six gates, thus reducing hydrologic risk and leaving more storage capacity in the reservoir. Improvements to Folsom Dam also include construction of a 3.5-foot dam raise, which began in December 2007 and is expected to be completed in 2015.

Natomas Levee Improvement Program Landside Improvement Project The Sacramento Area Flood Control Agency, acting in conjunction with USACE, is implementing the multiple-phase Natomas Levee Improvement Program Landside Improvements Project along the lower Sacramento River in the extended study area. The project involves improving the perimeter levee system of the Natomas basin in Sutter and Sacramento counties and modifying associated landscaping and irrigation/drainage infrastructure. The project objectives are to provide at least a 100-year level of flood protection to the Natomas basin as quickly as possible, provide "200-year" protection to the basin over time, and avoid any substantial increase in expected annual damages as new development occurs in the basin (SAFCA 2007).

Multiple CEQA and NEPA documents have been issued by the Sacramento Area Flood Control Agency and USACE for various phases of this project since 2008. The Final EIS for Phase 4a of the project was issued by USACE in February 2010. Some phases of the project have been completed. Further construction and completion of the project is contingent on Federal funding.

West Sacramento Levee Improvement Program The West Sacramento Levee Improvement Program involves constructing improvements to the levees that protect West Sacramento to meet local and Federal flood protection criteria. The program area includes the entire boundaries of the West Sacramento Area Flood Control Agency, which encompass portions of the Sacramento River, the Yolo and Sacramento bypasses, and the Sacramento Deep Water Ship Channel. The levee system associated with these waterways includes more than 50 miles of levees in Reclamation Districts 900, 537, and 811; DWR's Maintenance Area 4; and the Sacramento Deep Water Ship Channel. These levees completely surround West Sacramento. The Final EIS/EIR for the West Sacramento Levee Improvements Program has been completed (City of West Sacramento 2012). Construction began in 2008 and is ongoing.

Delta Islands and Levees Feasibility Study The Delta Islands and Levees Feasibility Study is USACE’s mechanism to participate in a cost-shared solution to address ecosystem restoration needs, flood risk management problems, and related water resources in the Delta and Suisun Marsh area. A Feasibility Cost Share Agreement was executed on May 26, 2006 with DWR, the non-Federal sponsor. The USACE-DWR study team meets regularly to move the study forward and holds periodic agency coordination meetings with associated Federal, State, and local agencies. The study will culminate in a feasibility report that will make recommendations on construction projects and/or additional studies for authorization by Congress (USACE 2012). The project is on USACE’s priority list and the scope is currently being revised.

Qualitative Assessment of Actions Related to Energy The actions related to energy that are described below were identified as present or reasonably foreseeable.

Increased Hydropower Generation Capacity at Lewiston Dam In March 2011, the U.S. Department of the Interior released the results of an internal study that shows it could generate up to 1,000 gigawatt-hours of electricity annually by adding hydropower capacity at 70 of its existing dams, canals, tunnels, and other water-handling facilities. The report, *Hydropower Resource Assessment at Existing Reclamation Facilities*, studied 530 sites throughout Reclamation’s jurisdiction and preliminarily identified the 70 facilities with the most potential to add hydropower. The Trinity Public Utilities District and Reclamation intend to boost the power-generating capacity at the Lewiston Dam from the existing 350 kilowatts. This upgrade would allow for better control of the flow from the dam to the river, and would provide an increase in revenue from power generation (DOI et al. 2007).

Federal Energy Regulatory Commission Project Licensing The Federal Energy Regulatory Commission (FERC) regulates non-Federal hydropower projects. FERC is responsible for the issuance of licenses for new hydropower projects, the continuance of existing projects (relicensing), and oversight of all ongoing project operations. Ongoing operations include dam safety inspections and environmental monitoring. Additionally, FERC may issue a preliminary permit for up to 3 years, which does not authorize construction but maintains the priority of application for license while the permittee studies the site and prepares to apply for a license. The permittee must submit periodic reports on the status of its studies. It is not necessary to obtain a permit to apply for or receive a license.

Shasta Dam is a Federal project and thus is not subject to FERC oversight; however, numerous hydropower projects in the primary and extended study areas are subject to this oversight and permitting process.

Pacific Gas & Electric Company Pit River 3, 4 & 5 Hydroelectric Projects License Implementation The Pit River 3, 4 & 5 Hydroelectric Projects’ license implementation involves three developments with a total of four dams, four reservoirs, and three powerhouses. Pit River 3, 4 & 5 is a 312.33-megawatt project located on the Pit River (the Sacramento River's largest tributary) that occupies 4,330 acres of both publicly owned and privately owned land.

Pacific Gas & Electric Company McCloud and Pit Rivers 6 and 7 FERC Relicensing The McCloud and Pit Rivers 6 and 7 FERC Relicensing includes the McCloud and Iron Canyon storage reservoirs, the Pit River 6 and 7 regulating reservoirs, the Pit 7 afterbay, two tunnels, three powerhouses, and transmission facilities. In 2010, the FERC final EIS recommended the relicensing of the McCloud-Pit hydroelectric project, a total of 382 megawatt-hours, on the McCloud and Pit rivers in Shasta County. The McCloud and Pit 6, 7 is currently being operated under a preliminary permit.

California Department of Water Resources Oroville Facilities FERC Relicensing The 762-megawatt project is located on the Feather River in Butte County and occupies 6,240 acres of Federal lands. The final EIR and notice of determination were issued in July 2008. The final EIS was issued in May 2007 (DWR 2007). DWR is currently undergoing the relicensing process with FERC.

Sacramento Municipal Utility District Upper American River Project FERC Relicensing The Sacramento Municipal Utility District's Upper American River Project is a hydroelectric facility located on the western slope of the Sierra Nevada. The facility is composed of several reservoirs and powerhouses located along streams and rivers within the American River basin. The proposed FERC relicensing includes the Iowa Hill Pumped Storage Development, a 400-megawatt pumped storage generating facility using the Slab Creek Reservoir as the lower reservoir and a new reservoir to be located on the top of Iowa Hill. The size of the Iowa Hill reservoir is under consideration and will range from 2,100 to 6,400 acre-feet.

Qualitative Assessment of Actions Related to Land Use Planning and Infrastructure Land use plans and policies are described in Chapter 17, "Land Use and Planning". Inconsistency with land use plans and policies does not necessarily indicate that adverse effects on the environment would occur. However, land use plans and policies guide development and land management activities that would affect the physical environment, and SLWRI actions could have additive or combined effects.

Antlers Bridge Replacement The California Department of Transportation (Caltrans), in cooperation with the Federal Transit Administration, is replacing Antlers Bridge over Shasta Lake, which is located on Interstate 5 near the community of Lakehead in Shasta County, in the primary study area. This project involves constructing a 1,942-foot, 5-lane segmental bridge with deep-pile foundations measuring 12 feet in diameter. The project also involves realigning a 0.4-mile-long segment of Interstate 5, which requires hillside excavation, construction of a 5-lane freeway section, and demolition of the existing 1,500 feet of steel deck truss bridge. The new bridge is being constructed next to the existing bridge, which will remain open to traffic until the new bridge is completed. This project will affect visual resources, fish and wildlife, and water quality standards. However, incorporation of mitigation will reduce these impacts to a less-than-significant level. The project is not expected to have any other significant impacts (Caltrans and FHWA 2007). Construction began in 2009 and is expected to be completed in 2015.

Jelly's Ferry Bridge Replacement The Tehama County Department of Public Works (County) in cooperation with Caltrans is proposing to replace the existing the Jellys Ferry Bridge over the Sacramento River, north of Red Bluff, in northern Tehama County, California. After conducting a seismic assessment, as part of the Local Bridge Seismic Safety Retrofit Program (LSSRP), the bridge was classified structurally and seismically deficient (Quincy 1997). Based on the results of the assessment, the County determined (with Caltrans concurrence) to replace rather than retrofit the existing bridge. The bridge will span the Sacramento River with abutments on adjacent sides of the river.

3.3 Resources Eliminated from Further Consideration

CEQA and the State CEQA Guidelines provide for identification and elimination from detailed study of the issues that are not significant or that have been covered by prior environmental review (PRC Section 21002.1; State CEQA Guidelines, Section 15143). The NEPA regulations provide similar provisions (40 CFR 1501.7(a)(3)).

During initial scoping with the public and governmental agencies, and based on information obtained through literature review, agency correspondence, consultations, and field data collection, it was determined that no resource areas could be eliminated from detailed study. Therefore, all resource areas covered by NEPA and CEQA are addressed in this DEIS.

3.4 Regulatory Framework

The following section generally describes the Federal, State, and local regulatory framework for the SLWRI. For a more detailed discussion of the "Regulatory Framework" by resource area, see Chapters 4-24. In addition, Chapter 26 "Other Required Disclosures" further describes the Federal and State laws, rules and regulations, Executive Orders, and compliance requirements that may be required if an alternative is selected for implementation.

3.4.1 Federal

National Environmental Policy Act

NEPA is the nation's broadest environmental law, applying to all Federal agencies and most of the activities they manage, regulate, or fund that affect the environment. This law requires Federal agencies to disclose and consider the environmental implications of their proposed actions. NEPA establishes environmental policies for the nation, provides an interdisciplinary framework for Federal agencies to avoid or minimize environmental impacts, and contains action-forcing procedures to ensure that Federal agency decision makers take environmental factors into account.

Clean Water Act

Section 404 Section 404 of the CWA requires that a permit be obtained from USACE for the discharge of dredged or fill material into "waters of the United States, including wetlands." Waters of the United States are wetlands and lakes, rivers, streams, and their tributaries. Waters of the United States are defined for regulatory purposes, at 33 CFR 328.3, as follows:

> *(1) All waters which are currently used, or were used in the past, or may be susceptible to use in interstate or foreign commerce, including all waters which are subject to the ebb and flow of tide; (2) All interstate waters, including interstate wetlands; (3) All other waters such as intrastate lakes, rivers, streams, mudflats, sandflats, wetlands, sloughs, prairie potholes, wet meadows, playa lakes, or natural ponds, the use, degradation or destruction of which could affect interstate or foreign commerce; (4) All impoundments of waters otherwise defined as waters of the United States under the definition; (5) Tributaries of waters identified in paragraphs 1–4 in this section; (6) The territorial seas; and (7) Wetlands adjacent to waters identified in paragraphs 1–6 in this section.*

CWA Section 404(b) requires that USACE process permits in compliance with guidelines developed by the U.S. Environmental Protection Agency (EPA). These guidelines (the CWA Section 404(b)(1) Guidelines) require the analysis of available alternatives that meet the project's purpose and need, including those alternatives that avoid and minimize discharges of dredged or fill materials in waters. Once alternatives deemed to be practicable have been identified, the only action that USACE can permit must be the least environmentally damaging practicable alternative.

Actions typically subject to Section 404 requirements are those that would take place in wetlands or stream channels, including intermittent streams, even if they have been realigned. For actions occurring within stream channels, a permit under Section 404 would be needed for any discharge activity below the ordinary high-water mark. (The ordinary high-water mark is the line on the shore established by the fluctuations of water. It is indicated by physical characteristics such as a clear, natural line impressed on the bank; shelving; changes in the character of soil; destruction of terrestrial vegetation; or the presence of litter or debris.)

The record of decision for the CALFED final programmatic EIS/EIR includes a CWA Section 404 memorandum of understanding signed by Reclamation, EPA, USACE, and DWR. Under the terms of the memorandum of understanding, when a project proponent applies for a Section 404 individual permit for CALFED projects, the proponent is not required to reexamine program alternatives already analyzed in the programmatic EIS/EIR. USACE and EPA will focus on project-level alternatives that are consistent with the CALFED programmatic EIS/EIR when they select the least environmentally damaging practicable alternative at the time of a Section 404 permit decision.

Section 401 Under CWA Section 401, applicants for a Federal license or permit to conduct activities that may discharge a pollutant into waters of the United States must obtain certification from the state in which the discharge would originate. If appropriate, the certification must be obtained from the interstate water pollution control agency with jurisdiction over affected waters at the point where the discharge would originate. Therefore, all projects that have a Federal component and may affect state water quality (including projects that require approval from a Federal agency, such as issuance of a Section 404 permit) must also comply with CWA Section 401.

In California, the authority to grant water quality certification has been delegated to the SWRCB. Applications for water quality certification under CWA Section 401 are typically processed by the regional water quality control board with local jurisdiction – in this case, the CVRWQCB. For a project to receive water quality certification, the project's potential impacts must be evaluated in light of water quality standards and CWA Section 404 criteria that govern discharges of dredged and fill materials into waters of the United States.

Endangered Species Act

USFWS and NMFS share responsibility for implementing the ESA. Generally, USFWS manages terrestrial and freshwater species, while NMFS manages marine and anadromous species such as Chinook salmon. Both agencies ensure that ESA requirements are followed and evaluate projects that may affect the continued existence of a Federally listed (threatened or endangered) species.

Section 9 of the ESA prohibits the take of Federally listed species. "Take" is defined under the ESA, in part, as killing, harming, or harassing. Under Federal regulations, take is further defined to include habitat modification or degradation where it actually results in death or injury to wildlife by significantly impairing essential behavioral patterns – breeding, feeding, or sheltering.

Section 7 of the ESA outlines procedures for Federal interagency cooperation to conserve Federally listed species and designated critical habitat. Section 7(a)(2) requires Federal agencies to consult with USFWS to ensure that they are not undertaking, funding, permitting, or authorizing actions likely to jeopardize the continued existence of listed species. NMFS also ensures that projects will not adversely affect essential fish habitat, as defined in the 1996 Sustainable Fisheries Act (Public Law 104-297). The goal is to stop or reverse the continued loss of fish habitats by protecting, conserving, and enhancing habitat.

Magnuson-Stevens Fishery Conservation and Management Act

The Magnuson-Stevens Fishery Conservation and Management Act (commonly known as Magnuson-Stevens Act) establishes a management system for national marine and estuarine fishery resources. This legislation requires Federal agencies to consult with NMFS regarding actions or proposed actions permitted, funded, or undertaken that may adversely affect "essential fish habitat." Essential fish habitat is defined as "waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity."

The Magnuson-Stevens Act states that migratory routes to and from the spawning grounds of anadromous fish are considered essential fish habitat. The phrase "adversely affect" refers to the creation of any impact that reduces the quality or quantity of essential fish habitat.

The concept of essential fish habitat is similar to that of "critical habitat" under the ESA; however, measures recommended by NMFS to protect essential fish habitat are advisory, not prescriptive. Federal activities that occur outside of essential fish habitat but that may nonetheless affect waters and substrate that constitute essential fish habitat must also be considered in the consultation process.

Under the Magnuson-Stevens Act, effects on habitat managed under the *Pacific Salmon Fishery Management Plan* must also be considered. The Magnuson-Stevens Act states that where appropriate, consultation regarding essential fish habitat should be consolidated with the interagency consultation, coordination, and environmental review procedures required by other Federal statutes, such as NEPA, the Federal Wildlife Coordination Act, the CWA, and the ESA.

Fish and Wildlife Coordination Act

Coordination under the Fish and Wildlife Coordination Act is intended to promote conservation of fish and wildlife resources by preventing their loss or damage. It also provides for development and improvement of fish and wildlife resources in connection with water projects. Federal agencies that undertake water projects must fully consider recommendations made by USFWS, NMFS, and the appropriate fish and wildlife agency – in this case, CDFW – in their project reports and include measures to reduce impacts on fish and wildlife in project plans.

Rivers and Harbors Appropriation Act of 1899

The Rivers and Harbors Appropriation Act of 1899 (commonly known as the Rivers and Harbors Act) addresses activities that involve constructing dams, bridges, dikes, or other obstructions across any navigable water. To place any obstruction to navigation outside established Federal lines, or to excavate from or deposit material in such waters, a permit must be obtained from USACE. Navigable waters are defined in 33 CFR 329.4 as follows:

> *Those waters that are subject to the ebb and flow of the tide and/or are presently used, or have been used in the past, or may be susceptible for use to transport interstate or foreign commerce. A determination of navigability, once made, applies laterally over the entire surface of the waterbody, and is not extinguished by later actions or events which impede or destroy navigable capacity.*

Sections of the River and Harbors Act applicable to the SLWRI are described below.

Section 9 Section 9 (33 USC 401) prohibits the construction of any dam or dike across any navigable water of the United States without consent from Congress and approval of the plans by the Chief of Engineers and the Secretary of the Army. Where the navigable portions of the water body lie wholly within the limits of a single state, the structure may be built under authority of that state's legislature if the location and plans, or any modification thereof, are approved by the Chief of Engineers and by the Secretary of the Army.

Section 10 Section 10 (33 USC 403) prohibits the unauthorized obstruction or alteration of any navigable water of the United States. Construction of any structure in or over any navigable water of the United States, or the accomplishment of other work affecting the course, location, condition, or physical capacity of such waters, is unlawful unless the work has been authorized by the Chief of Engineers.

Section 13 Section 13 (33 USC 407) states that the Secretary of the Army may permit the discharge of refuse into navigable waters if the Chief of Engineers has determined that the discharge will not injure anchorage and navigation. Discharges of refuse are prohibited unless a permit has been obtained. Although the prohibition in this section – known as the Refuse Act – is still in effect, the Secretary of the Army's permit authority has been superseded by the permit authority given to the EPA Administrator and the states under Sections 402 and 405 of the CWA, respectively.

Safe Drinking Water Act

The Safe Drinking Water Act mandates that EPA establish regulations to protect human health from contaminants in drinking water. This law authorizes EPA to develop national standards for drinking water and to create a joint

Federal/state/tribal system to ensure compliance with these standards. The law also directs EPA to protect underground sources of drinking water by controlling the underground injection of liquid wastes.

EPA has developed primary and secondary drinking water standards under its Safe Drinking Water Act authority. EPA and authorized states and tribes enforce the primary drinking water standards, which are contaminant-specific concentration limits that apply to certain public supplies of drinking water. The primary standards consist of two elements: goals for maximum contaminant levels, which are nonenforceable health-based goals; and maximum contaminant levels, which are enforceable limits set as close to the maximum contaminant level goals as possible, considering the cost and feasibility of attainment.

Federal Water Project Recreation Act

The Federal Water Project Recreation Act requires that Federal agencies with authority to approve water projects include recreation development as a condition of approving permits. Recreation development must be considered along with any navigation, flood control, reclamation, hydroelectric, or multipurpose water resource project. The act states that “consideration shall be given to the opportunities, if any, which the project affords for outdoor recreation and for fish and wildlife enhancement…wherever any such project can reasonably serve either or both of these purposes consistently” (Title 16, Section 460l-12 of the U.S. Code (16 USC 460l-12)).

Federal Clean Air Act

The Federal Clean Air Act (CAA) was enacted to protect and enhance the nation’s air quality to promote public health and welfare and the productive capacity of the nation’s population. The CAA requires that Federal actions be evaluated to determine their potential impacts on air quality in the project region. California has a corresponding law, which also must be considered during the EIS/EIR process.

For specific projects, Federal agencies must coordinate with the appropriate air quality management district and EPA. This coordination determines whether the project conforms to the CAA and the state implementation plan.

Section 176 of the CAA prohibits Federal agencies from engaging in or supporting an action or activity that does not conform to an applicable state implementation plan. Actions and activities must conform to the plan’s purposes of eliminating or reducing violations of national ambient air quality standards, reducing the severity of violations, and attaining those standards expeditiously.

National Historic Preservation Act

Section 106 of the National Historic Preservation Act of 1966 and its implementing regulations (36 CFR Part 800, as amended in 2004) requires

Federal agencies to consider the effects of their actions, or those they fund or permit, on properties that are listed or eligible for listing in the National Register of Historic Places (NRHP). The NRHP is a register of districts, sites, buildings, structures, and objects of significance in American history, architecture, archaeology, engineering, and culture. The regulations provided in 36 CFR Part 60.4 describe the criteria to evaluate cultural resources for inclusion in the NRHP. Cultural resources can be significant on the national, state, or local level. Properties may be listed in the NRHP if they possess integrity of location, design, setting, materials, workmanship, feeling, and association, and meet any one of the following criteria:

1. Are associated with events that have made a significant contribution to the broad patterns of our history

2. Are associated with the lives of persons significant in our past

3. Embody the distinctive characteristics of a type, period, or method of construction, or represent the work of a master, or possess high artistic values, or represent a significant and distinguishable entity whose components may lack individual distinction

4. Have yielded, or may be likely to yield, information important in prehistory or history

Generally, properties are not considered eligible for the NRHP if they have achieved significance within the past 50 years. Certain exceptions are made in the regulation, such as a religious property deriving primary significance from its architectural distinction, or a grave of a historical figure of outstanding importance if there is no appropriate site directly associated with his productive life.

Farmland Protection Policy Act

The Farmland Protection Policy Act requires that a Federal agency examine the potential impacts of a proposed action on Prime Farmland and Unique Farmland, as defined by the U.S. Natural Resources Conservation Service. If the action would adversely affect farmland preservation, the Federal agency must consider alternatives to lessen the adverse effects.

Migratory Bird Treaty Act

The Migratory Bird Treaty Act, first enacted in 1918, implements domestically a series of treaties between the United States and Great Britain (on behalf of Canada), Mexico, Japan, and the former Soviet Union that provide international protection of migratory birds. The act authorizes the Secretary of the Interior to regulate the taking of migratory birds. It is unlawful, except as permitted by regulations, “to pursue, take, or kill any migratory bird, or any part, nest or egg of any such bird…” (16 USC 703). This prohibition includes both direct and indirect acts, although harassment and habitat modification are not included unless they result in the direct loss of birds, nests, or eggs. Several hundred species, essentially including all native birds, are currently protected by the Migratory Bird Treaty Act. The act offers no statutory or regulatory mechanism for obtaining an incidental take permit for the loss of nongame migratory birds.

Bald and Golden Eagle Protection Act

The Bald and Golden Eagle Protection Act, enacted in 1940 and amended multiple times since, prohibits the taking of bald and golden eagles without a permit from the Secretary of the Interior. Similar to the ESA, the Bald and Golden Eagle Protection Act defines "take" to include "pursue, shoot, shoot at, poison, wound, kill, capture, trap, collect, molest or disturb" (16 USC 668-668c). Any disturbance that would injure an eagle, decrease productivity, or cause nest abandonment – including habitat alterations that could have these results – is considered take and can result in civil or criminal penalties.

National Forest Management Act

The National Forest Management Act requires USFS to "provide for a diversity of plant and animal communities" (16 USC 1604(g)(3)(B)) as part of its multiple-use mandate. USFS must maintain "viable populations of existing native and desired nonnative species in the planning area" (36 CFR 219.19). The Sensitive Species program is designed to meet this mandate and to demonstrate USFS's commitment to maintaining biodiversity on National Forest System lands.

A key requirement of the National Forest Management Act is preparation of land and resource management plans that establish the goals, objectives, and standards and guidelines for managing the lands and resources of National Forest System lands managed by the various National Forests.

Federal Land Policy and Management Act

Sections 201 and 202 of the Federal Land Policy and Management Act of 1976 (FLPMA) (43 USC 1711–1712) and the regulations in 43 CFR 1600 provide guidance and direction for implementing BLM's land use planning requirements, as established by resource management plans. Resource management plans and subsequent planning decisions are the basis for every on-the-ground action undertaken by BLM.

Resource management plans ensure that public lands are managed in accordance with the intent of Congress as stated in the FLPMA, under the principles of multiple use and sustained yield. As required by the FLPMA and BLM policy, public lands must be managed in a manner that will do all of the following:

- Protect the quality of ecological and scientific values
- Preserve and protect certain public lands in their natural condition, where appropriate

- Provide food and habitat for fish and wildlife and domestic animals
- Provide for outdoor recreation and human occupancy and use
- Recognize the nation's need for domestic sources of minerals, food, timber, and fiber from the public lands by encouraging collaboration and public participation throughout the planning process

Resource management plans are among the primary mechanisms for guiding BLM activities to achieve compliance with the FLPMA.

National Wild and Scenic Rivers Act

The National Wild and Scenic Rivers Act of 1968, as amended (Public Law 90-542; 16 USC 1271–1287), established the National Wild and Scenic Rivers System. This system identifies distinguished rivers of the nation that possess outstandingly remarkable scenic, recreational, geologic, fish and wildlife, historic, cultural, or other similar values. The National Wild and Scenic Rivers Act preserves the free-flowing condition of designated rivers and protects their local environments. Section 5(d)(1) of the act requires Federal agencies to consider potential national wild, scenic, and recreational river areas when planning for the use and development of water and related land resources. Wild, scenic, and recreational river areas are defined as follows:

- *"Wild" river areas* are rivers or sections of rivers that are free of impoundments and generally inaccessible except by trail, with watersheds or shorelines essentially primitive and waters unpolluted. These represent vestiges of primitive America.
- *"Scenic" river areas* are rivers or sections of rivers that are free of impoundments, with shorelines or watersheds still largely primitive and shorelines largely undeveloped, but accessible by roads in places.
- *"Recreational" river areas* are rivers or sections of rivers that are readily accessible by road or railroad, that may have some development along their shorelines, and that may have undergone some impoundment or diversion in the past.

Designation as a National Wild and Scenic River explicitly prohibits the Federal government from licensing or permitting new hydroelectric dams or major diversions on these rivers. Federal agencies are also prohibited from assisting any water resource projects that may directly affect the resources for which the river was designated. Public lands within a corridor averaging one-quarter mile on both sides of the rivers are managed to protect resources designated as outstandingly remarkable for their scenic, recreational, historical/cultural, fish, wildlife, ecological, geological, or hydrologic value.

Indian Trust Assets

All Federal agencies have a responsibility to protect Indian trust assets. Indian trust assets are legal interests in assets held in trust by the Federal government for Native American tribes or individuals. Assets may be owned property, physical assets, intangible property rights, a lease, or the right to use something. Typically, they include lands, minerals, water rights, hunting and fishing rights, natural resources, money, and claims.

Executive Order 11988 (Flood Hazard Policy)

Executive Order 11988 is a flood hazard policy for all Federal agencies that manage Federal lands, sponsor Federal projects, or provide Federal funds to state or local projects. The order requires that Federal agencies take necessary action to reduce the risk of flood loss; restore and preserve the natural and beneficial values served by floodplains; and minimize the impacts of floods on human safety, health, and welfare.

Executive Order 11990 (Protection of Wetlands)

Executive Order 11990 is an overall wetlands policy for all Federal agencies that manage Federal lands, sponsor Federal projects, or provide Federal funds to state or local projects. The order requires that Federal agencies follow avoidance, mitigation, and preservation procedures with public input before they propose new construction in wetlands. Executive Order 11990 can restrict the sale of Federal land containing wetlands; however, it does not apply to Federal discretionary authority for non-Federal projects (other than funding) on non-Federal land.

Executive Order 12898 (Environmental Justice Policy)

Executive Order 12898 requires Federal agencies to identify and address the disproportionately high and adverse human health and environmental effects of Federal programs, policies, and activities on minority and low-income populations. The requirements of Executive Order 12898 apply to all Federal actions that are located on Federal lands, sponsored by a Federal agency, or funded with Federal monies and may affect minority or low-income populations.

Executive Order 13007 (Indian Sacred Sites) and April 29, 1994, Executive Memorandum

Executive Order 13007 (May 24, 1996) requires Federal agencies with land management responsibilities to accommodate access to and ceremonial use of Indian sacred sites by Indian religious practitioners and avoid adversely affecting the physical integrity of such sacred sites. Where appropriate, agencies are to maintain the confidentiality of sacred sites. Among other things, Federal agencies must provide reasonable notice of proposed actions or land management policies that may restrict future access to or ceremonial use of, or adversely affect the physical integrity of, sacred sites. The agencies must comply with the April 29, 1994, executive memorandum, "Government-to-Government Relations with Native American Tribal Governments."

Executive Order 13112 (National Invasive Species Management Plan)

Executive Order 11312 directs all Federal agencies to prevent and control introductions of invasive nonnative species in a cost-effective and environmentally sound manner to minimize their economic, ecological, and human health impacts. Executive Order 11312 established the national Invasive Species Council, made up of Federal agencies and departments, and the supporting Invasive Species Advisory Committee, composed of state, local, and private entities. The Invasive Species Council and Advisory Committee oversee and facilitate implementation of the executive order, including preparation of a national invasive-species management plan.

Federal Transit Administration

To address the human response to ground-borne vibration, the Federal Transit Administration has set forth guidelines for maximum-acceptable vibration criteria for different types of land uses (FTA 2006):

- 65 vibration decibels for land uses where low ambient vibration is essential for interior operations (e.g., hospitals, high-tech manufacturing, and laboratory facilities)
- 80 vibration decibels for residential uses and buildings where people normally sleep
- 83 vibration decibels for institutional land uses with primarily daytime operations (e.g., schools, churches, clinics, and offices)

Standards have also been established to address the potential for ground-borne vibration to cause structural damage to buildings. These standards were developed by the Committee of Hearing, Bio Acoustics, and Bio Mechanics at the request of EPA (FTA 2006). For fragile structures, this committee recommends a maximum limit of 0.25 inch per second peak particle velocity (FTA 2006). (Peak particle velocity is a measure of the intensity of ground vibration, specifically the time rate of change of the amplitude of ground vibration.)

Federal Land Use Policies

Federal land use policies apply only to actions on or affecting the uses of Federal lands. The following are the Federal lands located in the vicinity of the study area:

- National Forest System lands administered by the Shasta-Trinity National Forest
- Reclamation-owned lands along the Sacramento River, just south of Shasta Dam
- BLM-owned lands along the Sacramento River, just north of Red Bluff

Encroachment within these Federal properties would require approval from these entities.

Shasta-Trinity National Forest Land and Resource Management Plan

The *Shasta-Trinity National Forest Land and Resource Management Plan* was most recently revised in 1995 (USFS 1995). This document is revised every 10–15 years; it supersedes any previous forest plans, timber management plans, or National Recreation Area (NRA) plans. It contains the goals and objectives for Shasta-Trinity National Forest, its standards and guidelines, management prescriptions to be applied to land areas, and management area direction. It also sets forth requirements for monitoring and implementation of the plan. The allocations associated with this plan not only reflect the capability and suitability of the land for various uses, but also respond to the public issues (such as recommendations for Wild and Scenic River designations) and development opportunities identified during the planning process.

Whiskeytown-Shasta-Trinity National Recreation Area Management Plan

The Whiskeytown-Shasta-Trinity NRA consists of the Shasta and Trinity units on the Shasta-Trinity National Forest (managed by the USFS) and the Whiskeytown Unit located outside the National Forest (managed by the National Park Service).The Whiskeytown-Shasta-Trinity NRA was established on November 8, 1965 with the signing of Public Law 89-336 by President Lyndon Johnson. The legislation provides that administration of the NRA be carried out under separate management plans, and that these plans are to be reviewed and revised periodically. The *Management Guide: Shasta and Trinity Units of the Whiskeytown-Shasta-Trinity NRA* (USFS 1996) provides a general framework to guide management of the Shasta and Trinity Units of the NRA, and by which to evaluate and gauge the appropriate NRA management efforts and analysis. This guide is not a decision document or an assessment under NEPA, and does not implement site-specific projects.

The NRA Guide relies on the Forest Plan for a broad umbrella of direction and is incorporated by reference into the Forest Plan. The periodic updates to the NRA Guide respond to changes in environmental conditions, public concern, and recreation use patterns, providing better management of the resources in the NRA and continued implementation of the management direction in the Forest Plan. The Guide was recently reviewed and updated and is in draft form.

Redding Resource Management Plan

BLM owns lands along the Sacramento River just north of Red Bluff. This land is managed by BLM in accordance with the *Redding Resource Management Plan*, which covers more than 250,000 acres in north-central California in Butte, Shasta, Siskiyou, Tehama, and Trinity counties. Many Areas of Critical Environmental Concern and National Wild and Scenic River corridors are included within these easily accessed and heavily used public lands. Completed in 1993, the *Redding Resource Management Plan* primarily addresses recreation, land tenure, access, and forest management.

Federal Energy Regulatory Commission

Changes to hydroelectric facilities on the Pit River – instream flow releases or modifications to downstream structures – may necessitate an amendment to a FERC license. Typical modifications that require an amendment to a license or exemption include capacity changes, design changes, operational changes, land status changes, and time extensions. Before issuing a license amendment, FERC ensures that proposed changes to hydropower facilities comply with NEPA. For noncapacity-related amendments, other factors – the nature of the proposed change, project type (based on proposed capacity), and construction status – determine which items outlined in the FERC Division of Hydropower Administration and Compliance's *Compliance Handbook* to include in the amendment application. If any item in the original license would be modified as a result of the project, a revised version must be filed along with the amendment application.

Once the need for an amendment is determined, the appropriate resource agencies are consulted. The extent of agency consultation depends on whether the amendment is capacity-related or noncapacity-related. After pre-filing consultation is completed, the licensee files the amendment application. The FERC Division of Hydropower Administration and Compliance then determines whether a public notice is warranted and whether NEPA review is required. NEPA review entails preparing an environmental assessment and/or an EIS. The license amendment process is detailed in the *Compliance Handbook*.

3.4.2 State

California Environmental Quality Act

Prompted by the passage of NEPA in 1969, CEQA was signed into law in 1970 as California's counterpart to NEPA. CEQA requires State and local agencies to identify the significant environmental impacts of their actions and to avoid or mitigate those impacts, if feasible. The objectives of CEQA are to do all of the following:

- Disclose to decision makers and the public the significant environmental effects of proposed activities
- Identify ways to avoid or reduce environmental damage
- Prevent environmental damage by requiring implementation of feasible alternatives or mitigation measures
- Disclose to the public the reasons for agency approval of projects with significant environmental effects
- Foster interagency coordination in the review of projects

- Enhance public participation in the planning process

California Endangered Species Act

Pursuant to the California Endangered Species Act (CESA), a permit from CDFW is required for projects that could result in the take of a plant or animal species that is State-listed as threatened or endangered. Under the CESA, "take" is defined as an activity that would directly or indirectly kill an individual of a species, but the CESA definition of take does not include "harming" or "harassing," as the Federal ESA definition does. As a result, the threshold for take is higher under the CESA than under the ESA (i.e., habitat modification is not necessarily considered take under the CESA).

Sections 3503 and 3503.5 of the California Fish and Game Code state that it is unlawful to take, possess, or needlessly destroy the nest or eggs of any bird, or to take, possess, or destroy any raptors (i.e., species in the orders Falconiformes and Strigiformes), including their nests or eggs. Destruction of active nests caused by removal of vegetation in which the nests are located is a typical violation of these codes. Violation of Section 3503.5 could also include failure of active raptor nests that results from disturbance of nesting pairs by nearby project construction. This statute does not provide for the issuance of any type of incidental take permit.

California Fish and Game Code – Fully Protected Species

Protection of fully protected species is described in Sections 3511, 4700, 5050, and 5515 of the California Fish and Game Code. These statutes prohibit take or possession of fully protected species. CDFW is unable to authorize incidental take of fully protected species when activities are proposed in areas inhabited by those species. CDFW has informed non-Federal agencies and private parties that they must avoid take of any fully protected species in carrying out projects.

California Fish and Game Code Section 1602 – Streambed Alteration

All diversions, obstructions, or changes to the natural flow or bed, channel, or bank of any river, stream, or lake in California that supports wildlife resources are subject to regulation by CDFW under Section 1602 of the California Fish and Game Code. Under Section 1602, it is unlawful for any person, governmental agency, or public utility to do the following without first notifying CDFW:

> *…substantially divert or obstruct the natural flow of, or substantially change or use any material from the bed, channel, or bank of any river, stream, or lake, or deposit or dispose of debris, waste, or other material containing crumbled, flaked, or ground pavement where it may pass into any river, stream, or lake.*

A stream is defined as a body of water that flows at least periodically or intermittently through a bed or channel that has banks and supports fish or other aquatic life. This definition includes watercourses with a surface or subsurface flow that supports or has supported riparian vegetation. CDFW's jurisdiction within altered or artificial waterways is based on the value of those waterways to fish and wildlife.

California Fish and Game Code Sections 5900–5904, 5930–5948, 7261, and 7370 – Fish Passage

The California Fish and Game Code includes the following provisions intended to protect fish passage:

- *Sections 5900–5904* prohibit constructing or maintaining any device or contrivance in any stream that prevents, impedes, or tends to prevent or impede the passing of fish upstream and downstream.

- *Sections 5930–5948* require CDFW to inspect California's dams to ensure that dam owners are maintaining fish passage. CDFW may require dam owners to install a suitable fishway if passage is impeded.

- *Section 7261* authorizes the California Fish and Game Commission to designate as "Heritage Trout Waters" any waters that provide anglers with an opportunity to catch native trout, consistent with the conservation of the California native trout. The McCloud River redband trout occurs in the McCloud River upstream from McCloud Dam.

- *Section 7370* prohibits taking or possessing for commercial purposes, buying or selling, or offering to buy or sell all or part of any sturgeon, including its eggs, unless the sturgeon was cultured, taken from another state, or taken pursuant to a sport fishing license. Green sturgeon occurs in the primary and extended study areas in the Sacramento River, its tributaries, and the Delta.

California Water Commission

In November 2009, California enacted a comprehensive water package to improve the state's water supply reliability and restore the Sacramento- San Joaquin River Delta ecosystem. The package included the Safe, Clean, and Reliable Drinking Water Supply Act which, if approved by voters in 2014, will direct the California Water Commission to develop tools and methods for the quantification of public benefits of water storage projects including CALFED surface storage, groundwater storage, conjunctive use and reservoir reoperation, and local and regional storage.

Delta Stewardship Council

In November 2009 the Sacramento-San Joaquin Delta Reform Act was passed by the California Legislature and signed by Governor Schwarzenegger. It established state policy of coequal goals for the Delta and created the Delta Stewardship Council as a new, independent state agency that will delineate exactly how to meet these goals through development and implementation of the Delta Plan.

The Council's principal task is to develop and implement the Delta Plan, a legally enforceable document that will include all the actions necessary to ensure the state's coequal goals for the Delta are met (Delta Stewardship Council 2013).

Central Valley Flood Protection Board Encroachment Permit

Under CCR Title 23, the Central Valley Flood Protection Board (formerly called the State of California Reclamation Board) issues encroachment permits to maintain the integrity and safety of flood control project levees and floodways that were constructed according to the flood control plans adopted by the board or the California Legislature.

California Water Rights

A water right is a legally granted and protected right to take possession of water and put it to beneficial use. As authorized by the California Water Code, the SWRCB allocates surface water rights and permits the diversion and use of water throughout the state. Through its Division of Water Rights, the SWRCB issues permits to divert water for new appropriations, change existing water rights, or store water for a certain length of time. The SWRCB attaches conditions to these permits to ensure that the water user prevents waste, conserves water, does not infringe on the rights of others, and puts the State's water resources to the most beneficial use in the best interest of the public.

California Public Resources Code

PRC Section 5093.542, established through enactment of the California Wild and Scenic Rivers Act, as amended (Sections 5093.50 through 5093.70), aims to preserve designated rivers that possess extraordinary scenic, recreation, fishery, or wildlife values. With the act's passage, the California system protected segments of the Smith and Klamath rivers and their tributaries, and the Scott, Salmon, Trinity, Eel, Van Duzen, and American rivers. Segments of the McCloud River, Deer Creek, and Mill Creek were subsequently protected under the act in 1989 and 1995, respectively, although these segments were not formally designated as components of the State's Wild and Scenic Rivers System.

No dam, reservoir, diversion, or other water impoundment facility may be constructed on any river segment included in the State system. No water diversion facility may be constructed on any river segment included in the State system unless the Resources Secretary determines that the facility is needed to supply domestic water to local residents and that the facility will not adversely affect the river's free-flowing condition and natural character. In reference to the McCloud River, PRC Section 5093.542(c) states the following:

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

Designation as a Wild and Scenic River does not affect existing water rights and facilities. Proposed changes in existing rights and facilities or applications for new water rights and facilities on designated segments are subject to the domestic-use restriction and the nondegradation standard. Designated segments are considered fully appropriated streams by the SWRCB.

PRC Section 5093.542 shares similar criteria and definitions in regard to the purpose of protecting rivers with the National Wild and Scenic Rivers Act: identifying free-flowing rivers with extraordinary values suitable for protection, establishing a study process to include rivers in the system, and classifying river segments as either wild, scenic, or recreational based largely on the degree of development along each river segment included in the system. The primary purpose of both the Federal Wild and Scenic Rivers Act and the California Public Resources Code is to prohibit new water impoundments on designated rivers.

The California Public Resources Code also contains several other sections relevant to the project. Some examples include PRC Section 5096.225 (the California Park and Recreational Facilities Act of 1984), PRC Section 5094 (the Federal Water Project Recreation Act), and the CWA.

California Harbors and Navigation Code

The California Harbors and Navigation Code details the jurisdiction of the California Department of Boating and Waterways, which is focused on the development of public access to waterways, the safety of vessels and boating facilities, and on-the-water safety.

Porter-Cologne Water Quality Control Act

Under the Porter-Cologne Water Quality Control Act, “waters of the State” fall under the jurisdiction of the appropriate regional water quality control board (in this case, the CVRWQCB). Under the act, the regional water quality control board must prepare and periodically update basin plans. Each basin plan sets forth water quality standards for surface water and groundwater, and actions to control nonpoint and point sources of pollution to achieve and maintain these standards. Projects that affect wetlands or waters must meet the regional water quality control board's waste discharge requirements, which may be issued in addition to a water quality certification under Section 401 of the CWA.

California Land Conservation Act of 1965 (Williamson Act)

The California Land Conservation Act of 1965, commonly known as the Williamson Act, is the principal method for encouraging preservation of agricultural lands in California. The Williamson Act enables local governments to enter into contracts with private landowners that restrict specific parcels of land to agricultural or related open-space use for 10 years. In return, landowners receive property tax assessments that are based on farming and open space uses rather than full market value. Local governments receive an annual subvention (subsidy) of forgone property tax revenues from the State via the Open Space Subvention Act of 1971.

The Williamson Act empowers local governments to establish "agricultural preserves" consisting of lands devoted to agricultural uses and other compatible uses. When establishing such preserves, the locality may offer to owners of included agricultural land the opportunity to enter into annually renewable contracts that restrict the land use for at least 10 years. In return, the landowner is guaranteed a relatively stable tax base, founded on the value of the land for agricultural/open space use only and unaffected by its development potential.

Cancelling a Williamson Act contract requires the landowner to undergo an extensive review and approval process and pay fees of up to 12.5 percent of the property value. The local jurisdiction approving the cancellation must find that the cancellation is consistent with the purpose of the California Land Conservation Act or is in the public interest. Several subfindings must be made to support either finding, as defined in Section 51282 of the California Government Code.

California Clean Air Act

The California Clean Air Act of 1988 requires nonattainment areas to achieve and maintain the State ambient air quality standards by the earliest practicable date. Local air districts must develop plans for attaining the State standards for ozone, carbon monoxide, sulfur dioxide, and nitrogen dioxide.

California Native Plant Protection Act

In addition to the CESA, the California Native Plant Protection Act provides protection to endangered and rare plant species, subspecies, and varieties of wild native plants in California. The definitions of "endangered" and "rare" in the California Native Plant Protection Act closely parallel the CESA definitions of "endangered" and "threatened" plant species.

California Surface Mining and Reclamation Act

The California Surface Mining and Reclamation Act of 1975 (SMARA) (PRC Section 2710 et seq.) addresses surface mining. Among the activities subject to SMARA are the mining of minerals, gravel, and borrow material. SMARA requires mitigation to reduce adverse impacts on public health, property, and the environment. Because the SLWRI may obtain borrow material for project construction from sites not previously permitted, Reclamation must comply with SMARA. SMARA applies to an individual or entity that would disturb more than 1 acre or remove more than 1,000 cubic yards of material through surface mining activities, including the excavation of borrow pits for soil material. SMARA is implemented through permitting ordinances developed by local government "lead agencies" that provide the regulatory framework under which local mining and reclamation activities are conducted. The State Mining and Geology Board reviews the local ordinances to ensure that they meet the procedures established by SMARA.

California Native Plant Society Species Designations

The California Native Plant Society is a statewide nonprofit organization that seeks to increase understanding of California's native flora and to preserve this rich resource for future generations. The organization has developed and maintains lists of vascular plants of special concern in California. Species listed by the California Native Plant Society have no formal legal protection, but the values and importance of these lists are widely recognized.

California Scenic Highway Program

The Scenic Highways Element is an optional element of the *California Highway Designs Manual* authorized by Section 65303 of the Government Code. The stated intent (Streets and Highways Code, Section 260) of the California Scenic Highway Program is to protect and enhance California's natural scenic beauty and to protect the social and economic values provided by the state's scenic resources. For a highway to receive official designation, the local jurisdiction must enact a scenic corridor protection program that protects and enhances scenic resources. A properly enforced program can do all of the following:

- Protect against encroachment of inappropriate land uses
- Mitigate uses that detract from scenic values by proper siting, landscaping, or screening
- Make development more compatible with the environment by requiring building siting, height, colors, and materials that are harmonious with the surroundings
- Regulate grading to cause minimal alteration of existing contours and to preserve important vegetative features along the highway

State Lands Commission Land Use Lease

The California State Lands Commission has the authority and responsibility to manage and protect the important natural and cultural resources on certain public lands in the state and the public's rights to access these lands. Two distinct types of public lands are under the commission's jurisdiction: sovereign lands and school lands. Sovereign lands encompass approximately 4 million acres. These lands include the beds of California's naturally navigable rivers, lakes, and streams, and the state's tidal and submerged lands along the coastline, extending from the shoreline out to 3 miles offshore.

State of California General Plan Guidelines

The State of California has developed land-use compatibility guidelines for community-noise environments. The *State of California General Plan Guidelines*, published by the Governor's Office of Planning and Research (OPR 2003), provides guidance for the acceptability of projects within specific community-noise-equivalent-level/day-night noise level (L_{dn}) contours. With regard to the SLWRI, water recreational uses are considered acceptable in areas where exterior noise levels do not exceed 75 A-weighted decibels community noise equivalent level/L_{dn}. Water recreational uses are normally unacceptable in areas exceeding 70 A-weighted decibels L_{dn} and clearly unacceptable in excess of 80 A-weighted decibels L_{dn}. The guidelines also present adjustment factors that may be used to arrive at noise-acceptability standards that reflect the particular community's noise-control goals, sensitivity to noise, and assessment of the relative importance of noise issues.

California Department of Transportation

Caltrans recommends thresholds of 0.2 inch per second peak particle velocity for normal residential buildings and 0.08 inch per second peak particle velocity for old or historically significant structures (Caltrans 2002). These standards are more stringent than the Federal standard established by the Committee of Hearing, Bio Acoustics, and Bio Mechanics, presented above under "Federal Transit Administration."

Caltrans is responsible for planning, designing, construction, operating, and maintaining all State-owned roadways in California. The *Caltrans Highway Design Manual* establishes uniform policies and procedures to carry out Caltrans's highway design functions. The highway design criteria and policies in the manual provide a guide for applying standards in the design of projects and, rather than implementing enforceable regulations, present information and guidance.

3.4.3 Regional and Local

Shasta County Air Quality Management District's Authority to Construct and Permit to Operate

Facilities with equipment that may emit air pollution or would be used for controlling air pollution are subject to SCAQMD permit requirements. SCAQMD grants two types of permits: Authority to Construct and Permit to Operate. An Authority to Construct permit must be obtained before building or installing a new emissions unit or modifying an existing emissions unit that requires a permit. A Permit to Operate is issued after all construction is completed and the emission unit is ready for operation.

Other Local Permits and Requirements

Several other local permits and requirements may apply to the SLWRI. Shasta and Tehama counties and their public works departments will require compliance with local plans and ordinances, such as the county general plan, zoning ordinances, grading plan, and various use permits. Utility easements and various encroachments also may be required.

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