Chapter 3
Plan Formulation

The plan formulation process for Federal water resources studies is identified in the P&G (WRC 1983) and consists of the following deliberate and iterative steps:

- Identifying existing and projected future resources conditions likely to occur in a study area.
- Defining water resources problems, needs, and opportunities to be addressed, and developing planning objectives, constraints, and criteria.
- Identifying potential management measures and formulating potential alternative plans to meet planning objectives within planning constraints.
- Comparing and evaluating alternative plans.
- Selecting a plan for recommendation to decision makers for implementation or no action.

For the SLWRI, this iterative process was separated into five phases, of which the first three have been completed. These planning phases are illustrated in Figure 3-1 and described below:

- **Mission Statement Phase –** This study phase consisted of projecting without-project future conditions; defining resulting resource problems, and needs; defining a specific set of planning objectives; and identifying constraints and criteria for addressing the planning objectives.
- **Initial Alternatives Phase –** This phase included developing a number of potential management measures or project actions or features designed to address planning objectives. These measures were then used to formulate a set of plans that were conceptual in scope (concept plans). These initial plans were evaluated and compared to the planning objectives to identify the most suitable plans for further development.
- **Comprehensive Plans Phase –** The measures and concept plans carried forward were further refined and developed with more

specificity to formulate comprehensive plans to address the planning objectives. These plans were then evaluated and compared.

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

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

Public and stakeholder outreach was performed concurrently with the above phases, as shown in Figure 3-1. Major reports include the *Strategic Agency Public Involvement Plan*, published in 2003 (Reclamation), and the *Environmental Scoping Report*, published in 2006 (Reclamation).

Planning Objectives

This section discusses national planning objectives and objectives, constraints, and considerations specific to the SLWRI.

National Planning Objectives

The Federal objective is defined in the P&G (WRC 1983):

> *The Federal objective of water and related resources project planning is to contribute to national economic development consistent with protecting the Nation's environment, pursuant to national environmental statutes, applicable executive orders, and other Federal planning requirements.*

Contributions to national economic development (NED) are further defined as "increases in the net value of the national output of goods and services, expressed in monetary units. Contributions to NED are direct net benefits that accrue in the planning area and the rest of the Nation" (WRC 1983).

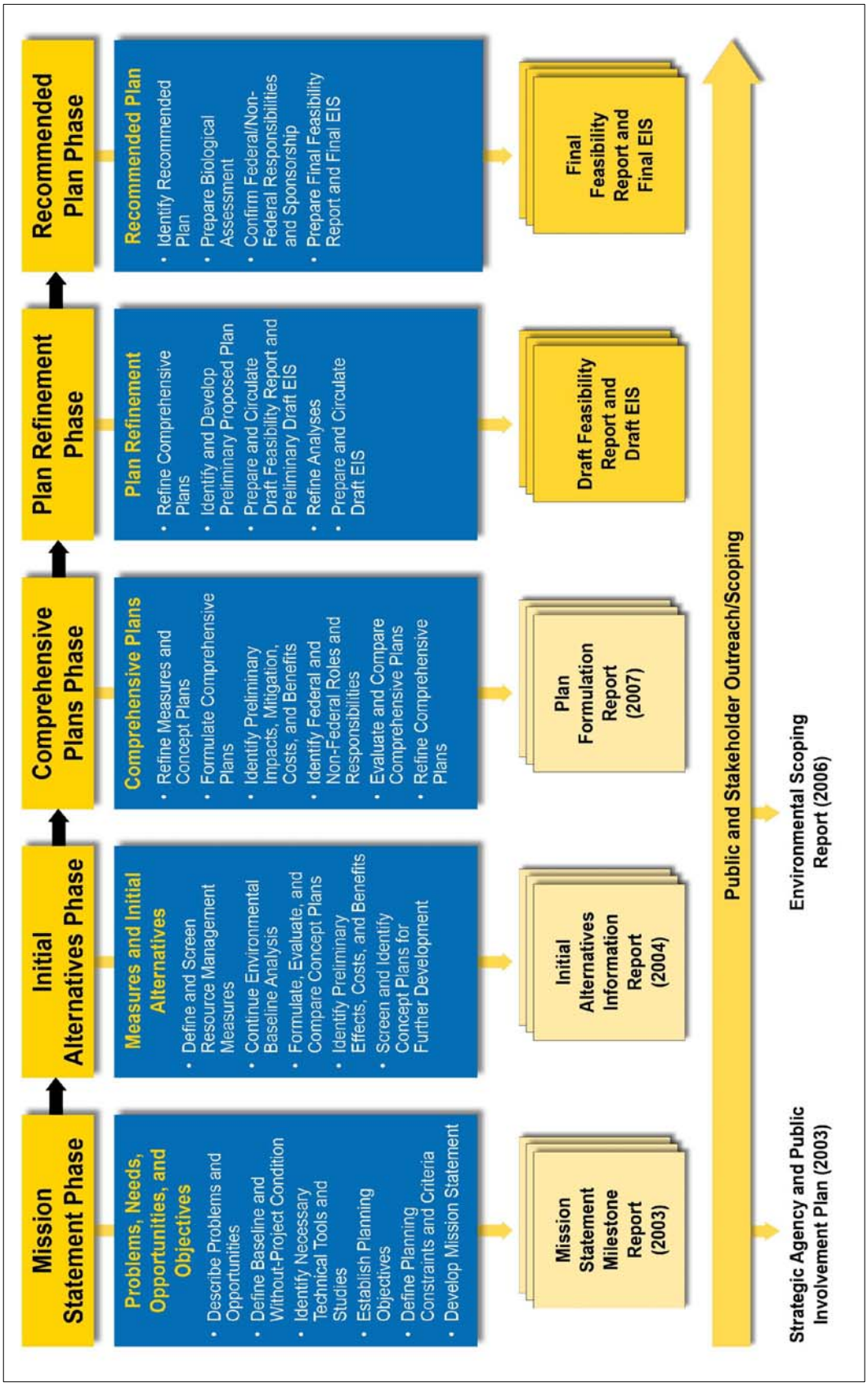


Figure 3-1. Plan Formulation Phases

The National Water Resources Planning Policy, specified in the Water Resources Development Act of 2007 (Public Law 110-114, Section 2031), is that Federal water resources investments should reflect national priorities, encourage economic development, and protect the environment by doing the following:

- Seek to maximize sustainable economic development
- Seek to avoid the unwise use of floodplains and flood-prone areas and minimize adverse impacts and vulnerabilities in any case in which a floodplain or flood-prone area must be used
- Protect and restore the functions of natural systems and mitigate any unavoidable damage to natural systems

In consideration of many complex water management challenges and competing demands for limited Federal resources, Federal agencies investing in water resources should strive to maximize public benefits, particularly compared to costs. Public benefits encompass environmental, economic, and social goals; include monetary and nonmonetary benefits; and allow for the inclusion of quantified and unquantified benefits. Stakeholders and decision makers expect the formulation and evaluation of a diverse range of alternative solutions. Such solutions may produce varying degrees of benefits and/or impacts relative to the three goals specified above. As a result, trade-offs among potential solutions will need to be assessed and properly communicated during the decision-making process.

SLWRI-Specific Planning Objectives

On the basis of the problems, needs, and opportunities identified and defined in Chapter 2, study authorities, and other pertinent direction, including information contained in the August 2000 CALFED ROD, primary and secondary planning objectives were developed. Primary planning objectives are those which specific alternatives are formulated to address. The primary objectives are considered to have coequal priority, with each pursued to the maximum practicable extent without adversely affecting the other. Secondary planning objectives are actions, operations, or features that should be considered in the plan formulation process, but only to the extent possible through pursuit of the primary planning objectives.

- **Primary Planning Objectives**
  - Increase the survival of anadromous fish populations in the Sacramento River, primarily upstream from the RBDD.
  - Increase water supply and water supply reliability for agricultural, M&I, and environmental purposes to help meet current and future

water demands, with a focus on enlarging Shasta Dam and Reservoir.

- **Secondary Planning 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.

Planning Constraints and Other Considerations

The P&G provides fundamental guidance for the formulation of Federal water resources projects. In addition, basic constraints and other considerations specific to this investigation must be developed and identified. Following is a summary of the constraints and considerations relevant to the SLWRI.

Planning Constraints

Planning constraints help guide the feasibility study. 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. Several key constraints identified for the SLWRI are as follows:

- **Study Authorizations** – Initial authorization for the SLWRI derives from Public Law 96-375, and additional guidance is contained in Public Law 108-361. These legislative actions authorized an investigation of the potential benefits of enlarging or replacing Shasta Dam and Reservoir.
- **CALFED ROD** – CALFED was established to "develop and implement a long-term comprehensive plan that will restore ecological health and improve water management for beneficial uses of the Bay-Delta system." The 2000 CALFED ROD includes program goals, objectives, and projects primarily to benefit the San Francisco Bay/Sacramento-San Joaquin Delta (Bay-Delta) system. The

objectives of the SLWRI are consistent with the CALFED ROD (CALFED 2000a) for Shasta enlargement, as follows:

> *Expand CVP storage in Shasta Lake by approximately 300,000 acre-feet. Such an expansion will increase the pool of cold water available to maintain lower Sacramento River temperatures needed by certain fish and provide other water management benefits, such as water supply reliability.*

- The ROD has been adopted by various Federal and State agencies as a framework for further consideration. In addition to objectives for potential enlargement of Shasta Dam and Reservoir, the Preferred Program Alternative in the CALFED ROD includes four other potential surface water and various groundwater storage projects to help reduce the gap between water supplies and projected demands. Expanding water storage capacity is critical to the successful implementation of all aspects of the program. Water supply reliability rests on capturing peak flows, especially during wet years. New storage must be strategically located to provide the needed flexibility in the current water system to improve water quality, support fish restoration goals, and meet the needs of a growing population. The CALFED ROD also includes numerous other projects to help improve the ecosystem functions of the Bay-Delta system. Developed plans should address the goals, objectives, and programs and projects of the CALFED ROD (2000a).

- **Laws, Regulations, and Policies** – Numerous laws, regulations, executive orders, and policies need to be considered, among them the P&G, NEPA, FWCA, Clean Air Act, CWA, National Historic Preservation Act, California Public Resources Code, Federal ESA and CESA, California Environmental Quality Act (CEQA), and CVPIA. Other important laws and regulations are discussed in Chapter 5.

Statewide Water Operation Considerations

A set of operational assumptions was developed in 2006 based on water operations described in the 2004 OCAP BA and the Coordinated Operations Agreement between Reclamation and DWR for the CVP and SWP, as ratified by Congress. These assumptions were used to guide development, modeling, and evaluation of potential effects of the No-Action Alternative and comprehensive plans included in this Draft Feasibility Report and accompanying Preliminary Draft EIS. Rationale for the decision to use these existing evaluations as the basis of analysis in the Draft Feasibility Report and accompanying Preliminary Draft EIS is provided in Chapter 2, "Water Resources and Related Conditions." Modeling studies will be updated to reflect changes in water operations resulting from ongoing OCAP reconsultation and other relevant water resources projects and programs, including, potentially,

BDCP/DHCCP efforts. The results of these updated studies will be incorporated into future SLWRI documents.

Other Planning Considerations

Other 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 USFWS, NMFS, USFS, Bureau of Indian Affairs (BIA), BLM, DWR, and DFG.

- 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 avoid any increases in flood damage or other significant, adverse hydraulic effects to areas downstream along the Sacramento River.

- Alternatives should strive to either avoid potential adverse effects to environmental resources or should include features to mitigate unavoidable adverse effects through enhanced designs, construction methods, and/or facilities operations.

- Alternatives should strive to avoid potential adverse effects to present or historical cultural resources, or 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 not result in a reduction of existing recreation capacity at Shasta Lake.

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

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

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

- Alternatives should 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.

Criteria

The Federal planning process in the P&G also includes four specific criteria for consideration in formulating and evaluating alternatives: (1) completeness, (2) effectiveness, (3) efficiency, and (4) acceptability (WRC 1983). Completeness is a determination of whether a plan includes all elements necessary to realize planned effects, and the degree that intended benefits of the plan depend on the actions of others. 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 while realizing specified objectives consistent with protecting the Nation's environment. Acceptability is the workability and viability of a plan with respect to its potential acceptance by other Federal agencies, State and local governments, and public interest groups and individuals. These criteria, and how they apply in helping to compare comprehensive alternative plans, are described in Chapter 4.

Management Measures

A management measure is any project action or feature that could address the planning objectives and satisfy the other applicable planning considerations. Concept plans are formulated by combining retained measures that address the primary planning objectives. These concept plans are then refined, as appropriate, considering measures to address the secondary planning objectives.

Measures Considered

More than 60 potential management measures were identified based on information from previous studies, programs, and projects to address the primary and secondary planning objectives and satisfy the other planning constraints, considerations, and criteria. These measures were reviewed and others developed during study team meetings, field inspections, scoping, and public outreach for the SLWRI. These measures were initially analyzed in the

Mission Statement Milestone Report (Reclamation 2003b) to determine whether they would be retained for further consideration. At each step of the plan formulation process, measures were reviewed, and in some cases reconsidered and incorporated into alternatives, or screened and eliminated from alternatives. The rationale for retaining or deleting each measure is described in greater detail in the Plan Formulation Appendix. Tables 3-1 through 3-4 list the management measures that address the planning objectives and other planning considerations, status of the measures (retained or deleted from further consideration), and rationale for the status determination.

Table 3-1. Management Measures Addressing Primary Planning Objective of Increasing Anadromous Fish Survival

Measure Description	Study Status	Status Rationale
Improve Fish Habitat		
Restore abandoned gravel mines along the Sacramento River	**Deleted**	Moderate potential to effectively address the primary planning objective and for likelihood of success. Although this measure was initially retained during preliminary analyses, it has been deleted from further consideration because of likely marginal benefits to anadromous fish and a general lack of interest from the public and stakeholders.
Construct instream aquatic habitat downstream from Keswick Dam	**Retained**	High potential for combining with other measures. This measure was retained for potential further development because of its potential to successfully address the first primary planning objective, and its potential to combine favorably with other potential measures. In addition, this measure received strong interest from fisheries and resource agencies.
Replenish spawning gravel in the Sacramento River	**Retained**	High potential for combining with other measures. Demonstrated benefits that continue as gravel moves downstream. Low initial cost. Concerns over induced downstream impacts to agricultural facilities. Consistent with Federal planning objectives and principles.
Construct instream fish habitat on tributaries to the Sacramento River	**Deleted**	Significant benefit to tributaries. Independent of hydraulic/hydrologic conditions in upper Sacramento River and would not directly contribute to improved ecological conditions along mainstem Sacramento River.
Remove instream sediment along Middle Creek	**Deleted**	Significant benefit to spawning conditions in tributaries. Independent of hydraulic/hydrologic conditions in upper Sacramento River and would not directly contribute to improved ecological conditions along mainstem Sacramento River. High uncertainty due to increased need for long-term remediation.
Rehabilitate inactive instream gravel mines along Stillwater and Cottonwood creeks	**Deleted**	Significant benefit to spawning conditions in tributaries. Independent of hydraulic/hydrologic conditions in upper Sacramento River, and would not directly contribute to improved ecological conditions along mainstem Sacramento River.
Improve Water Flows and Quality		
Make additional modifications to Shasta Dam for temperature control	**Retained**	High likelihood of combining with measures involving increasing Shasta Reservoir storage. Although existing TCD at Shasta effectively meets objectives, potential may exist to further modify the device to benefit anadromous fish with increased storage at Shasta Reservoir.
Enlarge Shasta Lake cold-water pool	**Retained**	High potential for combining with other measures. Consistent with other primary planning objective and secondary planning objectives. Consistent with goals of CALFED.
Modify storage and release operations at Shasta Dam	**Retained**	Moderate potential to meet the primary planning objective of increasing anadromous fish survival. This measure was initially deleted from consideration because of analyses indicating a decreased fisheries benefit with increasing Sacramento River flows compared to increasing the cold-water pool. However, this measure has been retained as part of an adaptive management strategy.
Modify ACID diversions to reduce flow fluctuations	**Deleted**	Conflicts with other primary planning objective of water supply reliability.
Increase instream flows on Clear, Cow, and Bear creeks	**Deleted**	Independent of hydraulic/hydrologic conditions in upper Sacramento River.

Table 3-1. Management Measures Addressing Primary Planning Objective of Increasing Anadromous Fish Survival (contd.)

Measure Description	Study Status	Status Rationale
Improve Water Flows and Quality (contd.)		
Construct a storage facility on Cottonwood Creek to augment spring instream flows	**Deleted**	Independent of hydraulic/hydrologic conditions in upper Sacramento River. Adverse environmental impacts expected to exceed benefits.
Transfer existing Shasta Reservoir storage from water supply to cold-water releases	**Deleted**	Violates basic plan formulation considerations – causes significant reduction in water supply reliability without development of a replacement supply.
Remove Shasta Dam and Reservoir	**Deleted**	Violates basic plan formulation considerations and no known project or projects could replace the lost benefits provided by Shasta and Keswick dams, reservoirs, and appurtenant facilities, at any price.
Improve Fish Migration		
Improve fish trap below Keswick Dam	**Deleted**	Although helps fish populations, would not contribute to favorable conditions for sustained spawning and rearing of anadromous fish along mainstem Sacramento River.
Screen diversions on Old Cow and South Cow creeks	**Deleted**	Significant benefit to spawning conditions in tributaries. Independent of hydraulic/hydrologic conditions in upper Sacramento River and would not contribute to improved ecological conditions along mainstem Sacramento River.
Remove or screen diversions on Battle Creek	**Deleted**	Significant benefit to spawning conditions in tributaries. Independent of hydraulic/hydrologic conditions in upper Sacramento River, and would not contribute to improved ecological conditions along mainstem Sacramento River.
Construct a migration corridor from the Sacramento River to the Pit River	**Deleted**	Extremely high cost. Multiple physical obstructions of effective fish passage even after implementation. Very low certainty of success.
Cease operating or remove the Red Bluff Diversion Dam	**Deleted**	As the result of another Federal investigation – Red Bluff Diversion Dam Fish Passage Improvement Project – Reclamation subsequently ceased operation of Red Bluff Diversion Dam.
Reoperate the CVP to improve overall fish management	**Deleted**	See above measure regarding the Red Bluff Diversion Dam. Issues regarding reoperating facilities on the Trinity River were addressed in the Trinity River Record of Decision in 2000 (DOI). Any further modification within that system would violate planning criteria for the SLWRI.
Construct a fish ladder on Shasta Dam	**Deleted**	Extremely high cost, relatively small benefit on limited stream system, and very low potential for physically implementing a workable ladder.
Reintroduce anadromous fish to areas upstream from Shasta Dam	**Deleted**	Likely high cost, low potential for successful recapture of out-migrants, and potential for major impacts to existing warm- and cold-water species in the upper river.

Key:
ACID = Anderson-Cottonwood Irrigation District
CALFED = CALFED Bay-Delta Program
CVP = Central Valley Project
DOI = U.S. Department of the Interior
Reclamation = U.S. Department of the Interior, Bureau of Reclamation
SLWRI = Shasta Lake Water Resources Investigation
TCD = temperature control device

Table 3-2. Management Measures Addressing Primary Planning Objective of Increasing Water Supply Reliability

Measure Description	Study Status	Status Rationale
Increase Surface Water Storage		
Increase conservation storage space in Shasta Reservoir by raising Shasta Dam	**Retained**	Consistent with primary planning objective and directly contributes to secondary planning objectives.
Construct new conservation storage reservoir(s) upstream from Shasta Reservoir	**Deleted**	Upstream storage sites capable of CVP system-wide benefits would be very costly, result in environmental impacts difficult to mitigate, and would be inconsistent with the 2000 CALFED ROD.
Construct new conservation storage on tributaries to the Sacramento River downstream from Shasta Dam	**Deleted**	Although potentially feasible sites/projects exist that could increase water supply reliability, significant overriding environmental and socioeconomic issues restrict implementation at this time.
Construct new conservation offstream surface storage near the Sacramento River downstream from Shasta Dam	**Deleted**	Not as efficient as developing additional storage in Shasta Dam. NODOS being pursued as added increment to system through a separate feasibility-scope study initiated under Public Law 108-361.
Construct new conservation surface water storage south of the Sacramento-San Joaquin Delta	**Deleted**	Not an effective alternative to additional storage at Shasta. Does not contribute to other planning objectives. Upper San Joaquin River storage being pursued as added increment to system through a separate feasibility-scope study initiated under Public Law 108-361.
Increase total or seasonal conservation storage at other CVP facilities	**Deleted**	Not an efficient alternative to increasing storage in Shasta Reservoir; significantly higher unit cost for increased water supply. Known efforts to increase space in other Northern California CVP (or SWP) reservoirs rejected by CALFED.
Dredge bottom of Shasta Reservoir	**Deleted**	Extremely high cost for a very small potential benefit and severe environmental impacts.
Reoperate Reservoir		
Increase effective conservation storage space in Shasta Reservoir by increasing efficiency of reservoir operation for water supply reliability	**Retained**	Moderate to high potential for increment of increased water supply reliability at Shasta Reservoir. Although potential for increased water supply reliability is limited, added opportunities exist for increased flood control and other management elements.
Increase the conservation pool in Shasta Reservoir by encroaching on dam freeboard	**Deleted**	Very limited potential to encroach on existing freeboard above full pool, which is only 9.5 feet. High relative cost to resolve uncertainty issues related to encroachment.
Increase conservation storage space in Shasta Reservoir by reallocating space from flood control	**Deleted**	Very low potential for implementation due to significant adverse impacts on system flood management.

Table 3-2. Management Measures Addressing Primary Planning Objective of Increasing Water Supply Reliability (contd.)

Measure Description	Study Status	Status Rationale
Improve Conjunctive Water Management		
Develop conservation offstream surface storage near the Sacramento River downstream from Shasta Dam	**Deleted**	Implementing additional surface water storage project increment for downstream from Shasta Dam would not be as efficient as new storage in Shasta Reservoir. Potential for shared storage in NODOS project is being considered in separate feasibility study initiated under Public Law 108-361.
Develop conservation groundwater storage near the Sacramento River downstream from Shasta Dam	**Deleted**	Moderate to high potential to enhance system yield when combined with new storage and reoperation of Shasta. Although this measure was initially retained during preliminary analyses, it has been eliminated because of operations analyses indicating tradeoffs between conjunctive use water supply benefits and critical gains in fisheries accomplishments.
Develop additional conservation groundwater storage south of the Sacramento-San Joaquin Delta	**Deleted**	Not as effective as storage north of the Delta and would not contribute to other study objectives.
Coordinate Operation and Precipitation Enhancement		
Improve Delta export and conveyance capability through coordinated CVP and SWP operations	**Deleted**	JPOD is being actively pursued in other programs. A likely without-project condition.
Implement additional precipitation enhancement	**Deleted**	Not an effective alternative to new storage. Very limited potential to benefit drought period water supply reliability. Being actively pursued under without-project conditions.
Reduce Demand		
Implement water use efficiency methods	**Retained**	Although water use efficiency does not increase supplies, conservation is being actively pursued through other programs. Conservation needs to be considered as an element of any plan for addressing California's water future.
Retire agricultural lands	**Deleted**	Not an alternative to new storage. Does not address planning objectives and considerations/criteria. Land retirement test programs being performed by Reclamation. On a large scale, could have significant negative impacts on agricultural industry.
Improve Water Transfers and Purchases		
Transfer water between users	**Deleted**	Not an alternative to new storage at Shasta Dam. Does not address planning objectives or considerations/criteria. Will likely be accomplished with or without additional efforts to develop new sources.

Table 3-2. Management Measures Addressing Primary Planning Objective of Increasing Water Supply Reliability (contd.)

Measure Description	Study Status	Status Rationale
Expand Delta Export and Conveyance Facilities		
Expand Banks Pumping Plant	**Deleted**	Not an alternative to new storage north of the Delta. Does not address planning objectives or considerations/criteria. Will likely be accomplished with or without additional efforts to develop new sources.
Construct DMC/CA intertie	**Deleted**	Not an alternative to new storage north of the Delta. Does not address planning objectives or considerations/criteria. Will likely be accomplished with or without additional efforts to develop new sources.
Improve Surface Water Treatment		
Implement treatment/supply of agricultural drainage water	**Deleted**	Not a viable alternative to new water storage. Very high unit water cost.
Construct desalination facility	**Deleted**	Not an alternative for drought period supplies. Not an alternative to new storage at Shasta. Very high unit water cost.

Key:
Banks Pumping Plant = Harvey O. Banks Pumping Plant
CALFED = CALFED Bay-Delta Program
CVP = Central Valley Project
Delta = Sacramento-San Joaquin Delta
DMC/CA = Delta-Mendota Canal/California Aqueduct
JPOD = Joint Point of Diversion
NODOS = North-of-the-Delta Offstream Storage
Reclamation = U.S. Department of the Interior, Bureau of Reclamation
ROD = Record of Decision
SWP = State Water Project

Table 3-3. Management Measures Addressing Secondary Planning Objective of Conserving, Restoring, and Enhancing Ecosystem Resources

Measure Description	Study Status	Status Rationale
Improve Cold-Water and Warm-Water Fishery Habitat		
Construct shoreline fish habitat around Shasta Lake	**Retained**	Would complement measures to increase storage in Shasta Lake.
Construct instream fish habitat on tributaries to Shasta Lake	**Retained**	Would complement measures to increase storage in Shasta Lake. High local interest.
Increase instream flows on the lower McCloud River	**Deleted**	Significant impacts to hydropower.
Reduce acid mine drainage entering Shasta Lake	**Deleted**	Significant implementation, O&M, and liability issues.
Reduce motorcraft access to upper reservoir arms	**Deleted**	Motorcraft management is under the purview of USFS.
Increase instream flows on the Pit River	**Deleted**	Significant impacts to hydropower.
Restore and Conserve Riparian and Wetland Habitat		
Restore riparian and floodplain habitat along the Sacramento River	**Retained**	Would be compatible with other primary planning objectives. Consistent with other restoration programs and projects in the primary study area.
Restore wetlands along the Fall River and Hat Creek	**Deleted**	Significantly removed from primary study area. Independent action with low potential to contribute to other primary or secondary planning objectives.
Conserve upper Pit River riparian areas	**Deleted**	Significantly removed from primary study area. Independent action with low potential to contribute to other primary or secondary planning objectives.
Restore riparian and floodplain habitat on lower Clear Creek	**Deleted**	Significant benefit to tributaries. Independent action and would not directly contribute to improved ecological conditions along mainstem Sacramento River.
Promote Great Valley cottonwood regeneration along the Sacramento River	**Deleted**	High uncertainty for Federal participation and low potential to contribute to primary and other secondary planning objectives.
Conserve riparian corridor along Cow Creek	**Deleted**	Significant benefit to tributaries. Independent action and would not directly contribute to improved ecological conditions along mainstem Sacramento River.
Remove and control nonnative vegetation in the Cow Creek and Cottonwood Creek watersheds	**Deleted**	Significant benefit to tributaries. Independent action and would not contribute to primary or secondary planning objective conditions along mainstem Sacramento River.

Table 3-3. Management Measures Addressing Secondary Planning Objective of Conserving, Restoring, and Enhancing Ecosystem Resources (contd.)

Measure Description	Study Status	Status Rationale
Improve Other Fish and Wildlife Habitat		
Create a parkway along the Sacramento River	**Deleted**	Primarily focuses on land acquisition and conversion to public uses. As a project element, it would be a non-Federal responsibility with little direct Federal interest. Elements are a likely without-project condition.
Enhance forest management practices to conserve bald eagle nesting habitat	**Deleted**	Likely a without-project condition; is an element of USFS forest recovery plans.
Remove and control nonnative plants around Shasta Lake	**Deleted**	Likely a without-project condition; is an element of USFS forest recovery plans.
Control erosion and restore affected habitat in the Shasta Lake area	**Deleted**	Likely a without-project condition; is an element of USFS forest recovery plans.
Develop geographic information system for Shasta to Red Bluff reach	**Deleted**	Would not directly contribute to other primary or secondary planning objectives. GIS mapping likely a without-project condition as part of other ongoing studies and projects.
Implement erosion control in tributary watersheds	**Deleted**	Significant benefit to tributaries. Independent action and would not directly contribute to improved ecological conditions near Shasta Lake or along mainstem Sacramento River.

Key:
GIS = geographic information system
O&M = operations and maintenance
USFS = U.S. Department of Agriculture, Forest Service

Table 3-4. Management Measures Addressing Secondary Planning Objectives of Reducing Flood Damage, Developing Additional Hydropower Generation, Maintaining and Increasing Recreation, and Maintaining or Improving Water Quality

Planning Objectives/ Measure Description	Study Status	Status Rationale
Reduce Flood Damage		
Update Shasta Dam and Reservoir flood management operations	**Retained**	Compatible with any potential modification of Shasta Dam and Reservoir. Potential to realize an increase in flood damage reduction with increasing size of Shasta Reservoir for primary planning objectives. Would not conflict with other secondary planning objectives or planning considerations/criteria.
Increase flood management storage space in Shasta Reservoir	**Deleted**	Would conflict with the primary planning objectives. Estimated low potential for economic justification (costs are expected to exceed benefits). For increased space via raising Shasta Dam, it is expected that dam raise construction costs would significantly exceed flood damage reduction benefits. For space increase through reoperation, expected costs to replace reduction in water reliability would also significantly exceed flood damage reduction benefits.
Implement nonstructural flood damage reduction measures	**Deleted**	Independent action and not directly related to accomplishing the primary or other secondary planning objectives.
Implement traditional flood damage reduction measures	**Deleted**	Independent action and not directly related to accomplishing the primary or other secondary planning objectives.
Route probable maximum flood from top of conservation pool	**Deleted**	This measure is already consistent with existing reservoir conditions and operations, making further changes unnecessary.
Develop Additional Hydropower Generation		
Modify existing/construct new generation facilities at Shasta Dam to take advantage of increased hydraulic head	**Retained**	Potential to realize an increase in hydropower output from Shasta with increasing size of Shasta Reservoir for primary planning objectives. Would not conflict with other secondary planning objectives or planning considerations/criteria.
Construct new hydropower generation facilities	**Deleted**	This measure would directly contribute to the secondary planning objective but it is an independent action and not directly related to accomplishing the primary planning objectives. Although this measure has potential to realize additional hydropower benefits with increased/replaced hydropower facilities, it could be pursued regardless of primary planning objectives.

Table 3-4. Management Measures Addressing Secondary Planning Objectives of Reducing Flood Damage, Developing Additional Hydropower Generation, Maintaining and Increasing Recreation, and Maintaining or Improving Water Quality (contd.)

Planning Objectives/ Measure Description	Study Status	Status Rationale
Maintain and Increase Recreation Opportunities		
Maintain and enhance recreation capacity, facilities, and opportunities	**Retained**	Compatible with any potential modification of Shasta Dam and Reservoir. Would be consistent with established planning guidelines for Federal water storage projects and with existing recreation uses at Shasta Reservoir.
Develop new National Recreation Area recreation plan	**Deleted**	Developing, coordinating, and implementing a new National Recreation Area as a stand-alone measure is believed to be a separate Federal action outside the scope of this investigation. It is understood, however, that other measures, such as enlarging Shasta Dam and Reservoir would likely require, at minimum, modification of existing recreation plan.
Reoperate reservoir for recreation	**Retained**	Compatible with any potential modification of Shasta Dam and Reservoir. Potential to realize an increase in recreation experiences with increasing size of Shasta Reservoir for primary planning objectives. Limited potential for reservoir reoperation to benefit recreation by allowing more reliable filling of the reservoir during the spring.
Maintain or Improve Water Quality		
Improve operational flexibility for Sacramento-San Joaquin Delta water quality by increasing storage in Shasta Reservoir	**Retained**	Compatible with any potential modification of Shasta Dam and Reservoir. Increased storage would contribute to meeting downstream water quality requirements and would provide for increased operational flexibility and Sacramento-San Joaquin Delta emergency response.

Measures to Address Primary Planning Objectives

As shown in Tables 3-1 and 3-2, numerous measures were identified to address the primary planning objectives of increasing anadromous fish survival and increasing water supply reliability.

Increase Anadromous Fish Survival A number of potential water management measures were identified to address increasing anadromous fish survival and other ecosystem restoration opportunities. Most are listed in the 2003 *Ecosystem Restoration Office Report* (Reclamation). These measures were separated into three broad categories: (1) improved fish habitat, (2) improved water flows and quality, and (3) improved fish migration. Of more than 20 measures identified specifically to address the primary planning objective of increasing anadromous fish survival in the Sacramento River, 6 measures were retained for possible inclusion in concept plans. Through the alternatives formulation and screening process, these measures were refined. Five measures were incorporated into the comprehensive plans evaluated in this Draft Feasibility Report (see Table 3-1).

Increase Water Supply Reliability Various potential water management measures were identified to address the primary planning objective of increasing water supply reliability for M&I, agricultural, and environmental purposes to help meet current and future water demands. These measures were separated into eight categories: (1) increased surface water storage, (2) reservoir reoperation, (3) improved conjunctive water management, (4) coordinated operation and precipitation enhancement, (5) demand reduction, (6) improved water transfers and purchases, (7) improved Delta export and conveyance, and (8) improved surface water treatment. Of 22 measures considered to help increase water supply reliability, 4 were retained for possible inclusion in concept plans. Through the alternatives formulation and screening process, these measures were refined. Three measures were incorporated into the comprehensive plans evaluated in this Draft Feasibility Report (see Table 3-2).

Measures to Address Secondary Planning Objectives

The following is a discussion of measures identified to address secondary planning objectives.

Conserving, Restoring, or Enhancing Ecosystem Resources Identifying potential ecosystem restoration opportunities included water management measures to address the secondary objective of ecosystem restoration in the Shasta Lake vicinity and along the Sacramento River downstream from Shasta Dam. The measures were separated into three categories: (1) improving cold-water and warm-water fisheries, (2) restoring and conserving riparian and wetland habitat, and (3) improving other fish and wildlife habitat. Of the 19 management measures identified to address this secondary planning objective, 3 were retained for further development (see Table 3-3).

In the discussion of SLWRI management measures and alternative plans, the term "enhancement" specifically refers to restoration actions that would 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 alternative plan impacts. The relationship between restoration, enhancement, and mitigation is illustrated in Figure 3-2.

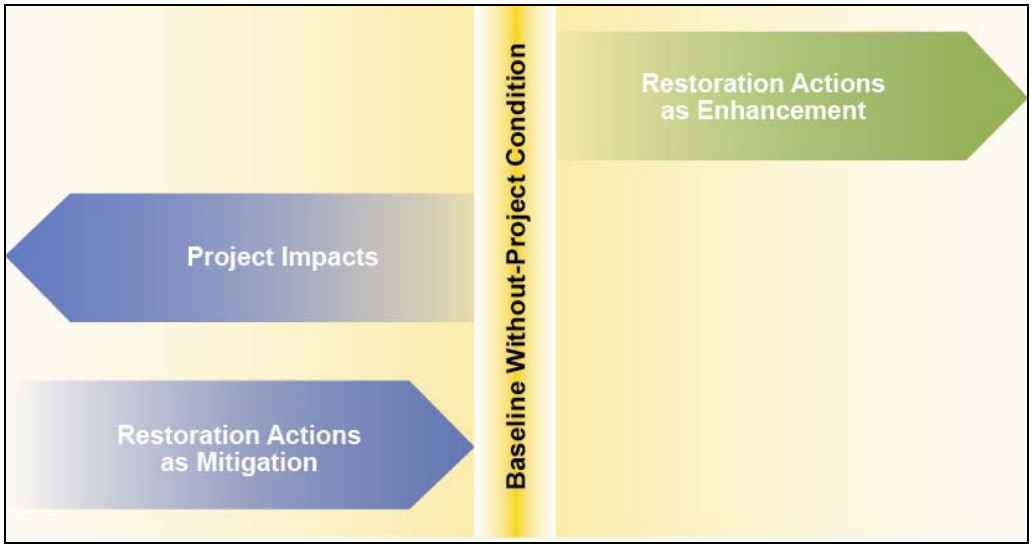


Figure 3-2. Conceptual Schematic of Restoration Actions as Enhancement Versus Restoration Actions as Mitigation

Reduce Flood Damage Five water management measures were identified to help reduce flood damage along the Sacramento River. Of the five, two were initially retained for further development and possible inclusion in concept plans. These included (1) updating Shasta Dam and Reservoir flood management operations and (2) routing the probably maximum flood from the top of the conservation pool. Through additional analyses, the second measure was found to be consistent with existing reservoir operations and was subsequently eliminated from further consideration; the first measure was incorporated into the comprehensive plans evaluated in this Draft Feasibility Report (see Table 3-4).

Develop Additional Hydropower Generation Two water management measures were considered to increase hydropower potential in the study area. They included (1) modifying the existing/constructing new generation facilities at Shasta Dam to take advantage of increased hydraulic head and (2) constructing new hydropower generation facilities in the area. As shown in Table 3-4, the first measure was retained for further development in concept and comprehensive plans.

Maintain and Increase Recreation Opportunities Three general water management measures were identified to help maintain and increase recreation opportunities at Shasta Lake. Of these three measures, two (see Table 3-4) were retained for further development in concept and comprehensive plans. They include (1) maintaining and enhancing recreation capacity, facilities, and opportunities, and, (2) reoperating the reservoir to stabilize early season filling in Shasta Lake.

Maintain or Improve Water Quality One management measure was identified to improve water quality in the Sacramento River and Delta (see Table 3-4). It was retained for further development in concept and comprehensive plans. This measure involves improving operational flexibility to improve Delta water quality by increasing storage in Shasta Reservoir.

Measures Retained for Further Development

Following is a brief description of the management measures retained for further consideration and incorporated into the comprehensive plans.

Increase Anadromous Fish Survival The following five measures were retained to address the primary objective of increasing the survival of anadromous fish populations in the Sacramento River.

- **Construct Instream Aquatic Habitat Downstream from Keswick Dam** – Keswick Dam is the uppermost barrier to anadromous fish migration on the Sacramento River. Releases from the dam have scoured the channel, and the dam blocks passage of gravels, bed sediments, and woody debris that were replenished historically by upstream tributaries. As a result, aquatic habitat is poor for spawning and rearing of anadromous fish, and predation can be high because of the lack of instream cover. Despite these unfavorable channel conditions, cold-water releases from Keswick Dam attract large numbers of spawners to this reach. This measure consists of constructing aquatic habitat in and adjacent to the Sacramento River downstream from Keswick Dam to encourage use of this reach by anadromous fish for reproduction. Habitat restoration would involve acquiring lands adjacent to the Sacramento River; earthwork along the riverbank to construct side channels for spawning; and strategic placement of instream cover structures within the river channel, including large boulders, anchored root wads, and other natural materials. Side channels and other features could be created to encourage spawning and rearing. Restored floodplain lands could be revegetated with native riparian plants.

  This measure was retained for potential further development as part of the SLWRI because it may have potential to successfully address the first primary planning objective, and because of high interest from fisheries agencies. Furthermore, it may combine favorably with other

potential measures related to Shasta Dam and Reservoir and their operation. This measure would not be expected to conflict with other known programs or projects on the upper Sacramento River.

- **Replenish Spawning Gravel in the Sacramento River –** The restoration of aquatic habitat between Keswick Dam and Red Bluff is of high priority because this reach is one of the few remaining spawning corridors available to anadromous fish along the Sacramento River. This measure would support the primary planning objective of increasing the survival of anadromous fish populations in the Sacramento River by contributing to the replenishment of spawning gravels used by anadromous fish. Gravel recruitment is of particular importance to anadromous fish, which require clean gravels for their spawning beds. Dams, river diversions, gravel mining, and other obstructions have blocked or reduced natural gravel sources. Suitable spawning gravel has been identified as a potential limiting factor in the recovery of anadromous fish populations on the Sacramento River. Several other programs, including CALFED and the AFRP, have provided gravel replenishment in selected locations. This measure would involve transporting and placing gravel into the Sacramento River downstream from Keswick Dam. Structural treatments may be required below Keswick Dam to prevent the gravel from being washed downstream. Temporary construction easements could be required. Suitable spawning gravel would consist of uncrushed, natural river rock, washed and placed in the river at strategic locations. Hydraulic and geomorphic evaluations are needed to determine the most effective gravel size distribution and the most appropriate locations for gravel placement.

- **Make Additional Modifications to Shasta Dam for Temperature Control** – For relatively small raises of Shasta Dam, the existing TCD structure would be retrofitted to account for additional dam height, and to reduce leakage of warm water into the structure, but no new structure would be needed. However, modifications to, or replacement of, the existing structure are more likely to be necessary for increasingly higher dam raises. This measure would support the primary planning objective of increasing the survival of anadromous fish populations by (1) increasing the ability of operators at Shasta Dam to meet downstream temperature requirements for anadromous fish, (2) providing more flexibility in achieving desirable water temperatures during critical spawning, rearing, and out-migration, and (3) extending the area of suitable spawning habitat farther downstream in the Sacramento River.

- **Enlarge Shasta Lake Cold-Water Pool** – Cold water released from Shasta Dam significantly influences water temperature conditions on the Sacramento River between Keswick and the RBDD. This measure

includes increasing the volume of the cold-water pool in Shasta Lake by raising Shasta Dam and enlarging Shasta Reservoir primarily to help maintain colder releases for anadromous fish during certain periods. Increased storage volume could also help increase seasonal flows during dry and critically dry years in the upper Sacramento River that are important to fish populations.

Possible operational changes to the timing and magnitude of releases from Shasta Dam, primarily to improve the quality of aquatic habitat, could be applied under an adaptive management plan. Changes in operating the cold-water pool could include increasing minimum flows, timing releases out of Shasta Dam to mimic more natural seasonal flows, meeting flow targets for side channels, or retaining the additional water in storage to meet temperature requirements. Reclamation would manage the cold-water pool each year based on recommendations from the Sacramento River Temperature Task Group (SRTTG).

This measure would support the primary planning objective of increasing survival of anadromous fish populations by (1) improving water temperature control, (2) extending suitable spawning habitat, and (3) improving overall physical aquatic habitat conditions in the Sacramento River.

- **Modify Storage and Release Operations at Shasta Dam** – In addition to water temperature, flow conditions in the upper Sacramento River are important in addressing anadromous fish needs. This measure consists of enlarging Shasta Dam and modifying seasonal storage and releases to benefit anadromous fisheries. Although this measure could help provide greater flexibility in meeting water temperature targets, it would be aimed primarily at improving flows and influencing physical channel conditions for anadromous fish. Changes would be made to the timing and magnitude of releases performed to maintain target flows in spawning areas, and improve the quality of aquatic habitat. The quality of aquatic habitat could be further improved by cleaning spawning gravels. This measure could also include release changes during the flood season to permit “pulse flows” and other releases that could improve aquatic habitat conditions. Further, the measure could help provide additional control and dilution of acid mine drainage from Spring Creek. This measure was retained as part of an adaptive management strategy.

Increase Water Supply Reliability The following three measures were retained to address the primary objective of increasing water supply and water supply reliability for agricultural, M&I, and environmental purposes.

- **Increase Conservation Storage Space in Shasta Reservoir by Raising Shasta Dam** – This measure consists of structural raises of Shasta Dam ranging from about 6.5 feet to approximately 200 feet. A range of potential dam raises has been considered in previous studies, including raises of more than 200 feet. A raise of 6.5 feet is included in the Preferred Program Alternative for the CALFED ROD (2000b). Raising Shasta Dam would contribute directly to the primary planning objectives, and previous studies have indicated that raising the dam would be technically feasible. Raising Shasta Dam also could contribute to the secondary planning objectives.

- **Increase Effective Conservation Storage Space in Shasta Reservoir by Increasing Efficiency of Reservoir Operation for Water Supply Reliability** – This measure consists of modifying the operation of Shasta Dam to improve water supply reliability. It could also assist in improving efforts to reduce flood damages. Potential methods to improve water supply reliability include modifying rainflood parameters – those which address space for flows from winter rainfall – in the operation rules for Shasta Reservoir and modifying the Shasta Dam release schedule. The goal of the operation changes would be to minimize required evacuation of the reservoir from about late November through March, and to possibly allow the reservoir to be filled more rapidly in the spring. A primary criterion would be to prevent adversely affecting existing flood protection provided by Shasta Dam.

- **Implement Water Use Efficiency Methods** – Water use efficiency methods can help reduce future water shortages by allowing a more effective use of existing supplies. As population and resulting water demands continue to grow, and available supplies remain relatively static, more effective use of supplies can reduce potential critical impacts to urban and agricultural resources resulting from water shortages. The *2009 California Water Plan Update* identified a host of urban and agricultural water use efficiency measures (DWR 2009). "Projection Level One," which includes urban and agricultural conservation savings, as described in the 2009 update, is included in the Common Assumptions for Water Storage Projects (see Chapter 1) as a without-project condition. It is estimated that additional water conservation measures, although costly to implement, will play a major role in California's water future. Accordingly, water use efficiency was retained for consideration as a potential project element for any plan to be considered for the SLWRI.

Conserve, Restore, and Enhance Ecosystem Resources The following measures were retained to address the secondary objective of conserving, restoring, and enhancing ecosystem resources in the Shasta Lake area and along the upper Sacramento River.

- **Construct Shoreline Fish Habitat Around Shasta Lake** – The mostly barren shoreline of Shasta Lake does not contribute to supporting juvenile fish. In addition, lack of shoreline cover structures, such as vegetation and woody debris, and suitable shallow-water fish habitat around the lake limit preferred habitat for juvenile fish. This measure would improve shallow, warm-water fish habitat at specific locations around the shoreline of Shasta Lake using resilient vegetation and aquatic "cover" structures within the upper drawdown area of the lake. The measure would involve (1) installing artificial fish cover, including complex woody structures, (2) planting water-tolerant and/or erosion-resistant vegetation at prescribed locations within the reservoir drawdown area, and (3) performing selective reservoir rim clearing of specific trees and vegetation. This measure would support the secondary planning objective of preserving and restoring ecosystem resources in the Shasta Lake area by (1) increasing the survival of juvenile fish through improving the quantity of available cover and overall quality of shallow-water habitat, and (2) benefiting land-based species that inhabit the shoreline of Shasta Lake through establishing resilient vegetation.

- **Construct Instream Fish Habitat on Tributaries to Shasta Lake** – This measure would conserve and/or restore instream aquatic habitat on lower reaches of key tributaries to Shasta Lake. Two categories of potential aquatic habitat restoration in tributaries include (1) identifying and correcting barriers to fish passage that are critical to various life stages for native fish species, particularly at culverts and other human-made barriers, and (2) identifying and implementing feasible aquatic habitat improvements intended to conserve or restore degraded aquatic and riparian habitat in tributaries to Shasta Lake. Fish passage improvements include restoring and/or enhancing a minimum of five perennial stream crossings to help enable upstream and downstream passage for all life stages of native fish in Shasta Lake. Aquatic habitat restoration includes efforts to reestablish or enhance aquatic connectivity, and reestablish or conserve riparian vegetation needed to provide shade, cover, and organic material. Additionally, aquatic habitat restoration includes reducing sediment and other pollutants associated with roads and other human-made disturbances from discharging into streams flowing into Shasta Lake. The lower reaches of intermittent and perennial streams tributary to Shasta Lake that support aquatic organisms native to the upper Sacramento River would be targeted for aquatic restoration under this measure, because they provide year-round fish habitat. This measure would support the

secondary planning objective of conserving and restoring ecosystem resources in Shasta Lake.

- **Restore Riparian and Floodplain Habitat Along the Sacramento River** – This measure consists of restoring riparian and floodplain habitat at specific locations along the Sacramento River to promote the health and vitality of the river ecosystem. It would involve acquiring and revegetating floodplain terraces and adjacent riparian areas with native plants. Suitable locations for restoration would be in areas with a 20 percent to 50 percent chance of flooding in any year (commonly referred to as 2-year to 5-year floodplains). Locations near the confluences of perennial creeks and streams tributary to the Sacramento River would have potential to provide maximum benefits. Continuity is also important to the health and vitality of riparian areas; small, isolated portions of riparian habitat tend to be less productive than larger, continuous stretches of habitat. A limited amount of land contouring and imported fill material would be required at several locations where the historic floodplain has been disconnected from the river or disturbed by human activity.

Reduce Flood Damage The following measure was retained to address the secondary objective of reducing flood damages along the Sacramento River.

- **Update Shasta Dam and Reservoir Flood Management Operations** – This measure would include reassessing existing seasonal flood management storage space needs at Shasta using updated information on regional hydrologic and meteorological conditions and rainfall/runoff characteristics in the drainage basin. Potential methods to improve flood management would include improved long-range weather forecasting, implementing additional forecast-based reservoir drawdown to provide additional space for anticipated high flow events, changing the criteria regarding the rate of outflows from Shasta Dam, and modifying target peak flows at Bend Bridge. Several possible reoperation opportunities are described in the document *Assessment of Potential Shasta Dam Reoperation for Flood Control and Water Supply Improvement* (Reclamation 2004d). This measure would not conflict with other secondary planning objectives, planning considerations, or criteria.

Develop Additional Hydropower Generation The following measure was retained to address the secondary objective of developing additional hydropower generation capabilities at Shasta Dam.

- **Modify Existing/Construct New Generation Facilities at Shasta Dam to Take Advantage of Increased Hydraulic Head** – This measure consists of modifying the hydropower generation facilities at Shasta Dam to take advantage of any increases in water surface

elevations resulting from enlarging the dam, if applicable. Nearly all releases from Shasta and Keswick dams are made through their generating facilities. On occasion, however, outflows during flood operations are made through the flood control outlets and over the spillway. During these instances, the existing powerplant is bypassed for much of the flood (space evacuation) release. Power generated during these brief and infrequent periods generally has a lower value because of usually abundant supplies during winter periods. Raising Shasta Dam would create the potential to reduce these flood releases in winter and allow water to pass through the generators later in the year when the water and power are usually more valuable. Further, with higher water surface elevation, greater energy levels (head) would be available for operating the turbines. With a greater total head, the existing power facilities, including turbines and penstocks, may need to be replaced, especially with large dam raises (e.g., 100- or 200-foot raises).

Maintain and Increase Recreation Opportunities The following measures were retained to address the secondary objective of maintaining and increasing recreation opportunities at Shasta Lake.

- **Maintain and Enhance Recreation Capacity, Facilities, and Opportunities** – Recreation is not a specific purpose of the Shasta Division of the CVP, and no formal recreation facilities were developed as part of the original project. However, in 1965, Congress established the Whiskeytown-Shasta-Trinity NRA. As a result of that act and subsequent direction, USFS manages recreation within the NRA, which includes managing numerous water resources and related recreation activities at Shasta Lake. Increasing the storage in Shasta Lake would provide a larger water surface for recreation. This measure focuses on maintaining existing recreation capacity at Shasta Dam and Lake through relocating and modernizing recreation facilities adversely affected by a higher lake level. It also includes enhancing opportunities related to the larger lake surface and modernized recreation facilities.

- **Reoperate Reservoir for Recreation** – This measure consists of changing the established rules for operating Shasta Dam and Reservoir for flood management to benefit recreation resources at Shasta Lake. A claim by many of the recreation interests around Shasta Lake is that often the lake has to be drawn down in early spring for flood management purposes and then, because of limited inflows in the remainder of the season, the lake cannot recover, which adversely impacts recreation (as well as water supply). Local residents identify 2004 as an example and also claim that the existing reservoir operation rules for flood management are outdated (based on a USACE report dated 1977, nearly 30 years ago) and that by using more recent data and current technologies, the drawdown would not be required in some

years, or would not be as significant. There is limited potential for changes in flood management rules to allow for more operational flexibility in reservoir drawdown requirements in response to storms with improved advanced forecasting. Additionally, with an increase in reservoir depth due to raising Shasta Dam, reservoir reoperation would likely include raising the bottom of flood control pool elevation, allowing for higher winter and spring water levels.

Maintain or Improve Water Quality The following measure was retained to address the secondary objective of maintaining or improving water quality conditions downstream from Shasta Dam and in the Delta.

- **Improve Operational Flexibility for Sacramento-San Joaquin Delta Water Quality by Increasing Storage in Shasta Reservoir** – This measure consists of enlarging Shasta Dam to improve operational flexibility, which could contribute to Delta water quality conditions and Delta emergency response. Shasta Dam has the ability to provide increased releases and high flow releases to reestablish Delta water quality. Improved Delta water quality conditions could provide benefits for both water supply reliability and ecosystem restoration by potentially increasing Delta outflow during drought years, and reducing salinity during critical periods.

Measures Summary

Table 3-5 summarizes the final management measures carried forward to address the primary and secondary planning objectives. Measures that have been carried forward are believed to best address the objectives of the SLWRI, with consideration of planning constraints and criteria. It should be noted that measures that have been deleted from consideration at this phase may be reconsidered as mitigation measures.

Concept Plans

Concept plans are plans that are conceptual in scope, formulated from retained management measures to investigate strategies to address project objectives. For the SLWRI, concept plans were first formulated from the retained management measures, as shown in Table 3-6. As noted in Table 3-6, some management measures initially carried forward and included in concept plans were later eliminated from further consideration during the planning process and are not included in the final management measures in Table 3-5. Each concept plan was reviewed for impacts, costs, and benefits and compared to planning 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 planning objectives, constraints, considerations, and

criteria, and (2) identify concepts that warranted further development in the comprehensive plans phase.

Table 3-5. Final Measures to Address Planning Objectives

Planning Objective	Management Measure	
Primary Planning Objectives		
Increase Anadromous Fish Survival	Construct Instream Aquatic Habitat	Construct instream aquatic habitat downstream from Keswick Dam through side channel restoration
	Replenish Spawning Gravel	Replenish spawning gravel in the Sacramento River
	Modify Temperature Control Device	Make additional modifications to Shasta Dam for temperature control
	Enlarge Shasta Lake Cold-Water Pool	Raise Shasta Dam to increase the cold-water pool in the lake to benefit anadromous fish
	Modify Storage and Release Operations at Shasta Dam	Modify storage and release operations at Shasta Dam to benefit anadromous fish (included as part of adaptive management strategy)
Increase Water Supply Reliability	Increase Conservation Storage	Increase conservation storage space in Shasta Reservoir by raising Shasta Dam
	Reoperate Shasta Dam	Increase the effective conservation storage space in Shasta Reservoir by increasing the efficiency of reservoir operation for water supply reliability
	Reduce Demand	Identify and implement, to the extent possible, water use efficiency methods
Secondary Planning Objectives		
Conserve, Restore, and Enhance Ecosystem Resources	Restore Shoreline Aquatic Habitat	Construct shoreline fish habitat around Shasta Lake
	Restore Tributary Aquatic Habitat	Construct instream fish habitat on tributaries to Shasta Lake
	Restore Riparian Habitat	Restore riparian and floodplain habitat along the upper Sacramento River
Reduce Flood Damage	Modify Flood Operations Guidelines	Update Shasta Dam and Reservoir flood management operations
Develop Additional Hydropower Generation	Modify Hydropower Facilities	Modify existing/construct new generation facilities at Shasta Dam to take advantage of increased head
Maintain and Increase Recreation	Maintain and Enhance Recreation Facilities	Maintain and enhance recreation capacity, facilities, and opportunities
	Reoperate Reservoir	Increase recreation use by stabilizing early season filling in Shasta Lake
Maintain or Improve Water Quality	Increase Operational Flexibility	Improve operational flexibility for Delta water quality by increasing storage in Shasta Reservoir

Key:
Delta = Sacramento-San Joaquin Delta

Table 3-6. Summary of Concept Plan Features

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

Notes:

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

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

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

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

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

First, two sets of plans were developed that focused on either anadromous fish survival (AFS) or water supply reliability (WSR) as the single primary planning objective. Three AFS plans and four WSR plans were developed. Although the AFS and WSR plans focused on single planning objectives, each generally contributed to both primary planning 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 planning objectives. These are termed combined objective (CO) plans.

Each of the concept plans (and later comprehensive plans) included various common features: (1) modifications to the TCD, (2) reoperation of Shasta Dam for flood management, and (3) facilities to take advantage of the increased head for hydropower. Concept plans are described in detail in the Plan Formulation Appendix and summarized briefly below.

Plans Focused on Anadromous Fish Survival

Three concept plans were formulated from the management measures retained to address the primary planning objective of AFS. Each plan includes raising Shasta Dam 6.5 feet and enlarging the reservoir by 256,000 acre-feet, but the plans differ in how the additional storage would be used to benefit anadromous fish. Progressively higher raises are expected to produce proportionally greater benefits to anadromous fish. Although larger dam raises could produce greater benefits to fisheries, the goal at this stage in plan formulation was to provide a common baseline from which the relative performance of the three AFS plans could be compared.

AFS-1 – Increase Cold-Water Assets with Shasta Operating Pool Raise

The primary focus of AFS-1 is to maintain cooler water temperatures in the upper Sacramento River by increasing the minimum end-of-October carryover storage target. This would allow additional cold water to be stored for use in the following year. No changes would be made to the existing seasonal temperature targets for anadromous fish on the upper Sacramento River, but the ability to meet these targets would be improved. It was found that this plan had a significant potential to benefit anadromous fish in the upper Sacramento River, but there would be no additional increase in water supply reliability. This plan was not retained for further development as a stand-alone plan because it did not meet the primary planning objective of increasing water supply reliability. However, major features of this plan were retained for further development into comprehensive plans.

AFS-2 – Increase Minimum Anadromous Fish Flow with Shasta Enlargement

AFS-2 focuses 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. No changes would be made to the carryover target

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

AFS-3 – Increase Minimum Anadromous Fish Flow and Restore Aquatic Habitat with Shasta Enlargement

AFS-3 is similar to AFS-2, except that it also includes acquiring, restoring, and reclaiming one or more inactive gravel mine along the upper Sacramento River to restore about 150 acres of aquatic and floodplain habitat. However, increasing minimum flows was not found to significantly benefit to anadromous fish, and concerns were expressed regarding significant uncertainties about offstream areas being able to successfully support viable fish spawning and rearing. Further, during public scoping activities in late 2005, little to no interest was demonstrated for restoring inactive gravel mines along the Sacramento River above the RBDD. Accordingly, this plan element was deleted from further consideration at this time.

Plans Focused on Water Supply Reliability

Four concept plans were formulated from the management measures retained to address the primary planning objective of increasing WSR. The magnitude of enlarging Shasta Dam was important when developing the WSR plans because storage capacity is the most influential factor in determining benefits to water supply reliability for this study. Hence, three dam raises were considered in the WSR plans: 6.5 feet, 18.5 feet, and 200 feet. Water supply reliability estimates presented in this section are from the 2004 *SLWRI Initial Alternatives Information Report* (Reclamation 2004a). Increases in south-of-Delta agricultural water deliveries comprise the majority of water supply reliability benefits for all WSR plans. The remaining benefits are seen in increased water deliveries for south-of-Delta M&I and north-of-Delta agricultural and M&I uses.

WSR-1 – Increase Water Supply Reliability with 6.5-foot Dam Raise

WSR-1 would increase water supply reliability by increasing critical and dry year yield of the CVP and SWP through increasing critical and dry period supplies by at least 72,000 acre-feet per year. In addition to water supply reliability, there would be benefits to anadromous fish in the upper Sacramento River, increases in power generation, and the potential for increases in reservoir area recreation. This plan was retained for further development.

WSR-2 – Increase Water Supply Reliability with 18.5-foot Dam Raise

The 18.5-foot raise is the largest practical dam raise that does not require relocating the Pit River Bridge, and would increase the capacity of the reservoir by 634,000 acre-feet to a total of 5.19 MAF. WSR-2 would increase water supply reliability by increasing the critical and dry year yield of the CVP and SWP by at least 125,000 acre-feet per year. Additionally, there would be

benefits to anadromous fish in the upper Sacramento River, increases in power generation, and the potential for increases in reservoir area recreation. This plan was retained for further development.

WSR-3 – Increase Water Supply Reliability with 200-foot Dam Raise

The 200-foot raise is the maximum amount considered to be technically feasible and would increase the capacity of the reservoir by 9.3 MAF to a total of 13.9 MAF. The magnitude of this raise would require significant modifications or replacement of most facilities associated with the dam, including hydropower facilities, and would require modifying Keswick Dam and its powerplant. This plan would provide a major increase in water supply reliability, anadromous fish, hydropower, flood damage reduction, and recreation resources. However, the plan is not financially feasible at this time because the construction cost is estimated at over $6 billion (at October 2008 price levels). Accordingly, this plan was deleted from further consideration in this Draft Feasibility Report.

WSR-4 – Increase Water Supply Reliability with 18.5-foot Dam Raise and Conjunctive Water Management

This plan is similar to WSR-2, but includes implementing a conjunctive water management component consisting largely of contracts between Reclamation and certain Sacramento River basin water users. The conjunctive water management component includes downstream facilities, such as additional river diversions and transmission and groundwater pumping facilities, to facilitate exchanges. Reclamation would provide additional surface supplies in wet and normal water years to participating CVP users, in exchange for reducing deliveries in dry and critically dry years, when users would rely more on groundwater supplies. Preliminary estimates of the conjunctive water management component associated this alternative indicated that water supply yield could be increased between 10 to 20 percent. However, few to no fishery benefits would result and no strong indication of non-Federal participation in a conjunctive water management component was identified. Accordingly, this plan element was deleted from further consideration.

Plans Focused on Combined Objectives

Five combination plans are summarized below that were developed to represent a reasonable balance between the two primary planning objectives. The CO concept plans also include measures to actively address the secondary planning objectives, as appropriate. The CO plans identified below are believed to be reasonably representative, although not exhaustively, of the range of potential and applicable actions.

CO-1 and CO-2 – Increase Anadromous Fish Habitat and Water Supply Reliability with 6.5-foot and 18.5-foot Dam Raises, Respectively

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. Similar to AFS-3, both CO plans include restoring one or

more inactive gravel mine along the upper Sacramento River, providing additional aquatic and floodplain resources to the Sacramento River between Keswick and Battle Creek, a critical spawning reach. Both plans could increase water supply reliability by increasing CVP and SWP critical and dry year yields by 72,000 acre-feet and 125,000 acre-feet, for CO-1 and CO-2, respectively. A higher water surface elevation in the reservoir would result in a net increase in power generation, and increase the maximum surface area, which would benefit recreation. 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 18.5-foot Dam Raise

CO-3 includes features similar to those of CO-2, except a portion of the additional storage created by the 18.5-foot dam raise would be dedicated to managing flows for winter-run Chinook salmon on the upper Sacramento River. Under this preliminary plan, approximately 320,000 acre-feet would be dedicated to increasing minimum flows from approximately 3,250 cfs to about 4,200 cfs between October 1 and April 30. However, as described for ASF-2, while it was concluded that although at various stages of development the concept of increasing minimum flows would be beneficial for fish, at other life stages, increasing minimum flows would be detrimental. Accordingly, this plan was deleted from further development.

CO-4 and CO-5 – Multipurpose with 6.5-foot and 18.5-foot Dam Raise, Respectively

CO-4 and CO-5 address both the primary and secondary planning objectives of the SLWRI through a combination of measures, including raising Shasta Dam, restoring habitat, and adding recreation facilities in the Shasta Lake area. Enlargement of the reservoir and limited reservoir reoperation would also help improve operations for flood management and recreation. The secondary planning objective of environmental restoration also would be addressed through shoreline and tributary habitat improvements, including restoring (1) resident fish habitat in Shasta Lake and (2) riparian habitat at locations along the lower arms of the Sacramento River, McCloud River, and Squaw Creek. This plan, at the 18.5-foot dam raise (CO-5), was retained for further development.

Comprehensive Plan Development and Influencing Factors

Following is a summary of the rationale used to formulate each of the comprehensive plans, a description of measures common to all comprehensive plans, major components of dam raise scenarios, and costs and benefits of each comprehensive plan.

Formulation of Comprehensive Plans

As described above, numerous management measures were identified, evaluated, and screened. Through continued refinement of management measures and concept plans carried forward, the following plan types were identified for further development into comprehensive plans (CP):

- 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 planning objectives (subsequently developed into CP1, CP2, and CP3)

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

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

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

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

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

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

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

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

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

Once the five comprehensive plans were developed, CP4 was further refined to determine the best combination of previously identified management measures to maximize anadromous fish survival. The process used to refine CP4 into the anadromous fish survival alternative is described below.

Refinement of Anadromous Fish Survival Focus Alternative

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

To formulate CP4, three dam height raises were considered (6.5 feet, 12.5 feet, and 18.5 feet), resulting in 256,000 acre-feet, 443,000 acre-feet, and 634,000 acre-feet of increased storage, respectively. For each of these proposed dam raises, several combinations for allocating the increased storage were analyzed. For instance, assuming a dam raise of 12.5 feet, three options were considered: (1) no increase in the minimum pool, (2) an increase in the minimum pool similar to a 6.5-foot dam raise, and (3) all of the increased space dedicated to increased fisheries. The combinations considered represent scenarios developed to focus on increasing the cold-water pool, and are listed in Table 3-7.

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 Program (USFWS 2001). These scenarios are listed in Table 3-8.

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

Table 3-7. Scenarios Considered for Cold-Water Storage – Anadromous Fish Survival Focus Plan

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

Key:
CP = comprehensive plan

Table 3-8. 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 Program (USFWS 2001)
cfs = cubic foot per second

Management Measures Common to All Comprehensive Plans

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

Enlarge Shasta Lake Cold-Water Pool

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

Modify Temperature Control Device

For all comprehensive plans, 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 comprehensive plans 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 capacity of the reservoir available to store water for subsequent release to increase water supply reliability for M&I, agricultural, and environmental purposes. The comprehensive plans include a range of dam enlargements and various increases in conservation space.

Reduce Demand

All comprehensive plans include an additional water conservation program for new water supplies created by the project, to augment current water use efficiency practices. The proposed program would consist of a 10-year initial program in which Reclamation would allocate approximately $2.3 million to $3.8 million, proportional to additional water supplies delivered, to fund water conservation efforts. Funding would focus on assisting project beneficiaries (agencies receiving increased water supplies because of the project), with developing new or expanded urban water conservation, agricultural water conservation, and water recycling programs. Program actions would be a combination of technical assistance, grants, and loans to support a variety of water conservation projects such as recycled wastewater projects, irrigation

system retrofits, and urban utilities retrofit and replacement programs. The program could be established as an extension of existing Reclamation programs, or as a new program through teaming with SLWRI cost-sharing partners. Combinations and types of water use efficiency actions funded would be tailored to meet the needs of identified cost-sharing partners, including consideration of cost-effectiveness at a regional scale for agencies receiving funding.

Modify Flood Operations

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

Modify Hydropower Facilities

Under each comprehensive plan, physical enlargement of Shasta Dam would likely require various minimum modifications, commensurate with the magnitude of the enlargement, to the existing hydropower facilities at the dam to enable their continued efficient use. These modifications, in conjunction with increased lake surface elevations, may provide incidental benefits to hydropower generation. Although modifications could also be included to further increase the power production capabilities of the reservoir (e.g., additional penstocks, 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 comprehensive plans address, to some extent, the secondary planning objective of maintaining and 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 NRA. Recreation within these lands is managed by USFS. As part of this administration, USFS either directly operates and maintains, or manages through leases, numerous public campgrounds, marinas, boat launching facilities, and related water-oriented recreation facilities. Enlarging Shasta Dam and Reservoir would affect some of these facilities. Consistent with the position of USFS, and planning conditions described in this chapter, all of the comprehensive plans include features to, at a minimum, maintain the overall recreation capacity of the existing facilities. All comprehensive plans also provide for modernization of recreation facilities.

Maintain or Improve Water Quality

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

Major Components of Comprehensive Plans

Three dam raise options were considered for the comprehensive plans: 6.5-foot, 12.5-foot, and 18.5-foot raises. Other raise options up to 18.5 feet are possible; however, it is believed that the above three adequately represent the extent of benefits, effects, and costs associated with any raise within the range considered for this feasibility study. Table 3-9 summarizes the physical features associated with the comprehensive plans. Figure 3-3 illustrates major features in the Shasta Lake area common to all comprehensive plans.

Table 3-9. Physical Features of Comprehensive Plans

Main Features	Project 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)[1]	8.5	14.5	20.5	20.5	20.5
Elevation of Full Pool (feet)[2]	1,075.5	1,081.5	1,087.5	1,087.5	1,087.5
Capacity Increase (acre-feet)	256,000	443,000	634,000	634,000	634,000
Wing Dams	Raise to meet dam crest. Build new visitor center along left wing dam. Relocate gantry crane on right wing dam.	Raise to meet dam crest. Build new visitor center along left wing dam. Relocate gantry crane on right wing dam.	Raise to meet dam crest. Build new visitor center along left wing dam. Relocate gantry crane on right wing dam.	Raise to meet dam crest. Build new visitor center along left wing dam. Relocate gantry crane on right wing dam.	Raise to meet dam crest. Build new visitor center along left wing dam. Relocate gantry crane on right wing dam.
Spillway	Raise crest and extend piers. Replace 3 drum gates with 6 sloping wheel gates.	Raise crest and extend piers. Replace 3 drum gates with 6 sloping wheel gates.	Raise crest and extend piers. Replace 3 drum gates with 6 sloping wheel gates.	Raise crest and extend piers. Replace 3 drum gates with 6 sloping wheel gates.	Raise crest and extend piers. Replace 3 drum gates with 6 sloping wheel gates.
Temperature Control Device	Raise/modify controls.	Raise/modify controls.	Raise/modify controls.	Raise/modify controls.	Raise/modify controls.
Shasta Powerplant	Raise hoists.	Raise hoists.	Raise hoists.	Raise hoists.	Raise hoists.
Pit 7 Dam	Install a tailwater depression system.	Install a tailwater depression system.	Install a tailwater depression system.	Install a tailwater depression system.	Install a tailwater depression system.
Reservoir Area Dikes and Railroad Embankments	Construct 5 new dikes.	Construct 6 new dikes.	Construct 7 new dikes.	Construct 7 new dikes.	Construct 7 new dikes.
Relocations					
Roadways					
Length of Relocated Roadway (lf)	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 Bridges	Modify 3 bridges.	Modify 3 bridges.	Modify 3 bridges.	Modify 3 bridges.	Modify 3 bridges.

Table 3-9. Physical Features of Comprehensive Plans (contd.)

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

Notes:

[1] 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.

[2] Elevation based on National Geodetic Vertical Datum of 1929 (NGVD29).

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

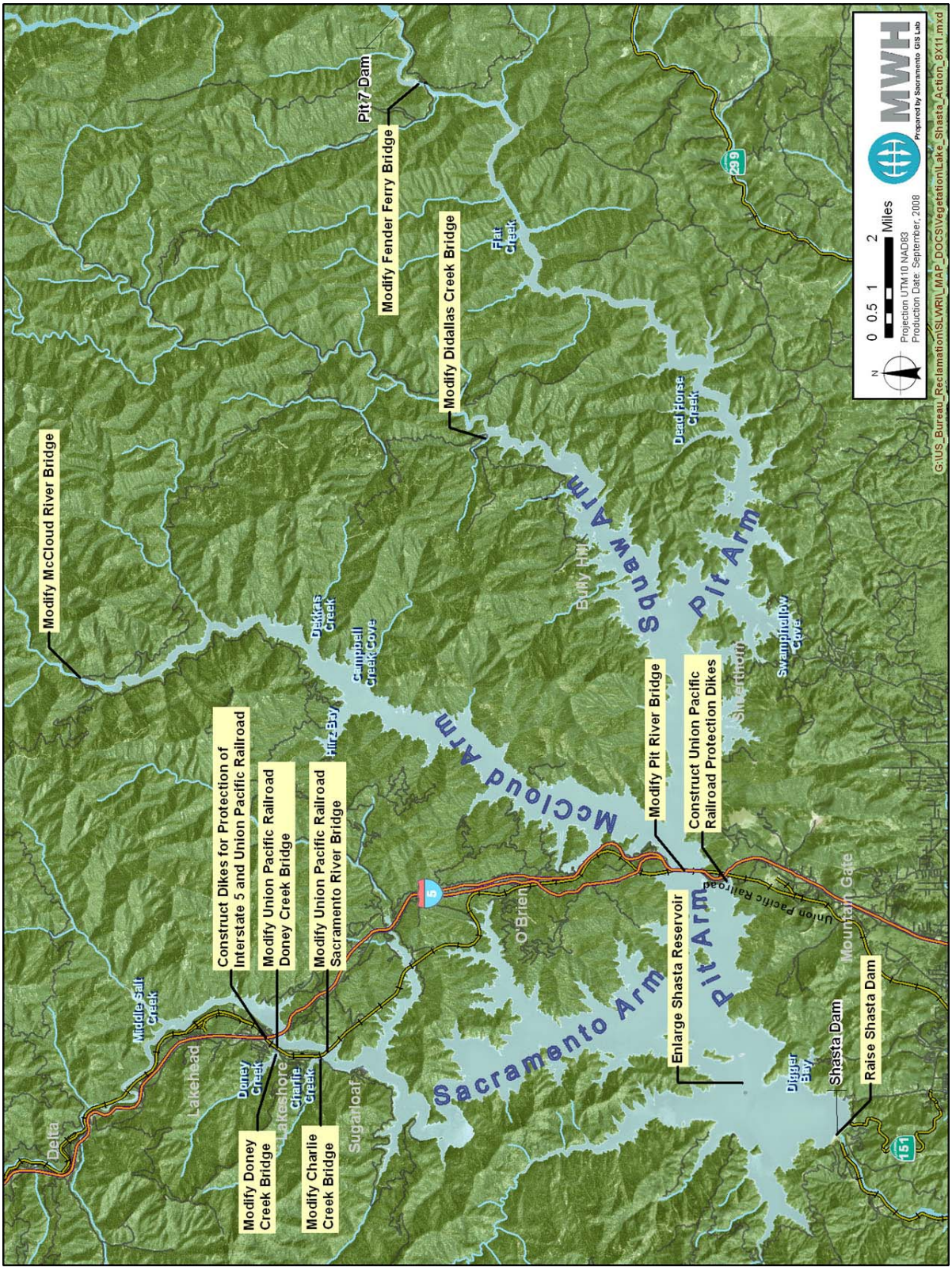


Figure 3-3. Major Components Common to All Comprehensive Plans in Shasta Lake Area

Descriptions of No-Action Alternative and Comprehensive Plans

The following is a description of the No-Action alternative, representing a scenario in which a project is not implemented, and the five comprehensive plans developed as action alternatives for the SLWRI.

No-Action Alternative (No Additional Federal Action)

For all Federal feasibility studies of potential water resources projects, the 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. The No-Action Alternative is considered to be the basis for comparison with potential action alternatives, consistent with the *Federal Water Resources Council Principles and Guidelines for Water and Related Land Resources Implementation Studies* (WRC 1983) and NEPA guidelines.

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 planning objectives of the SLWRI.

Plan formulation efforts and analysis of the No-Action Alternative and comprehensive plans discussed in this chapter are based on CVP and SWP operational conditions described in the 2004 OCAP BA (Reclamation) and the Coordinated Operations Agreement between Reclamation and DWR for the CVP and SWP, as ratified by Congress. Modeling studies will be updated to reflect changes in water operations when the Final Feasibility Report is prepared.

Anadromous Fish Survival

Much has been done to address anadromous fish survival problems in the upper Sacramento River. Solutions have ranged from changes in the timing and magnitude of releases from Shasta Dam to constructing and operating the TCD at the dam. Actions also include site-specific projects, such as introducing spawning gravel to the Sacramento River, and work to improve or restore spawning habitat in tributary streams. However, some actions have had an adverse effect on Sacramento River habitat, including implementing requirements of the Trinity River December 2000 ROD (Reclamation), as amended, 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 urban, agricultural, 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 2009b). The risk associated with a prolonged drought is especially high in the Sacramento River because Shasta Reservoir is operated to maintain only 1 year of carryover storage. Under the No-Action Alternative, after 2 years of drought, Shasta Reservoir storage would be insufficient to provide cold water throughout the winter-run Chinook salmon spawning season. A drought lasting several years would likely result in the extirpation of winter-run Chinook salmon (NMFS 2009b).

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

Water Supply Reliability

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

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

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

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

As opportunities arise, some locally sponsored efforts would likely continue to improve environmental conditions on tributaries to Shasta Lake and along the upper Sacramento River. However, overall, future environmental-related conditions in these areas would likely be similar to existing conditions. The quantity, quality, diversity, and connectivity of riparian, wetland, and riverine habitats along the Sacramento River have been limited by confinement of the river system by levees, reclamation of adjacent lands for farming, bank protection, channel stabilization, and land development. Shasta Dam and Reservoir have greatly reduced flood damage along the Sacramento River. Shasta Dam and Reservoir were constructed at a total cost of about $36 million. During flood events in 1983, 1986, and 1997, Shasta Dam, in combination with the Sacramento River Flood Control Project, prevented an estimated $14 billion in property losses due to flooding. Accordingly, from a flood damage perspective only, Shasta Dam has far more than paid for itself. However, residual risks to human life, health, and safety along the Sacramento River remain. Development in flood-prone areas has exposed the public to the risk of flooding. Storms producing peak flows, and volumes greater than the existing flood management system was designed for, can occur, and result in extensive flooding along the upper Sacramento River. Under the No-Action Alternative, the threat of flooding would continue, and may increase as population growth increases.

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

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

Comprehensive Plan 1 – 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 features of CP1 in the Shasta Lake area are shown in Figure 3-3.

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.

As shown in Table 3-9, by raising Shasta Dam 6.5 feet from a crest at elevation 1,077.5 above mean sea level (elevation 1077.5) to elevation 1,084.0, CP1 would increase the height of the reservoir full pool by 8.5 feet. The additional 2-foot increase in the height of the full pool above the dam raise height would result from spillway modifications, including replacing the three drum gates with six sloping, fixed-wheel gates. This increase in full pool height would add approximately 256,000 acre-feet of additional storage to the overall reservoir capacity. Accordingly, the overall full pool storage would increase from 4.55 MAF to 4.81 MAF. Figure 2-3 shows the increase in surface area and storage capacity for each dam raise.

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

This plan would also include the potential to revise the operational rules for flood control for Shasta Dam and Reservoir, which could reduce the potential for flood damage, and benefit recreation. Reservoir reoperation would likely include increasing the bottom of the flood control pool elevation based on increased dam height and reservoir capacity. Because of reservoir geometry, this would decrease the depth of the flood control pool, allowing higher winter and spring water levels. Increased reservoir capacity could have further flood damage reduction benefits in years when water levels are below the new flood control pool elevation at the onset of a flood event. There is also limited potential for changes in flood control rules to allow more operational flexibility in reservoir drawdown requirements in response to storms, resulting in a net increase in the rate of spring reservoir filling during some years. Higher spring water levels and associated increases in reservoir surface area would benefit recreation.

Potential Benefits of CP1

Major potential benefits of CP1, related to the SLWRI planning objectives and broad public services, are summarized in Tables 3-10 and 3-11 and described below. In addition, Table 3-12 qualitatively compares the benefits and effects of each of the comprehensive plans relative to the beneficial water uses recognized by the SWRCB.

Table 3-10. Summary of Potential Features and Benefits of SLWRI Comprehensive Plans (Compared to No-Action Alternative)

Item	CP1	CP2	CP3	CP4	CP5
Raise Shasta Dam (feet)	**6.5**	**12.5**	**18.5**	**18.5**	**18.5**
Total Increased Storage (TAF)	256	443	634	634	634
Benefits					
Increase Anadromous Fish Survival					
Dedicated Storage (TAF)	-	-	-	378	-
Production Increase (thousand fish)[1]	366	234	607	1,199	607
Spawning Gravel Augmentation (tons)[2]				10,000	10,000
Side-Channel Rearing Habitat Restoration (miles)				0.8	0.8
Increase Water Supply Reliability					
Total Increased Firm Water Supplies (TAF/year)[3]	76.4	105.1	133.4	76.4	133.4
Increased Firm Water Supplies NOD (TAF/year)[3]	9.6	19.8	29.6	9.6	29.6
Increased Firm Water Supplies SOD (TAF/year)[3]	66.8	85.3	103.8	66.8	103.8
Increased Water Use Efficiency Funding	Yes	Yes	Yes	Yes	Yes
Increased Emergency Water Supply Response Capability	Yes	Yes	Yes	Yes	Yes
Reduce Flood Damages					
Increased Reservoir Capacity for Capture of Flood Flows	Yes	Yes	Yes	Yes	Yes
Develop Additional Hydropower Generation					
Increased Hydropower Generation (GWh/year)	42	68	96	138	96
Conserve, Restore, and Enhance Ecosystem Resources					
Shoreline Enhancement (acres)	-	-	-	-	130
Tributary Aquatic Habitat Enhancement (miles)[4]	-	-	-	-	6
Riparian, Floodplain, and Side Channel Habitat Restoration (acres)	-	-	-	2.9	2.9
Increased Ability to Meet Flow and Temperature Requirements Along the 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 Opportunities					
Recreation[5] (increased user days, thousands)	83	141	224	224	224
Modernization of Relocated Recreation Facilities	Yes	Yes	Yes	Yes	Yes

Notes:

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

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

[3] Total increased deliveries during dry and critical years (based on the Sacramento Valley Water Year Hydrologic Water Classification) to CVP and SWP. Does not reflect benefits related to water use efficiency actions included in all comprehensive plans.

[4] Tributary aquatic enhancement provides for the connectivity of native fish species and other aquatic organisms between Shasta Lake and its tributaries. Estimates of benefits reflect only connectivity with perennial streams and do not reflect additional miles of connectivity with intermittent streams.

[5] These values do not account for increased visitation due to modernization of recreation facilities associated with all comprehensive plans.

Key:
- = not applicable
CP = comprehensive plan
CVP = Central Valley Project
Delta = Sacramento-San Joaquin Delta
GWh/year = gigawatt-hours per year
NOD = north of Delta
SLWRI = Shasta Lake Water Resources Investigation
SOD = south of Delta
SWP = State Water Project
TAF = thousand acre feet

Table 3-11. Summary of Additional Broad Public Benefits

Category	Benefit Description
System-Wide Water Management Flexibility	All CPs improve system-wide water management flexibility for storage and operations to meet multiple competing public needs
Air Quality	All CPs provide for increased clean energy generation, potentially reducing GHG emissions
Groundwater	All CPs allow for decreased groundwater pumping and related groundwater overdraft conditions in CVP/SWP water service areas
Reservoir Water Quality	All CPs replace reservoir area septic systems with centralized wastewater treatment plants
Shasta Lake Cold-Water Fisheries	All CPs improve Shasta Lake cold-water fisheries conditions through increasing the cold-water pool
Traffic and Transportation	All CPs modernize relocated roadways and bridges with facilities designed to meet current public safety standards
Public Services	All CPs relocate USFS emergency response facilities to a more centralized location adjacent to major transportation corridors

Note:
[1] Broad public benefits above are additional to benefits associated with project planning objectives.

Key:
CP = Comprehensive Plan
CVP = Central Valley Project
GHG = greenhouse gas
SWP = State Water Project
USFS = U.S. Forest Service

Table 3-12. Comparison of Comprehensive Plans Relative to Beneficial Uses of Water in California

SWRCB Recognized Beneficial Use[1]	CP1	CP2	CP3	CP4	CP5
Agricultural Supply	+++	++++	++++++	+++	++++++
Municipal and Industrial Supply[2]	++	++	++	++	++
Groundwater Recharge[3]	+	++	+++	+	+++
Freshwater Replenishment	+	++	+++	+++	+++
Navigation	0	0	0	0	0
Hydropower Generation	+	++	+++	++++	+++
Water Contact Recreation	+	++	+++	+++	+++
Noncontact Water Recreation	+	++	+++	+++	+++
Ocean, Commercial, and Sport Fishing	++	++	+++	++++++	++++
Aquaculture	0	0	0	0	0
Warm Freshwater Habitat	+	+	+	+	+++
Cold Freshwater Habitat	++	++	+++	++++++	++++
Inland Saline Water Habitat	0	0	0	0	0
Estuarine Habitat	+	++	+++	+++	+++
Marine Habitat	+	+	++	++++	++
Preservation of Biological Habitats of Special Significance	++	++	+++	++++++	++++
Rare, Threatened, or Endangered Species – Aquatic	++	++	+++	++++++	+++
Rare, Threatened, or Endangered Species – Terrestrial	–	–	–	–	–
Migration of Aquatic Organisms	++	++	+++	++++++	++++
Spawning, Reproduction, and/or Early Development	++	++	+++	++++++	++++
Shellfish Harvesting	0	0	0	0	0

Notes:
[1] Listed beneficial use categories are those officially recognized by the SWRCB, as described in the *2002 California 305(b) Report on Water Quality* (SWRCB 2003).
[2] "Municipal and Industrial Supply" combines the SWRCB "Municipal and Domestic Supply," "Industrial Process Supply," and "Industrial Service Supply" beneficial use categories.
[3] Although the SLWRI comprehensive plans do not include specific features to fund or assist groundwater storage, enlarging Shasta Reservoir could allow for additional system flexibility for surface water deliveries, decreasing reliance on groundwater pumping and reducing groundwater overdraft conditions in CVP and SWP service areas.

Key:
+ = net positive effect (net benefit)\
0 = minimal anticipated effect
– = net negative effect (net impact)
CP = comprehensive plan
SWRCB = California State Water Resources Control Board

Increase Anadromous Fish Survival Water temperature is one of the most important factors in achieving recovery goals for anadromous fish in the Sacramento River. CP1 would increase the ability of Shasta Dam to make cold-water releases and regulate water temperatures for fish in the upper Sacramento River, primarily in dry and critically dry water years. This would be accomplished by raising Shasta Dam 6.5 feet, thus increasing the depth of

the cold-water pool in Shasta Reservoir and resulting in an increase in seasonal cold-water volume below the thermocline (layer of greatest water temperature and density change). Cold water released from Shasta Dam significantly influences water temperature conditions in the Sacramento River between Keswick Dam and the RBDD. Hence, the most significant benefits to anadromous fish would occur upstream from the RBDD. It is estimated that under CP1, improved water temperature conditions could result in an average annual increase in the salmon population of about 366,000 out-migrating juvenile Chinook salmon.

Figure 3-4 shows an exceedence probability relationship of maximum annual storage in Shasta Lake for CP1 and other comprehensive plans compared to the No-Action Alternative, illustrating expected increases in storage volumes under each comprehensive plan. Storage volumes for Figure 3-4 were simulated with the CalSim-II model based on the Common Assumptions for Water Storage Projects 2030 level of development projections, as discussed in detail in the Modeling Appendix. Figure 3-5 shows simulated reservoir storage fluctuations for the No-Action Alternative and all comprehensive plans for a representative period of 1972 through 2002.

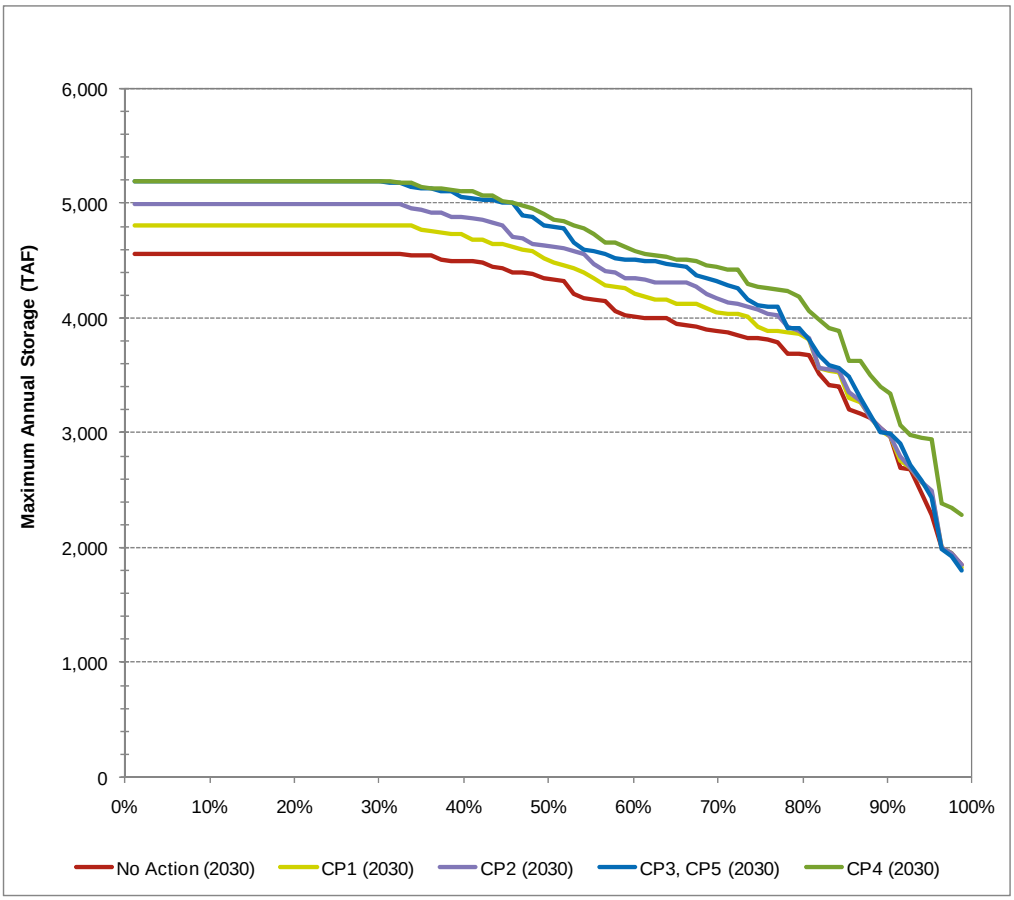


Figure 3-4. Simulated Exceedence Probability Relationship of Maximum Annual Storage in Shasta Lake for Future Level of Development (2030)

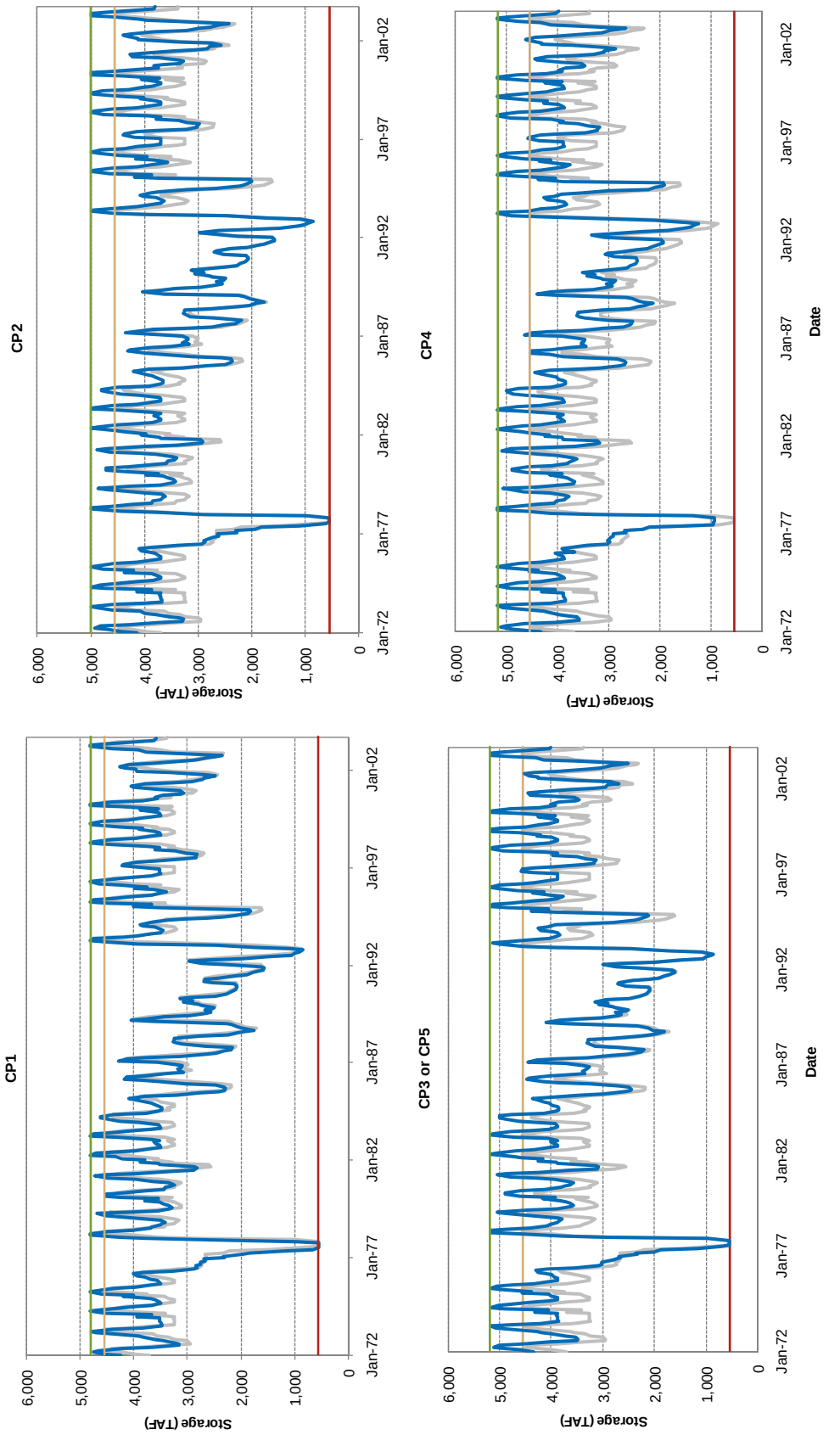
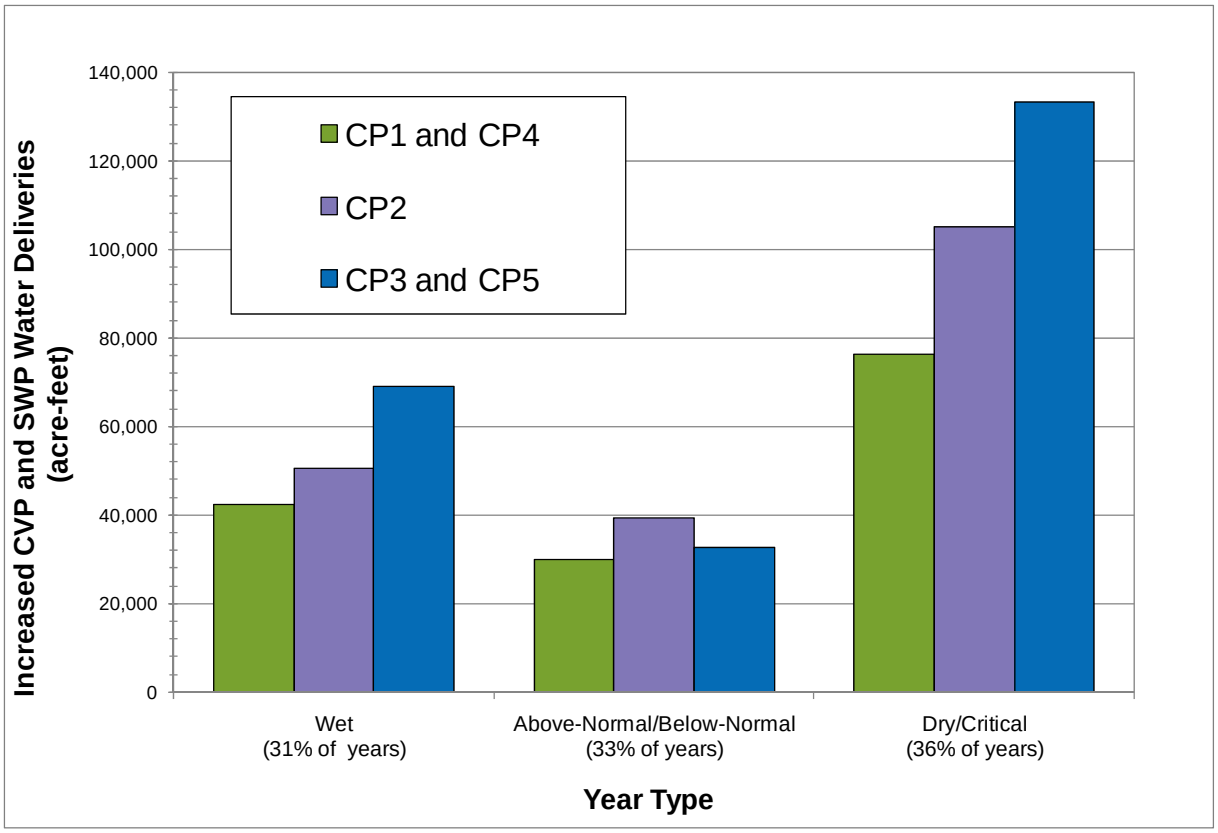


Figure 3-5. Simulated Shasta Reservoir Storage from 1972 Through 2002 for No-Action Alternative and Comprehensive Plans

Increase Water Supply Reliability CP1 would increase water supply reliability by increasing firm water supplies for irrigation and M&I deliveries primarily during drought periods. Resulting increases in deliveries, based on CalSim-II modeling results, are shown in Figure 3-6 and Table 3-13. This action would contribute to replacement of supplies redirected to other purposes in the CVPIA, which would help reduce estimated future water shortages by increasing firm yield for agricultural and M&I deliveries by at least 76,400 acre-feet per year and average annual yield by about 46,400 acre-feet per year. For this report, firm yield is considered equivalent to the estimated increase in the reliability of supplies during dry and critically dry periods. As shown in Table 3-13, the majority of increased firm yield, 66,800 acre-feet, would be for south-of-Delta agricultural and M&I deliveries. In addition, water use efficiency could help reduce current and future water shortages by allowing a more effective use of existing supplies. As population and resulting water demands continue to grow and available supplies continue to remain relatively static, more effectively using these supplies could reduce potential critical impacts to agricultural and urban areas resulting from water shortages. Under CP1, approximately $2.3 million would be allocated over an initial 10-year period to fund agricultural and M&I water conservation programs, focused on agencies benefiting from increased reliability of project water supplies.



Note: Deliveries were simulated Using CalSim-II and water year types based on the Sacramento Valley Water Year Hydrologic Classification.

Figure 3-6. Comparison of Increased CVP and SWP Water Deliveries by Year Type for Comprehensive Plans

Table 3-13. Increases in CVP and SWP Water Deliveries for Comprehensive Plans

Total CVP/SWP Deliveries	Average All Years			Dry and Critical Years[2]		
	CP1/CP4 (acre-feet)	CP2 (acre-feet)	CP3/CP5 (acre-feet)	CP1/CP4 (acre-feet)	CP2 (acre-feet)	CP3/CP5 (acre-feet)
North of Delta						
Agriculture	5,200	11,500	16,100	7,800	17,100	25,300
M&I	1,000	1,600	2,300	1,800	2,700	4,300
Total[1]	6,200	13,100	18,400	9,600	19,800	29,600
South of Delta						
Agriculture	22,700	36,200	43,700	42,600	66,900	86,300
M&I	17,500	13,500	13,700	24,200	18,400	17,500
Total[1]	40,200	49,700	57,400	66,800	85,300	103,800
Combined North and South of Delta						
Agriculture[1]	27,900	47,700	59,700	50,400	84,100	111,600
M&I[1]	18,500	15,100	16,000	26,000	21,000	21,800
Total[1]	***46,400***	***62,800***	***75,800***	***76,400***	***105,100***	***133,400***

Notes:
[1] All numbers are rounded for display purposes, and therefore line items may not sum to totals.
[2] Based on the Sacramento Valley Water Year Hydrologic Classification.
Key:
CP = Comprehensive Plan
CVP = Central Valley Project
M&I = Municipal and Industrial
SWP = State Water Project

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

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

Benefits Related to Other SLWRI Planning Objectives CP1 could also provide benefits related to flood damage reduction, ecosystem restoration, and water quality. Enlarging Shasta Dam would provide for incidental increased reservoir capacity to capture flood flows, which could reduce flood damage along the upper Sacramento River. Improved fisheries conditions as a result of CP1, as described above, and increased flexibility to meet flow and temperature requirements, could also enhance overall ecosystem resources in the Sacramento River. Furthermore, CP1 could potentially benefit ecosystem restoration through improved Delta water quality conditions by increasing Delta

outflow during drought years and reducing salinity during critical periods. CP1 may also contribute to improving Delta water quality through increased Delta emergency response capabilities. When Delta emergencies occur, additional water in Shasta Reservoir could improve operational flexibility for increasing releases to supplement existing water sources to reestablish Delta water quality. In addition to Delta emergency response, increased storage in Shasta Reservoir could increase emergency response capability for CVP/SWP water supply deliveries.

Additional Broad Public Benefits Additional broad public benefits of CP1 obtained through pursuing project objectives are summarized in Table 3-11. These include benefits to reservoir water quality, traffic and transportation, and public services from modernization and upgrades of relocated facilities. Long-term benefits to air quality, groundwater, Shasta Lake fisheries, and system-wide operations are due to increased overall system capacity, allowing for increases in clean energy production, surface water deliveries, and storage capacity in Shasta Reservoir.

Potential Primary Effects of CP1

Following is a summary of potential environmental consequences of this comprehensive plan. A detailed discussion of potential effects and proposed mitigation measures are included in Chapters 4 through 25 of the Preliminary Draft EIS. Proposed mitigation measures to address potential adverse impacts of CP1 are summarized in Table 3-14.

Table 3-14. Summary of Proposed Mitigation Measures for Comprehensive Plans

Resource Topic/Impact	Alternative	Mitigation Measure
Geology, Geomorphology, Minerals, and Soils		
Impact Geo-2: Alteration of Fluvial Geomorphology and Hydrology of Aquatic Habitats	CP1 – CP5	Mitigation Measure Geo-2: Replace Lost Ecological Functions of Aquatic Habitats by Restoring Existing Degraded Aquatic Habitats in the Vicinity of the Impact
Impact Geo-9: Substantial Increase in Channel Erosion and Meander Migration	CP1 – CP5	Mitigation Measure Geo-9: Implement Channel Sensitive Water Release Schedules
Air Quality and Climate		
Impact AQ-1: Short-Term Emissions of Criteria Air Pollutants and Precursors at Shasta Lake and Vicinity During Project Construction	CP1 – CP5	Mitigation Measure AQ-1: Implement Standard Measures and Best Available Mitigation Measures to Reduce Emissions Levels
Hydrology, Hydraulics, and Water Management		
No mitigation measures proposed.		
Water Quality		
Impact WQ-1: Temporary Construction-Related Sediment Effects on Shasta Lake and Its Tributaries That Would Cause Violations of Water Quality Standards or Adversely Affect Beneficial Uses	CP1 – CP5	Mitigation Measure WQ-1: Prepare and Implement a Stormwater Pollution Prevention Plan That Minimizes the Potential Contamination of Surface Waters, and Comply with Applicable Federal Regulations Concerning Construction Activities
Impact WQ-4: Long-Term Sediment Effects That Would Cause Violations of Water Quality Standards or Adversely Affect Beneficial Uses in Shasta Lake or Its Tributaries	CP1 – CP5	Mitigation Measure WQ-4: Implement Mitigation Measure WQ-1: Prepare and Implement a Stormwater Pollution Prevention Plan That Minimizes the Potential Contamination of Surface Waters, and Comply with applicable Federal Regulations Concerning Construction Activities
Impact WQ-6: Long-Term Metals Effects That Would Cause Violations of Water Quality Standards or Adversely Affect Beneficial Uses in Shasta Lake or Its Tributaries	CP1 – CP5	Mitigation Measure WQ-6: Prepare and Implement a Site-Specific Remediation Plan for Historic Mine Features Subject to Inundation in the Vicinity of the Bully Hill and Rising Star Mines
Impact WQ-7: Temporary Construction-Related Sediment Effects on the Upper Sacramento River That Would Cause Violations of Water Quality Standards or Adversely Affect Beneficial Uses	CP1 – CP3	Mitigation Measure WQ-7: Implement Mitigation Measure WQ-1: Prepare and Implement a Stormwater Pollution Prevention Plan That Minimizes the Potential Contamination of Surface Waters, and Comply with Applicable Federal Regulations Concerning Construction Activities
	CP4 – CP5	Mitigation Measure WQ-7: Implement Mitigation Measure WQ-1: Prepare and Implement a Stormwater Pollution Prevention Plan That Minimizes the Potential Contamination of Surface Waters, and Comply with Applicable Federal Regulations Concerning Construction Activities and Gravel Augmentation BMPs

Table 3-14. Summary of Proposed Mitigation Measures for Comprehensive Plans (contd.)

Resource Topic/Impact	Alternative	Mitigation Measure
Impact WQ-12: Long-Term Metals Effects That Cause Violations of Water Quality Standards or Adversely Affect Beneficial Uses in the Upper Sacramento River	CP1 – CP5	Mitigation Measure WQ-12: Implement Mitigation Measure WQ-6: Prepare and Implement a Site-Specific Remediation Plan for Historic Mine Features Subject to Inundation in the Vicinity of the Bully Hill and Rising Star Mines
Impact WQ-18: Long-Term Metals Effects That Would Cause Violations of Water Quality Standards or Adversely Affect Beneficial Uses in the Extended Study Area	CP1 – CP5	Mitigation Measure WQ-18: Implement Mitigation Measure WQ-6: Prepare and Implement a Site-Specific Remediation Plan for Historic Mine Features Subject to Inundation in the Vicinity of the Bully Hill and Rising Star Mines
Noise and Vibration		
Impact Noise-1: Exposure of Sensitive Receptors in the Primary Study Area to Project-Generated Construction Noise	CP1 – CP5	Mitigation Measure Noise-1: Implement Measures to Prevent Exposure of Sensitive Receptors to Temporary Construction Noise at Project Construction Sites
Hazards and Hazardous Materials and Waste		
Impact Haz-1: Wildland Fire Risk (Shasta Lake and Vicinity and Upper Sacramento River)	CP1 – CP5	Haz-1: Coordinate and Assist Public Services Agencies to Reduce Fire Hazards.
Impact Haz-2: Release Potentially Hazardous Materials or Hazardous Waste (Shasta Lake and Vicinity and Upper Sacramento River)	CP1 – CP5	Haz-2: Reduce Potential for Release of Hazardous Materials and Waste
Impact Haz-4: Expose Sensitive Receptors to Hazardous Materials (Shasta Lake and Vicinity and Upper Sacramento River)	CP1 – CP5	Haz-4: Reduce Potential for Exposure of Sensitive Receptors to Hazardous Materials or Waste
Agriculture and Important Farmlands		
No mitigation measures proposed.		
Fisheries and Aquatic Ecosystems		
Impact Aqua-4: Effects on Special-Status Aquatic Mollusks	CP1 – CP5	Mitigation Measure Aqua-4: Implement Mitigation Measure Geo-2: Replace Lost Ecological Functions of Aquatic Habitats by Restoring Existing Degraded Aquatic Habitats in the Vicinity of the Impact

Table 3-14. Summary of Proposed Mitigation Measures for Comprehensive Plans (contd.)

Resource Topic/Impact	Alternative	Mitigation Measure
Impact Aqua-14: Reduction in Ecologically Important Geomorphic Processes in the Upper Sacramento River Resulting from Reduced Frequency and Magnitude of Intermediate to High Flows	CP1 – CP5	Mitigation Measure Aqua-14: Implement Mitigation Measure Bot-7: Develop and Implement a Riverine Ecosystem Mitigation and Adaptive Management Plan to Avoid and Compensate for the Impact of Altered Flow Regimes on Riparian and Wetland Communities
Impact Aqua-15: Changes in Flow and Water Temperatures in the Lower Sacramento River and Tributaries and Trinity River Resulting from Project Operation – Fish Species of Primary Management Concern	CP1 – CP5	Mitigation Measure Aqua-15: Maintain Flows in the Feather River, American River, and Trinity River Consistent with Existing Regulatory and Operational Requirements and Agreements
Impact Aqua-16: Reduction in Ecologically Important Geomorphic Processes in the Lower Sacramento River Resulting from Reduced Frequency and Magnitude of Intermediate to High Flows	CP1 – CP5	Mitigation Measure Aqua-16: Implement Mitigation Measure Bot-7: Develop and Implement a Riverine Ecosystem Mitigation and Adaptive Management Plan to Avoid and Compensate for the Impact of Altered Flow Regimes on Riparian and Wetland Communities
Botanical Resources and Wetlands		
Impact Bot-2: Loss of MSCS Covered Species	CP1 – CP5	Mitigation Measure Bot-2: Acquire and Preserve Mitigation Lands; Avoid Populations; Relocate MSCS Plants and Revegetate Affected Areas
Impact Bot-3: Loss of USFS Sensitive, BLM Sensitive, or CRPR Species	CP1 – CP5	Mitigation Measure Bot-3: Acquire and Preserve Mitigation Lands; Avoid Populations; Relocate USFS Sensitive, BLM Sensitive, and CRPR Plants and Revegetate Affected Areas
Impact Bot-4: Loss of Jurisdictional Waters	CP1 – CP5	Mitigation Measure Bot-4: Mitigate Loss of Jurisdictional Waters
Impact Bot-5: Loss of General Vegetation Habitats	CP1 – CP5	Mitigation Measure Bot-5: Acquire and Preserve Mitigation Lands for Loss of General Vegetation Habitats
Impact Bot-6: Spread of Noxious and Invasive Weeds	CP1 – CP5	Mitigation Measure Bot-6: Develop a Weed Management Plan
Impact Bot-7: Altered Structure and Species Composition and Loss of Sensitive Plant Communities and Special-Status Plant Species Resulting from Altered Flow Regimes	CP1 – CP5	Mitigation Measure Bot-7: Develop and Implement a Riverine Ecosystem Mitigation and Adaptive Management Plan to Avoid and Compensate for the Impact of Altered Flow Regimes on Riparian and Wetland Communities

Table 3-14. Summary of Proposed Mitigation Measures for Comprehensive Plans (contd.)

Resource Topic/Impact	Alternative	Mitigation Measure
Impact Bot-8: Conflict with Approved Local or Regional Plans with Objectives of Riparian Habitat Protection or Watershed Management	CP1 – CP5	Mitigation Measure Bot-8: Implement Mitigation Measure Bot-7: Develop and Implement a Riverine Ecosystem Mitigation and Adaptive Management Plan to Avoid and Compensate for the Impact of Altered Flow Regimes on Riparian and Wetland Communities
Impact Bot-11: Loss of Sensitive Natural Communities or Habitats Resulting from Implementing the Gravel Augmentation Program or the Reading Island Restoration Plan, Rehabilitating the Reading Island Boat Ramp, or Constructing a Handicap Fishing Access Area	CP4 – CP5	Mitigation Measure Bot-11: Revegetate Disturbed Areas, Consult with DFG
Impact Bot-12: Loss of Special-Status Plants Resulting from Implementing the Gravel Augmentation Program, Restoring Sacramento River Flow Through Anderson Slough, Rehabilitating the Reading Island Boat Ramp, or Constructing a Handicap Fishing Access Area	CP4 – CP5	Mitigation Measure Bot-12: Conduct Preconstruction Surveys for Special-Status Plants and Avoid Special-Status Plant Populations During Construction
Impact Bot-13: Spread of Noxious and Invasive Weeds Resulting from Implementing the Gravel Augmentation Program, Restoring Sacramento River Flow Through Anderson Slough, Rehabilitating the Reading Island Boat Ramp, or Constructing a Handicap Fishing Access Area	CP4 – CP5	Mitigation Measure Bot-13: Implement Weed Management Measures and Revegetation
Impact Bot-14: Altered Structure and Species Composition and Loss of Sensitive Plant Communities and Special-Status Plant Species Resulting from Altered Flow Regimes on the Lower Sacramento River	CP1 – CP5	Mitigation Measure Bot-14: Implement Mitigation Measure Bot-7: Develop and Implement a Riverine Ecosystem Mitigation and Adaptive Management Plan to Avoid and Compensate for the Impact of Altered Flow Regimes on Riparian and Wetland Communities
Impact Bot-15: Conflict with Approved Local or Regional Plans with Objectives of Riparian Habitat Protection or Watershed Management Along the Lower Sacramento River	CP1 – CP5	Mitigation Measure Bot-15: Implement Mitigation Measure Bot-7: Develop and Implement a Riverine Ecosystem Mitigation and Adaptive Management Plan to Avoid and Compensate for the Impact of Altered Flow Regimes on Riparian and Wetland Communities
Wildlife Resources		
Impact Wild-1: Take and Loss of Habitat for the Shasta Salamander	CP1 – CP5	Mitigation Measure Wild-1: Avoid, Relocate, and Acquire Mitigation Lands for Shasta Salamander
Impact Wild-2: Impact on the Foothill Yellow-Legged Frog and Tailed Frog and Their Habitat	CP1 – CP5	Mitigation Measure Wild-2: Avoid, Relocate, and Acquire Mitigation Lands for Foothill Yellow-Legged Frog and Tailed Frog

Table 3-14. Summary of Proposed Mitigation Measures for Comprehensive Plans (contd.)

Resource Topic/Impact	Alternative	Mitigation Measure
Impact Wild-3: Impact on the Northwestern Pond Turtle and Its Habitat	CP1 – CP5	Mitigation Measure Wild-3: Avoid, Relocate, and Acquire Mitigation Lands for Northwestern Pond Turtle
Impact Wild-4: Impact on the American Peregrine Falcon	CP1 – CP5	Mitigation Measure Wild-4: Conduct Preconstruction Surveys for the American Peregrine Falcon and Establish Buffers
Impact Wild-5: Take and Loss of Habitat for the Bald Eagle	CP1 – CP5	Mitigation Measure Wild-5: Acquire and Preserve Mitigation Lands; Conduct Protocol-Level Surveys for the Bald Eagle and Establish Buffers
Impact Wild-6: Take and Loss of Nesting and Foraging Habitat for the Northern Spotted Owl	CP1 – CP5	Mitigation Measure Wild-6: Acquire and Preserve Mitigation Lands; Conduct Protocol-Level Surveys for the Northern Spotted Owl and Establish Buffers
Impact Wild-7: Impact on the Purple Martin and Its Habitat	CP1 – CP5	Mitigation Measure Wild-7: Conduct a Preconstruction Survey for Purple Martin and Establish Buffers
Impact Wild-8: Impacts on the Willow Flycatcher, Vaux's Swift, Yellow Warbler, and Yellow-Breasted Chat and Their Foraging and Nesting Habitat	CP1 – CP5	Mitigation Measure Wild-8: Acquire and Preserve Mitigation Lands; Conduct a Preconstruction Survey for the Willow Flycatcher, Vaux's Swift, Yellow Warbler, and Yellow-Breasted Chat and Establish Buffers
Impact Wild-9: Impacts on the Long-Eared Owl, Northern Goshawk, Cooper's Hawk, Great Blue Heron, and Osprey and Their Foraging and Nesting Habitat	CP1 – CP5	Mitigation Measure Wild-9: Acquire and Preserve Mitigation Lands; Conduct a Preconstruction Survey for the Long-Eared Owl, Northern Goshawk, Cooper's Hawk, and Great Blue Heron and Establish Buffers
Impact Wild-10: Take and Loss of Habitat for the Pacific Fisher	CP1 – CP5	Mitigation Measure Wild-10: Acquire and Preserve Mitigation Lands; Conduct Preconstruction Surveys for the Pacific Fisher and Establish Buffers
Impact Wild-11: Impacts on Special-Status Bats (Pallid Bat, Spotted Bat, Western Red Bat, Western Mastiff Bat, Townsend's Big-Eared Bat, Long-Eared Myotis, and Yuma Myotis), the American Marten, and Ringtails and Their Habitat	CP1 – CP5	Mitigation Measure Wild-11: Acquire and Preserve Mitigation Lands; Conduct a Preconstruction Survey for Special-Status Bats, American Marten, and Ringtails and Establish Buffers
Impact Wild-12: Impacts on Special-Status Terrestrial Mollusks (Shasta Sideband, Wintu Sideband, Shasta Chaparral, and Shasta Hesperian) and Their Habitat	CP1 – CP5	Mitigation Measure Wild-12: Avoid Suitable Habitat; Acquire and Preserve Mitigation Lands for Special-Status Terrestrial Mollusks
Impact Wild-13: Permanent Loss of General Wildlife Habitat	CP1 – CP5	Mitigation Measure Wild-13: Acquire and Preserve Mitigation Lands for Permanent Loss of General Wildlife Habitat

Table 3-14. Summary of Proposed Mitigation Measures for Comprehensive Plans (contd.)

Resource Topic/Impact	Alternative	Mitigation Measure
Impact Wild-14: Impacts on Other Birds of Prey (Red-Tailed Hawk and Red-Shouldered Hawk) and Migratory Bird Species (American Robin, Anna's Hummingbird) and Their Foraging and Nesting Habitat	CP1 – CP5	Mitigation Measure Wild-14: Conduct Preconstruction Surveys for Other Nesting Raptors and Migratory Birds and Establish Buffers
Impact Wild-15: Loss of Critical Deer Winter and Fawning Range	CP1 – CP5	Mitigation Measure Wild-15: Acquire and Preserve Mitigation Lands for Permanent Loss of Critical Deer Wintering and Fawning Range
Impact Wild-16: Take and Loss of California Red-Legged Frog	CP1 – CP5	TBD
Impact Wild-17: Impacts on Riparian-Associated Special-Status Wildlife Resulting from Modifications to the Existing Flow Regime in the Primary Study Area	CP1 – CP5	Mitigation Measure Wild-17: Implement Mitigation Measure Bot-7: Develop and Implement a Riverine Ecosystem Mitigation and Adaptive Management Plan to Avoid and Compensate for the Impact of Altered Flow Regimes on Riparian and Wetland Communities
Impact Wild-20: Consistency with Local and Regional Plans with Goals of Promoting Riparian Habitat in the Primary Study Area	CP1 – CP5	Mitigation Measure Wild-20: Implement Mitigation Measure Bot-7: Develop and Implement a Riverine Ecosystem Mitigation and Adaptive Management Plan to Avoid and Compensate for the Impact of Altered Flow Regimes on Riparian and Wetland Communities
Impact Wild-21: Impacts on Riparian-Associated Special-Status Wildlife Resulting from the Gravel Augmentation Program	CP4 – CP5	Mitigation Measure Wild-21: Conduct Preconstruction Surveys for Elderberry Shrubs, Northwestern Pond Turtle, and Nesting Riparian Raptors and Other Nesting Birds. Avoid Removal or Degradation of Elderberry Shrubs and Avoid Vegetation Removal Near Active Nest Sites.
Impact Wild-22: Impacts on Riparian-Associated Special-Status Wildlife Species Resulting from Restoration of Reading Island	CP4 – CP5	Mitigation Measure Wild-22: Implement Mitigation Measure Wild-21: Conduct Preconstruction Surveys for Elderberry Shrubs, Northwestern Pond Turtle, and Nesting Riparian Raptors and Other Nesting Birds. Avoid Removal or Degradation of Elderberry Shrubs and Avoid Vegetation Removal near Active Nest Sites.
Impact Wild-23: Impacts on Riparian-Associated and Aquatic Special-Status Wildlife Resulting from Modifications to Existing Flow Regimes in the Lower Sacramento River and Delta	CP1 – CP5	Mitigation Measure Wild-23: Implement Mitigation Measure Bot-7: Develop and Implement a Riverine Ecosystem Mitigation and Adaptive Management Plan to Avoid and Compensate for the Impact of Altered Flow Regimes on Riparian and Wetland Communities.
Impact Wild-26: Consistency with Local and Regional Plans with Goals of Promoting Riparian Habitat Along the Lower Sacramento River and in the Delta	CP1 – CP5	Mitigation Measure Wild-26: Implement Mitigation Measure Bot-7: Develop and Implement a Riverine Ecosystem Mitigation and Adaptive Management Plan to Avoid and Compensate for the Impact of Altered Flow Regimes on Riparian and Wetland Communities.

Table 3-14. Summary of Proposed Mitigation Measures for Comprehensive Plans (contd.)

Resource Topic/Impact	Alternative	Mitigation Measure
Cultural Resources		
Impact Culture-1: Disturbance or Destruction of Archaeological and Historic Resources Due to Construction or Inundation	CP1 – CP5	Mitigation Measure Culture-1: Comply with Section 106 of the NHPA
Impact Culture-3: Disturbance or Destruction of Archaeological and Historic Resources near the Upper Sacramento River Due to Construction	CP4 – CP5	Mitigation Measure Culture-3: Implement Mitigation Measure Culture-1: Comply with Section 106 of the NHPA.
Indian Trust Assets		
No mitigation measures proposed.		
Socioeconomics, Population, and Housing		
Impact Socio-14: Potential Temporary Reduction in Shasta Project Water or Hydropower Supplied to the CVP and SWP Service Areas During Construction	CP1 – CP5	Mitigation Measure Socio-14: Secure Replacement Water or Hydropower During Project Construction
Land Use Planning		
Impact LU-1: Disrupt Existing Land Uses (Shasta Lake and Vicinity and Upper Sacramento River)	CP1 – CP5	Mitigation Measure LU-1: Minimize and/or Avoid Temporary Disruptions to Local Communities
Impact LU-2: Conflict with Existing Land Use Goals and Policies of Affected Jurisdictions (Shasta Lake and Vicinity and Upper Sacramento River)	CP1 – CP5	Mitigation Measure LU-2: Minimize and/or Avoid Conflicts with Land Use Goals and Policies
Recreation and Public Access		
Impact Rec-1 (CP1–CP5): Seasonal Inundation of Shasta Lake Recreation Facilities or Portions of Recreation Facilities and Public Access at Pool Elevations Above the Current Full Pool Elevation	CP1 – CP5	Mitigation Measure Rec-1: Modify and Relocate Recreation Facilities Inundated by Increases in Shasta Lake Full Pool Elevation
Impact Rec-2 (CP1 – CP5): Temporary Construction-Related Disruption of Recreation Access and Activities at and near Shasta Dam	CP1 – CP5	Mitigation Measure Rec-2: Provide Information About and Improve Alternate Recreation Access and Opportunities to Mitigate the Temporary Loss of Recreation Access and Opportunities During Construction at Shasta Dam

Table 3-14. Summary of Proposed Mitigation Measures for Comprehensive Plans (contd.)

Resource Topic/Impact	Alternative	Mitigation Measure
Impact Rec-4 (CP1 – CP5): Increased Hazards to Boaters and Other Recreationists at Shasta Lake from Standing Timber and Stumps Remaining in Untreated Areas of the Inundation Zone	CP1 – CP5	Mitigation Measure Rec-4: Provide Information to Shasta Lake Visitors About Potential Safety Hazards in Newly Inundated Areas from Standing Timber and Stumps
Impact Rec-15 (CP1 – CP5): Increased Difficulty for Boaters and Anglers in Using the Sacramento River and Rivers Below CVP and SWP Reservoirs as a Result of Decreased River Flows	CP1 – CP5	Mitigation Measure Rec-15: Implement Mitigation Measure Aqua-15: Maintain Flows in the Feather River, American River, and Trinity River Consistent with Existing Regulatory and Operational Requirements and Agreements
Aesthetics and Visual Resources		
Impact Vis-3: Generation of Increased Daytime Glare and/or Nighttime Lighting (Shasta Lake and Vicinity and Upper Sacramento River)	CP1 – CP5	Mitigation Measure Vis-3: Minimize or Avoid Visual Impacts of Daytime Glare and Nighttime Lighting
Transportation and Traffic		
Impact Trans-1: Short-Term and Long-Term Increases in Traffic in the Primary Study Area in Relation to the Existing Traffic Load and Capacity of the Street System	CP1 – CP5	Mitigation Measure Trans-1: Prepare and Implement a Traffic Control and Safety Assurance Plan
Impact Trans-2: Adverse Effects on Access to Local Streets or Adjacent Uses in the Primary Study Area	CP1 – CP5	Mitigation Measure Trans-2: Implement Mitigation Measure Trans-1: Prepare and Implement a Traffic Control and Safety Assurance Plan.
Impact Trans-4: Adverse Effects on Emergency Access in the Primary Study Area	CP1 – CP5	Mitigation Measure Trans-4: Implement Mitigation Measure Trans-1: Prepare and Implement a Traffic Control and Safety Assurance Plan.
Impact Trans-5: Accelerated Degradation of Surface Transportation Facilities in the Primary Study Area	CP1 – CP5	Mitigation Measure Trans-5: Identify and Repair Roadway Segments Damaged by the Project
Utilities and Service Systems		
Impact Util-1: Damage or Disruption of Public Utility and Service Systems Infrastructure (Shasta Lake and Vicinity and Upper Sacramento River)	CP1 – CP5	Mitigation Measure Util-1: Implement Procedures to Avoid Damage to or Temporary Disruption of Service
Impact Util-2: Utility Infrastructure Relocation or Modification (Shasta Lake and Vicinity and Upper Sacramento River)	CP1 – CP5	Mitigation Measure Util-2: Adopt Measures to Minimize Infrastructure Relocation Impacts

Table 3-14. Summary of Proposed Mitigation Measures for Comprehensive Plans (contd.)

Resource Topic/Impact	Alternative	Mitigation Measure
Public Services		
Impact PS-1: Disruption of Public Services (Shasta Lake and Vicinity and Upper Sacramento River)	CP1 – CP5	Mitigation Measure PS-1: Coordinate and Assist Public Services Agencies
Impact PS-2: Degraded Level of Public Services (Shasta Lake and Vicinity and Upper Sacramento River)	CP1 – CP5	PS-2: Provide Support to Public Services Agencies
Power and Energy		
No mitigation measures proposed.		
Environmental Justice		
No mitigation measures proposed.		
Wild and Scenic Rivers		
No mitigation measures proposed.		

Key:
AQ = Air Quality and Climate
Aqua = Fisheries and Aquatic Ecosystems
BLM = U.S. Department of the Interior, Bureau of Land Management
BMP = best management practice
Bot = Botanical Resources and Wetlands
CP = Comprehensive Plan
CRPR = California Rare Plant Rank
Culture = Cultural Resources
CVP = Central Valley Project
Delta = Sacramento-San Joaquin Delta
DFG = California Department of Fish and Game
Geo = Geology, Geomorphology, Minerals, and Soils
Haz = Hazards and Hazardous Materials and Waste
LU = Land Use Planning
MSCS = Multi-Species Conservation Strategy
NHPA = National Historic Preservation Act
Noise = Noise and Vibration
PS = Public Services
Rec = Recreation and Public Access
Socio = Socioeconomics, Population, and Housing
SWP = State Water Project
TBD = to be determined
Trans = Transportation and Traffic
USFS = U.S. Department of Agriculture, Forest Service
Util = Utilities and Service Systems
Vis = Aesthetics and Visual Resources
Wild = Wildlife Resources
WQ = Water Quality

Shasta Lake Area Within the reservoir area, the primary long-term impacts of this and other comprehensive plans would be due to the increased water surface elevations and inundation area. Raising the full pool of the lake would cause direct impacts due to higher water surface elevations and inundation area. General types of impacts would include potential inundation of terrestrial and aquatic habitat, and inundation and resulting relocations of buildings, sections of paved and nonpaved roads, campground facilities, such as parking areas and restrooms, and low-lying bridges. Use of, and access to, recreation facilities also would be impacted, including trails, day-use picnic areas, boat ramps, marinas, campgrounds, resorts, and beaches. Several of the main buildings associated with Bridge Bay Resort and Marina, the largest resort and marina complex on Shasta Lake, are located within a few feet of the existing full pool elevation. Any potential real estate acquisition or necessary relocations of displaced parties would be accomplished under Public Law 91-646.

Under existing and future conditions, Shasta Reservoir fills to (or near) full pool levels about once every 4 years. On the basis of water operations modeling (CalSim-II), Shasta Reservoir fills to 80 percent or its current capacity in about 82 percent of the years over the 82-year period of analysis of the CalSim-II model. With this plan, Shasta Reservoir would fill to the new full pool storage of 4.81 MAF at a frequency similar to existing and future conditions. Figure 3-4 shows an exceedence probability relationship of maximum annual storage in Shasta Lake for this and other dam raises. As shown in the figure, Shasta Lake would also fill to 80 percent of the new capacity in about 79 percent of the years in the period of analysis. Accordingly, annual operations in the reservoir would generally mirror existing operations, but the water surface in the reservoir would be about 8.5 feet higher. The primary difference in the reservoir area would be that during extended drought periods, the reservoir would be drawn down to the level it would have been under existing and future conditions. The increased area of inundation for this plan equates to an average increase in lateral zone of about 21 feet. Figure 3-5 shows the changes from existing and future conditions for a dam raise of 6.5 feet for a representative period of 1972 through 2002.

The duration of inundation at given drawdown levels (e.g., 10 feet from top of full pool) would be similar to existing conditions. Water would inundate the highest levels of the reservoir for periods ranging from several days to about 1 month. Much of the vegetation in the enlarged drawdown zone on steeper lands would be removed during construction. However, it is expected that significant amounts of vegetation could remain on the flatter slopes because of the infrequent inundation.

The McCloud River is of specific interest. California Public Resources Code 5093.542 (c) and (d) may limit State involvement in studies to enlarge Shasta Dam and Reservoir if that action could have an adverse effect on the free-flowing conditions of the McCloud River or its wild trout fishery. Figure 3-7 illustrates the estimated increase in area of inundation on the McCloud River

upstream from the McCloud Bridge for the 6.5-foot (and 18.5-foot) dam raise. As shown in Figure 3-7, raising Shasta Dam 6.5 feet would result in inundating an additional 1,470 lineal feet (about 9 acres) of the lower McCloud River, compared to existing conditions. Raising Shasta Dam 18.5 feet would result in inundating an additional 3,550 lineal feet (about 27 acres) of the lower McCloud River, compared to existing conditions. This represents a maximum of about 3 percent of the 24-mile-reach of river between the McCloud Bridge and McCloud Dam, which controls flows on the river.

Additional long-term effects on biological resources associated with the relocation of reservoir area infrastructure are anticipated. Short-term, construction-related impacts are also anticipated in the primary study area.

Upper Sacramento River Potential effects on flow and stages of the upper Sacramento River from this plan and other comprehensive plans would be minimal. Figure 3-8 shows Sacramento River flows below the RBDD, simulated using CalSim-II, under wet, above- and below-normal, and dry and critical year conditions for the No-Action Alternative, and CP1 and CP4. Additional figures are included in the Plan Formulation Appendix that show simulated Sacramento River flows below Keswick Dam, the RBDD, and Stony Creek, under wet, above- and below-normal, and dry and critical year conditions for all of the alternatives. As shown in Figure 3-8, during most years, annual operations of Shasta Reservoir, and subsequent flows and stages in the Sacramento River, would be relatively unchanged. Also, flows and stages would increase slightly in June and July. Although small, this increase would be most pronounced during dry periods as more water is released from Shasta Dam for water supply reliability purposes. During dry periods, however, there are few to no changes in water flows or changes during the winter and spring periods. All potential noticeable changes in flows and stages would diminish rapidly downstream from Red Bluff.

Changes in river flows and stages may impact geomorphic conditions along the river, existing riparian vegetation, and other wildlife resources. As described above, the changes in temperatures and flows are expected to have a beneficial impact on anadromous fish resources. A possibility exists, however, that by benefiting anadromous fish, a slightly altered temperature and flow regime may adversely impact warm-water species in the Sacramento River. This impact is not expected to be significant.

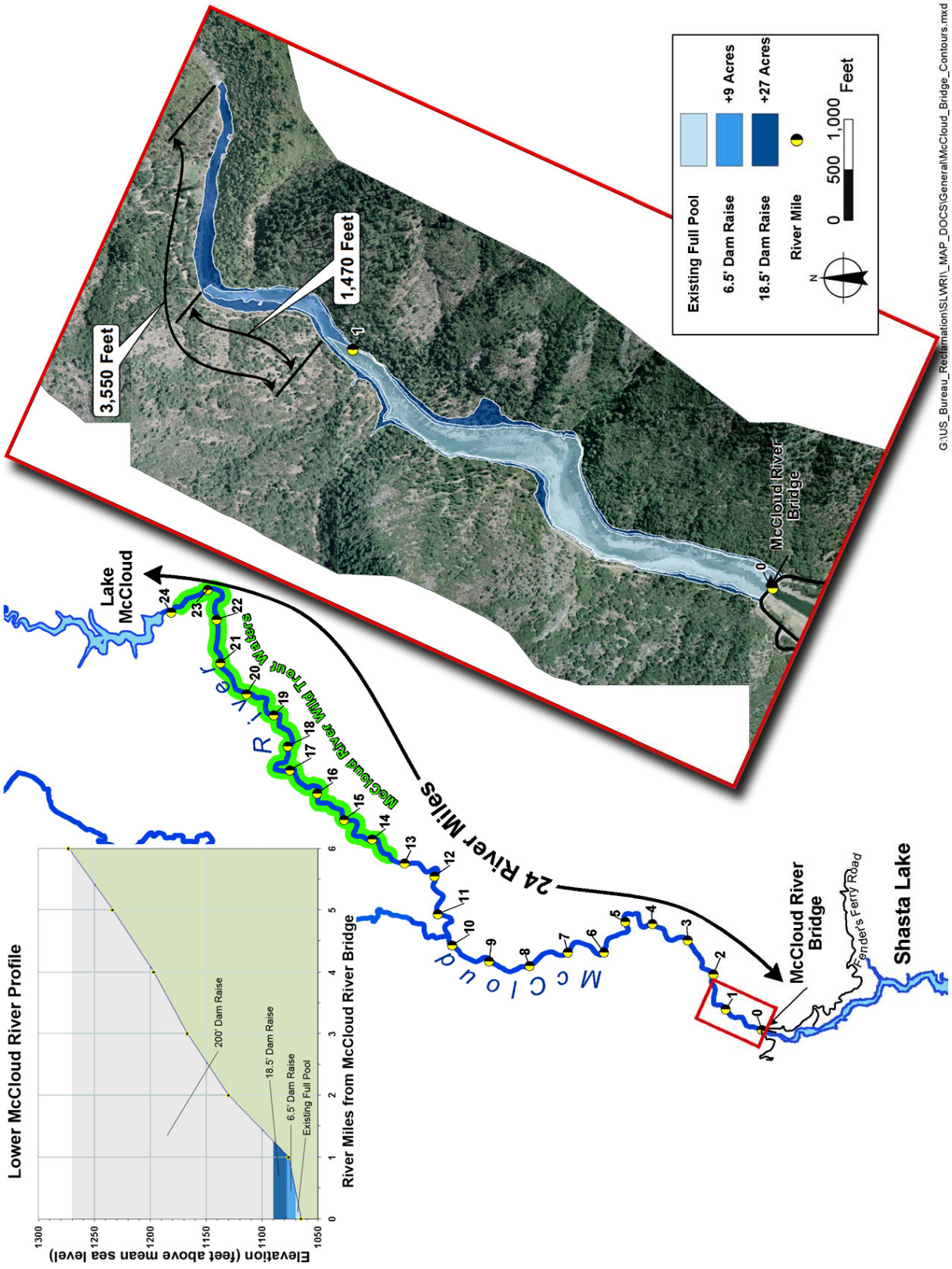
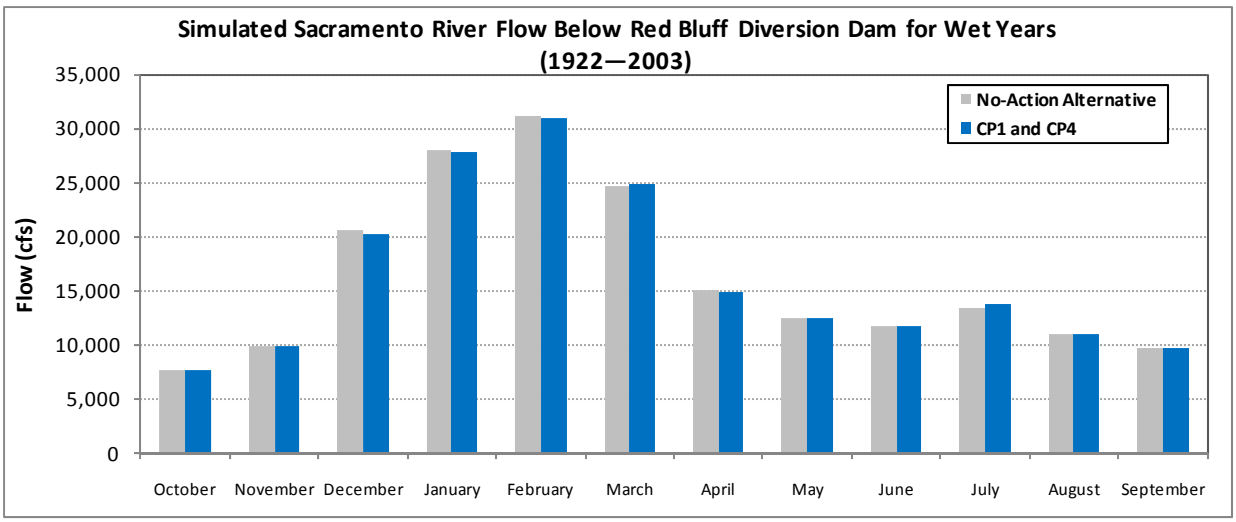
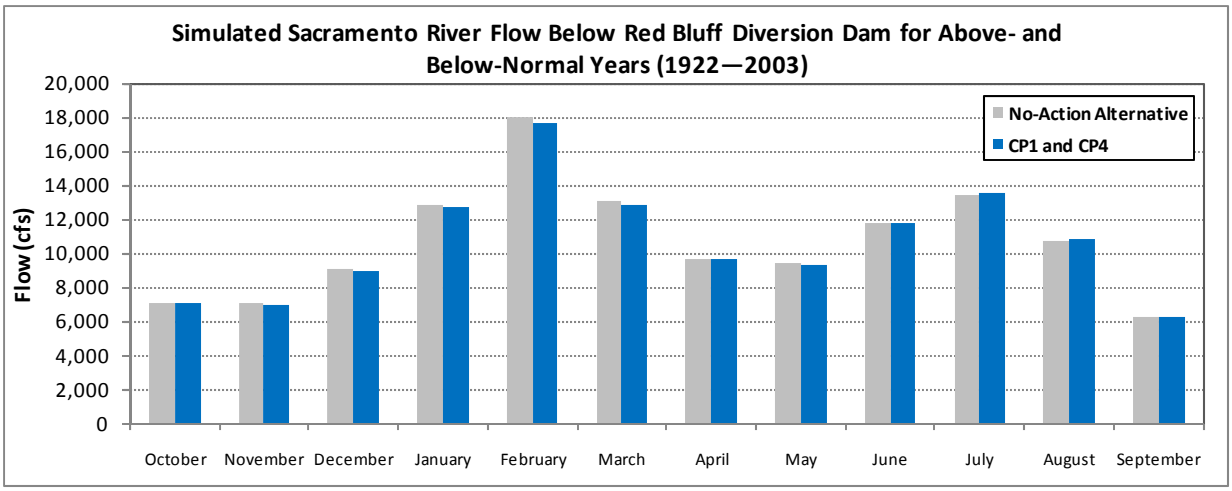


Figure 3-7. McCloud River Extent of Maximum Inundation for 6.5-foot Raise and 18.5-foot Raise





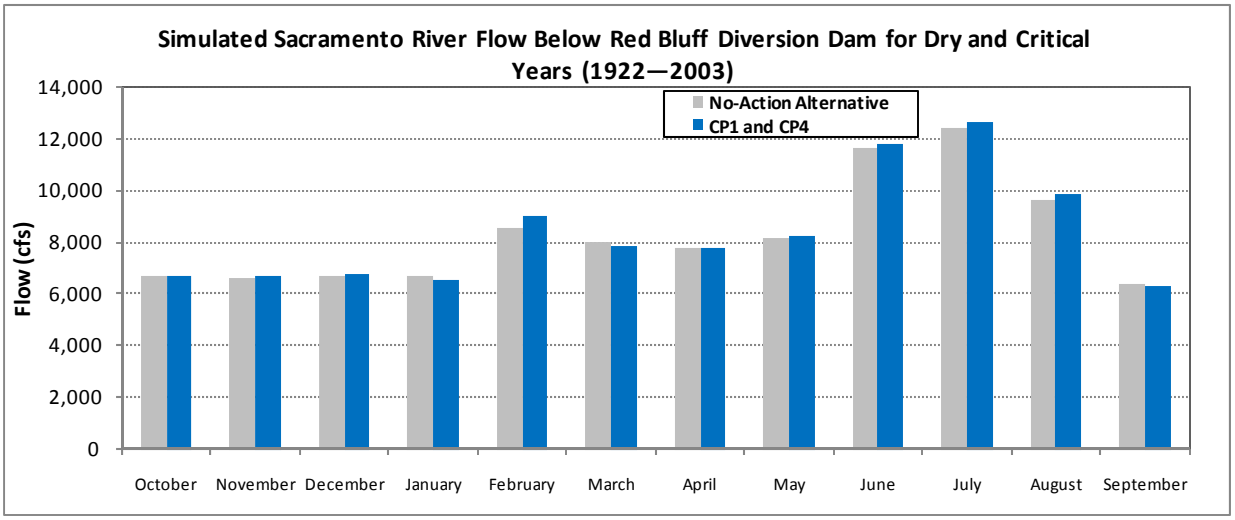


Figure 3-8. Simulated Sacramento River Flow Below Red Bluff Diversion Dam in Wet, Above- and Below-Normal, and Dry and Critical Years for CP1 and CP4 (Water Year Types Based on the Sacramento Valley Water Year Hydrologic Classification)

Preliminary Economics Assessment of CP1

Estimated Costs Estimated construction cost and annual cost of CPI are included in Table 3-15. As shown, the estimated construction cost for CP1 is about $827 million. The estimated total annual cost of CP1 is $42.6 million.

Table 3-15. Estimated Construction and Annual Costs

Item	CP1 6.5 ft ($ millions)	CP2 12.5 ft ($ millions)	CP3 18.5 ft ($ millions)	CP4 18.5 ft ($ millions)	CP5 18.5 ft ($ millions)
Construction Costs					
Field Costs					
Relocations					
Vehicular Bridges	32	32	48	48	48
Doney Creek Railroad Bridge	51	51	51	51	51
Sacramento River Railroad Bridge, Second Crossing	105	105	105	105	105
Pit River Bridge Modifications	15	21	28	28	28
Railroad Realignment	7	7	7	7	7
Roads	15	23	34	34	34
Utilities	23	24	29	29	29
Buildings/Facilities – Recreation	120	135	153	153	153
Dams and Reservoirs					
Main Dam	49	58	69	69	69
Outlet Works	25	25	25	25	25
Spillway	95	98	100	100	100
Temperature Control Device	26	27	28	28	28
Powerhouse and Penstocks	1	1	1	1	1
Right Wing Dam	4	5	6	6	6
Left Wing Dam	12	17	23	23	23
Visitor Center	8	8	8	8	8
Dikes	13	15	23	23	23
Reservoir Clearing	4	7	18	18	18
Pit 7 Dam and Powerhouse Modifications	0.2	0.2	0.2	0.2	0.2
Environmental Restoration	-	-	-	6	17
Recreation Enhancement	-	-	-	-	1
Total Field Costs	605	658	757	763	764
Planning, Engineering, Design, and Construction Management	121	132	151	153	153
Lands	26	41	60	61	61
Environmental Mitigation	61	66	76	76	76
Cultural Resource Mitigation	12	13	15	15	15
Water Use Efficiency Actions	2	3	4	2	4
Total Construction Cost	**827**	**913**	**1,064**	**1,070**	**1,073**
Annual Cost					
Interest and Amortization	$38	$42	$48	$49	49
Operations and Maintenance	$4.9	$4.8	$5.2	$5.2	$5.2
Total Annual Cost	**$42.6**	**$46.4**	**$53.7**	**$54.0**	**$54.1**

Note:
[1] Based on April 2010 price levels, 100-year period of analysis, and 4-1/8 percent interest rate.

Key: CP = Comprehensive Plan
- = not applicable ft = feet

Estimated Economic Benefits As shown in Table 3-16, the estimated average annual monetary benefit of CP1, assuming the cost of water and energy supplies increases at the same rate as inflation, is about $47.6 million. The largest monetary benefit is increased dry year water supply reliability. Assuming the cost of water supplies and hydropower increases at 2 percent above inflation, to account for future diminishment of water and energy supplies and increasing demands, the average annual benefit could exceed about $68.8 million per year.

Table 3-16. Average Annual Economic Benefit Summary[1]

Economic Benefit Category[2 3]	CP1 ($ millions)	CP2 ($ millions)	CP3 ($ millions)	CP4 ($ millions)	CP5 ($ millions)
Anadromous Fish	15.1	9.6	25.0	49.2	25.0
Water Supply Reliability[4]	27.0	25.0	26.7	27.0	26.7
Hydropower Generation	2.4	3.9	5.4	7.7	5.4
Recreation[5]	3.1	5.2	8.3	8.3	8.4
Total Benefits					
Estimated Value (At Inflation)[6]	47.6	43.7	65.4	92.2	65.5
Estimated Value (2% Above Inflation) [7]	68.8	64.6	88.7	117.2	89.3

Notes:

[1] Based on Central Valley Project and State Water Project operational conditions described in the 2004 and 2005 Biological Opinions released by the National Marine Fisheries Service and the U.S. Fish and Wildlife Service, respectively.

[2] Economic benefits have not been monetized for ecosystem restoration, including (1) restoring resident fish habitat in Shasta Lake, (2) restoring fisheries and riparian habitat at several locations along the lower reaches of the upper Sacramento River and tributaries to Shasta Lake, (3) augmenting spawning gravel in the upper Sacramento River, and (4) restoring riparian, floodplain, and side channel habitat along the upper Sacramento River.

[3] Benefits for flood control and water quality are minimal and have not been monetized.

[4] Includes irrigation and municipal and industrial water supply. Does not reflect benefits related to water use efficiency actions included in all comprehensive plans.

[5] These values do not account for increased visitation due to modernization of recreation facilities associated with all comprehensive plans.

[6] Assumes the costs of water supplies and hydropower increase at the same rate as inflation.

[7] Includes increase of water supply and hydropower costs at 2 percent above inflation to account for growing scarcity in the future. Sensitivity analyses for change in water supply benefits are included in the Economic Valuation Appendix.

Key:

CP = comprehensive plan

Comprehensive Plan 2 – 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 features of CP2 in the Shasta Lake area are shown in Figure 3-3.

Major Components of CP2

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

A dam raise of 12.5 feet was chosen because it represents a midpoint between the likely smallest dam raise considered and the largest practical dam raise that would not require relocating the Pit River Bridge. By raising Shasta Dam from a crest at elevation 1,077.5 to elevation 1,090.0, CP2 would increase the height of the reservoir's full pool by 14.5 feet. The additional 2-foot increase in the height of the full pool above the dam raise height would result from spillway modifications similar to CP1. This increase in full pool height would add approximately 443,000 acre-feet of storage to the reservoir's capacity. Accordingly, storage in the overall full pool would increase from 4.55 MAF to 5.0 MAF. Figure 2-3 shows the increase in surface area and storage capacity for CP2.

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

As described for CP1, this plan would 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 the SLWRI planning objectives and broad public services, are summarized in Tables 3-10 and 3-11 and described below.

Increase Anadromous Fish Survival Similar to CP1, raising Shasta Dam by 12.5 feet would increase the cold-water pool and increase the ability of Shasta Dam to make cold-water releases and regulate water temperatures for fish in the upper Sacramento River, primarily in dry and critically dry water years. It is estimated that improved water temperature conditions under CP2 could result in an average annual increase in the Chinook salmon population of about 234,000 out-migrating juvenile fish.

Increase Water Supply Reliability CP2 would increase water supply reliability by increasing firm water supplies for irrigation and M&I deliveries primarily during drought periods. This action would contribute to replacement of supplies redirected to other purposes in the CVPIA, which would help reduce estimated future water shortages by increasing the reliability of firm water supplies for agricultural and M&I deliveries by at least 105,100 acre-feet per year and average annual yield by about 62,800 acre-feet per year. As shown in Table 3-13, the majority of increased firm yield, 85,300 acre-feet, would be for south-of-Delta agricultural and M&I deliveries. In addition, water use efficiency could help reduce current and future water shortages by allowing a more effective use of existing supplies. Under CP2, approximately $3.1 million would be allocated over an initial 10-year period to fund agricultural and M&I

water conservation programs, focused on agencies benefiting from increased reliability of project water supplies.

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

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

Benefits Related to Other SLWRI Planning 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.

Additional Broad Public Benefits Additional broad public benefits of CP2 obtained through pursuing project objectives are summarized in Table 3-11. Broad public benefits for CP2 are similar to those for CP1 but amplified because of increased system capacity and the facility upgrades associated with additional relocations.

Potential Primary Effects of CP2

Following is a summary of potential environmental consequences of CP2. Potential environmental effects are generally comparable between comprehensive plans; some adverse impacts would be exacerbated by larger dam raises and the associated scale of those effects, such as expanded construction areas and increased area of inundation around Shasta Lake. Proposed mitigation measures to address potential adverse impacts of CP2 are summarized in Table 3-14. A detailed discussion of potential effects and proposed mitigation measures are included in Chapters 4 through 25 of the Preliminary Draft EIS.

Shasta Lake Area As with CP1, the primary long-term effects of this comprehensive plan would be due to the increased water surface elevations and inundation area. CP2 includes modifying four bridges and replacing four other bridges, inundating a number of small segments of existing paved and nonpaved roads, and relocating a number of potable water facilities, wastewater facilities, gas and petroleum facilities, and power distribution and telecommunications facilities. A number of recreation facilities would also be impacted, including

campgrounds, marinas, resorts, boat ramps, day-use areas, and trails. Approximately 21 segments of roadway would be relocated, including portions of Lakeshore Drive, Fenders Ferry Road, Gilman Road, and Silverthorn Road. Embankments would be constructed to protect I-5 at Lakeshore and the UPRR at Bridge Bay. Any potential real estate acquisitions or necessary relocations of displaced parties would be accomplished under Public Law 91-646.

Shasta Reservoir would fill to the new full pool storage of 5.0 MAF at a frequency similar to existing and future conditions. On the basis of water operations modeling (CalSim-II), Shasta Reservoir fills to 80 percent or its current capacity in about 82 percent of the years over the 82-year period of analysis of the CalSim-II model. Figure 3-4 shows an exceedence probability relationship of maximum annual storage in Shasta Reservoir for this and other dam raises. Under CP2, Shasta Reservoir would fill to 80 percent of the new capacity in about 78 percent of the years. Accordingly, annual operations in the reservoir would generally mirror existing operations, but the water surface in the reservoir would be about 12.5 feet higher. The primary difference in the reservoir area would be that during extended drought periods, the reservoir would be drawn down to existing and future minimum levels. Figure 3-5 shows the changes from existing and future conditions for a dam raise of 12.5 feet for a representative period of 1972 through 2002.

As with CP1, much of the vegetation in the enlarged drawdown zone on steeper lands would be removed during construction. However, it is expected that significant amounts of vegetation could remain on the flatter slopes because of infrequent inundation. The lower reaches of tributaries to Shasta Lake also would experience increased inundation.

Raising Shasta Dam 12.5 feet would result in inundating an additional 2,740 lineal feet (about 18 acres) of the lower McCloud River. This represents about 2 percent of the 24-mile-reach of river between the McCloud Bridge and McCloud Dam, which controls flows on the river.

Although recreation would generally improve under this plan, water in the reservoir would be drawn down to existing conditions during the late fall and winter periods of some dry years, representing a drawdown 14.5 feet greater than under existing conditions. In addition, clearances for boat traffic under the Pit River Bridge would be restricted to the north end of the bridge during periods of high reservoir levels (at or near full pool). This condition would typically occur in the late spring (May to June) in about 1 out of 4 years, and could last several days to a week. The estimated minimum clearance at the new full pool would be about 20 feet between Piers 6 and 7.

Additional long-term effects on biological resources associated with the relocation of reservoir area infrastructure are anticipated. Short-term, construction-related impacts are also anticipated in the primary study area.

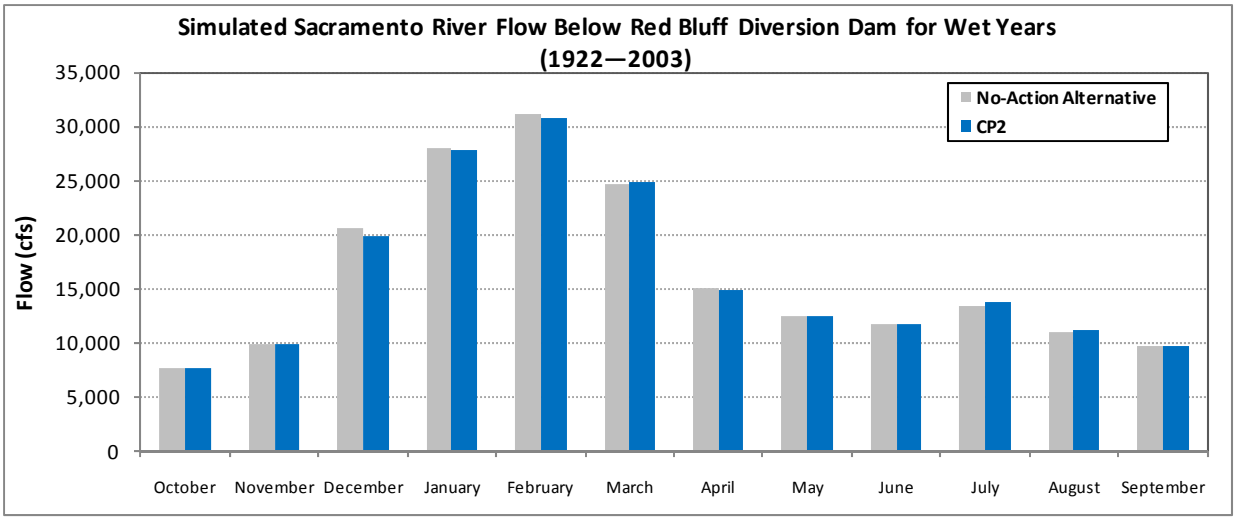
Upper Sacramento River As with the previous plan, potential effects on flow and stages of the upper Sacramento River from this plan and other comprehensive plans would be minimal. Figure 3-9 shows Sacramento River flows below the RBDD, simulated using CalSim-II, under above- and below-normal, and dry and critical year conditions for the No-Action Alternative, and CP2. Additional figures are included in the Plan Formulation Appendix that show simulated Sacramento River flows below Keswick Dam, the RBDD, and Stony Creek under wet, above- and below-normal, and dry and critical year conditions for all of the alternatives. As shown in Figure 3-9, during most years, annual operations of Shasta Reservoir, and subsequent flows and stages in the Sacramento River, would be relatively unchanged. Also, flows and stages would increase slightly in June and July. Although small, this increase would be most pronounced during dry periods as more water is released from Shasta Dam for water supply reliability purposes. During dry periods, however, there are few to no changes in water flows or changes during the winter and spring periods. All potential noticeable changes in flows and stages would diminish rapidly downstream from Red Bluff.

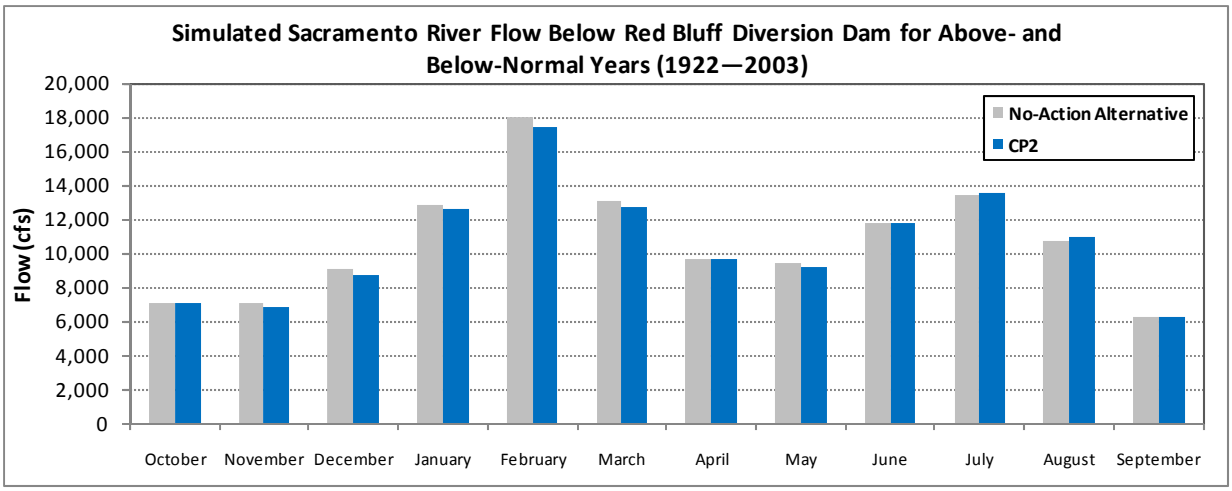
Similar to CP1, changes in river flows and stages may impact geomorphic conditions, existing riparian vegetation, and other wildlife resources of the upper Sacramento River. As described above, the changes in temperatures and flows are expected to have a beneficial impact on anadromous fish resources. A possibility exists, however, that by benefiting anadromous fish, a slightly altered temperature and flow regime may adversely impact warm-water species in the Sacramento River. This impact is not expected to be significant.

Preliminary Economics Assessment of CP2

Estimated Costs Estimated construction cost and annual cost of CP2 are included in Table 3-15. As shown, the estimated construction cost is about $913 million. The estimated total annual cost of this plan is $46.4 million.

Estimated Economic Benefits As shown in Table 3-16, the estimated average annual monetary benefit of this plan, assuming the cost of water and energy supplies increases at the same rate as inflation, is about $43.7million. The largest monetary benefit is increased dry year water supply reliability. Assuming the cost of water supplies and hydropower increases at 2 percent above inflation, to account for future diminishment of water and energy supplies and increasing demands, the average annual benefit could exceed about $64.6 million per year.





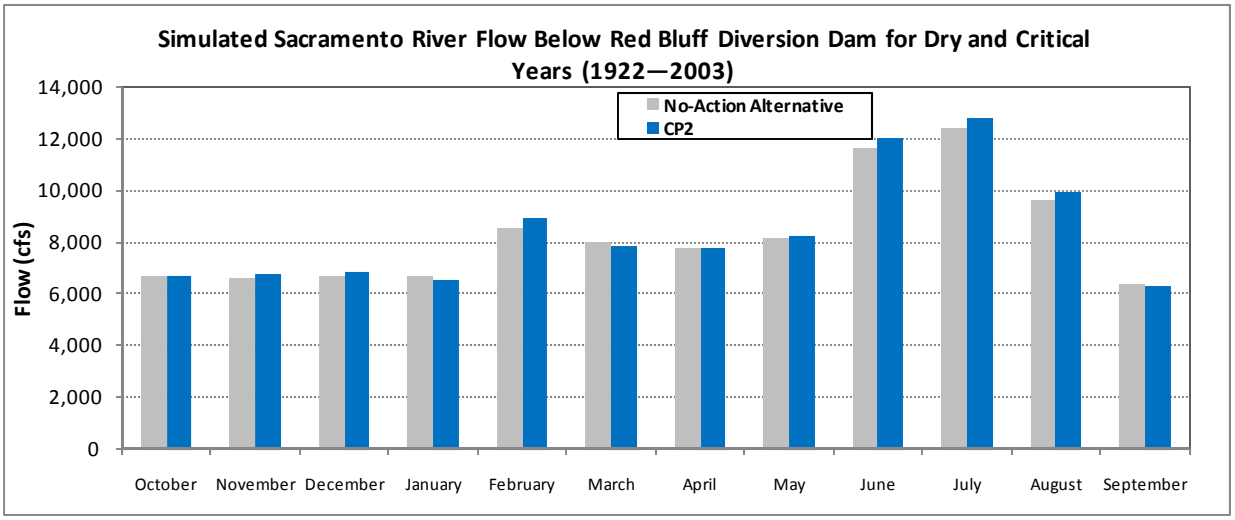


Figure 3-9. Simulated Sacramento River Flow Below Red Bluff Diversion Dam in Wet, Above- and Below-Normal, Dry and Critical Years for CP2 (Water Year Types Based on the Sacramento Valley Water Year Hydrologic Classification)

Comprehensive Plan 3 – 18.5-Foot Dam Raise, Anadromous Fish Survival and Water Supply Reliability

CP3 consists primarily of enlarging Shasta Dam and Reservoir by raising the dam crest 18.5 feet and enlarging the reservoir by 634,000 acre-feet. Major features of CP3 in the Shasta Lake area are shown in Figure 3-3.

Major Components of CP3

- Raising Shasta Dam and appurtenant facilities by 18.5 feet.

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

As shown in Table 3-9, by raising Shasta Dam 18.5 feet, from a crest at elevation 1,077.5 to elevation 1,096.0, CP3 would increase the height of the reservoir's full pool by20.5 feet. The additional 2-foot increase in the height of the full pool above the dam raise height would result from spillway modifications similar to CP1. This increase in full pool height would add approximately 634,000 acre-feet of storage to the reservoir's capacity. Accordingly, storage in the overall full pool would increase from 4.55 MAF to 5.19 MAF. Although higher dam raises are technically and physically feasible, 18.5 feet is the largest dam raise that would not require extensive and costly reservoir area relocations such as relocating the Pit River Bridge, I-5, and the UPRR, as shown in Figure 3-10. Raising the dam 18.5 feet would provide the minimum clearance required (4 feet) at the south end of the Pit River Bridge, while still providing more than 14 feet of clearance at the north end of the bridge. Figure 2-3 shows the increase in surface area and storage capacity for CP3.

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

As described for the above comprehensive plans, this plan would also include the potential to modify the 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 the SLWRI planning objectives and broad public services, are summarized in Tables 3-10 and 3-11 and described below.

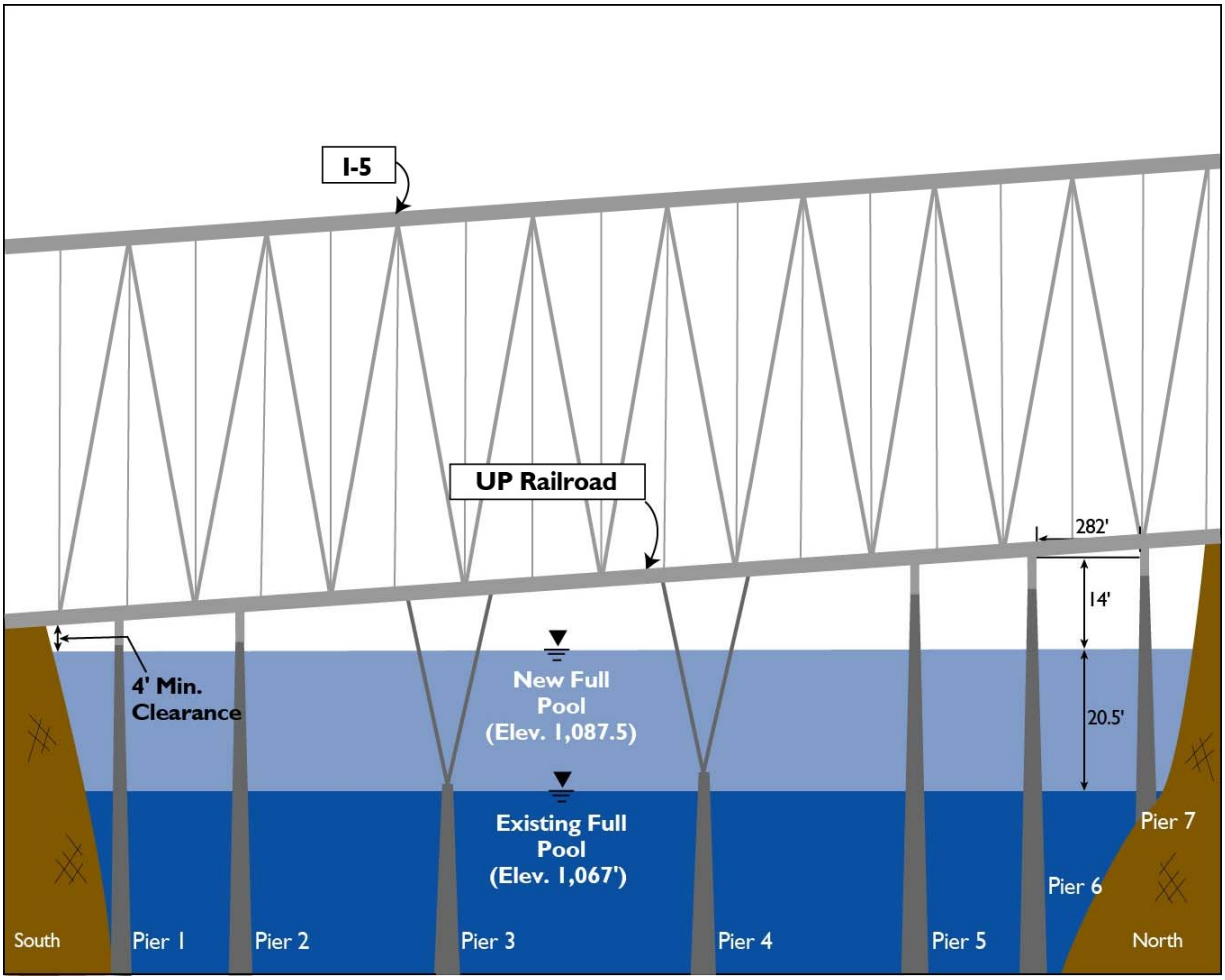


Figure 3-10. Minimum Clearance for Boat Traffic at Pit River Bridge, Full Pool with 18.5-foot Dam Raise

Increase Anadromous Fish Survival Similar to the above comprehensive plans, raising Shasta Dam by 18.5 feet would increase the ability of Shasta Dam to make cold-water releases and regulate water temperatures for fish in the upper Sacramento River, primarily in dry and critically dry water years. It is estimated that improved water temperature conditions under CP3 could result in an average annual increase in the Chinook salmon population of about 607,000 out-migrating juvenile fish.

Increase Water Supply Reliability CP3 would increase water supply reliability by increasing firm water supplies for irrigation and M&I deliveries primarily during drought periods. This action would contribute to replacement of supplies redirected to other purposes in the CVPIA, which would help reduce estimated future water shortages by increasing the reliability of firm water supplies for agricultural and M&I deliveries by at least 133,400 acre-feet per year, and average annual yield by about 75,800 acre-feet per year**.** As shown in Table 3-13, the majority of increased firm yield, 103,800 acre-feet, would be for south-of-Delta agricultural and M&I deliveries. In addition, water use efficiency

could help reduce current and future water shortages by allowing a more effective use of existing supplies. Under CP3, approximately $3.8 million would be allocated over an initial 10-year period to fund agricultural and M&I water conservation programs, focused on agencies benefiting from increased reliability of project water supplies.

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

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

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

Additional Broad Public Benefits Additional broad public benefits of CP3 obtained through pursuing project objectives are summarized in Table 3-11. Broad public benefits for CP3 are similar to CP1 and CP2, but amplified because of increased system capacity and facility upgrades associated with additional relocations.

Potential Primary Effects of CP3

Following is a summary of potential environmental consequences of CP3.Environmental effects are generally comparable between comprehensive plans; some adverse effects would be exacerbated by larger dam raises and the associated scale of those effects, such as expanded construction areas and increased area of inundation around Shasta Lake. Proposed mitigation measures to address potential adverse impacts of CP3 are summarized in Table 3-14. A detailed discussion of potential effects and proposed mitigation measures are included in Chapters 4 through 25 of the Preliminary Draft EIS.

Shasta Lake Area As with the other comprehensive plans, the primary long-term effects of CP3 would be due to the increased water surface elevations and inundation area. The dam raise scenario under CP3 is greater than under CP1 or CP2; therefore, anticipated effects under CP3 are expected to be slightly greater. CP3 includes modifying four bridges and replacing four other bridges,

inundating a number of small segments of existing paved and nonpaved roads, and relocating a number of potable water facilities, wastewater facilities, gas and petroleum facilities, and power distribution and telecommunications facilities. A number of recreation facilities would also be impacted, including campgrounds, marinas, resorts, boat ramps, day-use areas, and trails. Approximately 30 segments of roadway would be relocated, including portions of Lakeshore Drive, Fenders Ferry Road, Gilman Road, and Silverthorn Road. Embankments would be constructed to protect I-5 at Lakeshore and the UPRR at Bridge Bay. Any potential real estate acquisitions or necessary relocations of displaced parties would be accomplished under Public Law 91-646.

With CP3, Shasta Reservoir would fill to the new full pool storage of 5.19 MAF at a frequency similar to existing and future conditions (see Figure 3-3). On the basis of water operations modeling (CalSim-II), Shasta Reservoir fills to 80 percent or its current capacity in about 82 percent of the years over the 82-year period of analysis of the CalSim-II model. Under CP3, Shasta Reservoir would fill to 80 percent of the new capacity in about 76 percent of the years (see Figure 3-4). Accordingly, annual operations in the reservoir would generally mirror existing operations, but the water surface in the reservoir would be about 18.5 feet higher. The primary difference in the reservoir area would be that during extended drought periods, the reservoir would be drawn down to existing and future minimum levels. Figure 3-5 shows the changes from existing and future conditions for a dam raise of 18.5 feet for a representative period of 1972 through 2002.

As with the previous plans, much of the vegetation in the enlarged drawdown zone on steeper lands would be removed during construction. However, significant amounts of vegetation could likely remain on the flatter slopes because of infrequent inundation. The lower reaches of tributaries to Shasta Lake would experience increased inundation.

Raising Shasta Dam 18.5 feet would result in inundating an additional 3,550 lineal feet (about 27 acres) of the lower McCloud River (see Figure 3-6). This represents about 9 percent of the 24-mile-reach of river between the McCloud Bridge and McCloud Dam, which controls flows on the river. Studies are underway to estimate the potential level of impact on the wild trout fishery.

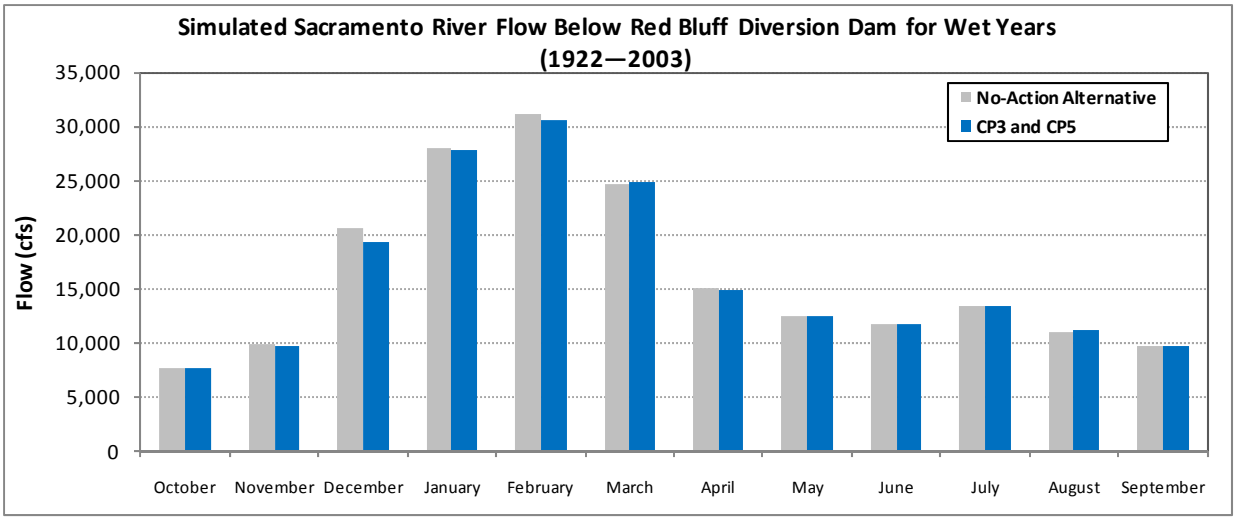
Although it is believed that recreation use would generally improve under this plan, water in the lake would be drawn down to existing conditions during the late fall and winter periods of some dry years, representing a drawdown 20.5 feet greater than under existing conditions. During these periods, the drawdown zone could increase by about 50 lineal feet. In addition, clearances for boat traffic under the Pit River Bridge would be restricted to the north end of the bridge during periods of high reservoir levels (at or near full pool). This condition would typically occur in the late spring (May to June) in about 1 out of 4 years, and could last several days to a week. Figure 3-10 illustrates that the minimum clearance at the new full pool would be about 14 feet between Piers 6

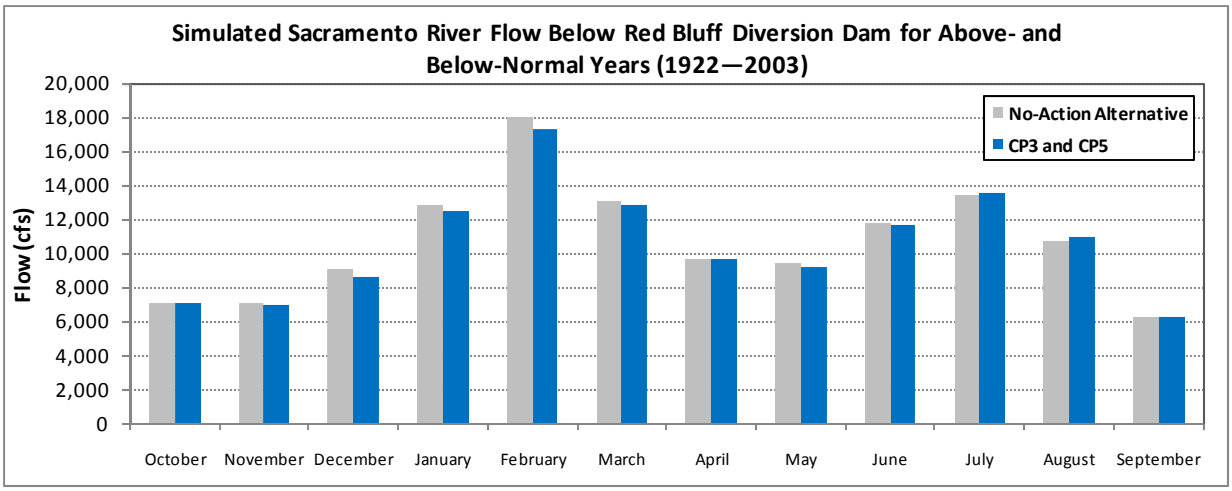
and 7. This could impact boating on the lake, as some houseboats exceed 16 feet in height. Since houseboating is a major recreational experience on Shasta Lake, especially around Memorial Day, restrictions on large boat traffic under the Pit River Bridge during maximum pool levels could adversely impact lake area boat rentals, marinas, and other recreation-dependent businesses.

Additional long-term effects on biological resources associated with the relocation of reservoir area infrastructure are anticipated. Short-term, construction-related impacts are also anticipated in the primary study area.

Upper Sacramento River Potential effects on flow and stages of the upper Sacramento River from this plan and other comprehensive plans would be minimal. Figure 3-11 shows Sacramento River flows below the RBDD, simulated using CalSim-II, under wet, above- and below-normal, and dry and critical year conditions for the No-Action Alternative, CP3, and CP5. Additional figures are included in the Plan Formulation Appendix that show simulated Sacramento River flows below Keswick Dam, the RBDD, and Stony Creek, under wet, above- and below-normal, and dry and critical year conditions for all of the alternatives. As shown in Figure 3-11, during most years, annual operations of Shasta Reservoir, and subsequent flows and stages in the Sacramento River, would be relatively unchanged. All potential noticeable changes in flows and stages would diminish rapidly downstream from Red Bluff.

Similar to other comprehensive plans, changes in river flow and stages may impact geomorphic conditions, existing riparian vegetation, and wildlife resources of the upper Sacramento River. As described above, the changes in temperature and flows are expected to have a beneficial impact on anadromous fish resources. A possibility exists, however, that by benefiting anadromous fish, a slightly altered temperature and flow regime may adversely impact warm-water species in the Sacramento River. This impact is not expected to be significant.





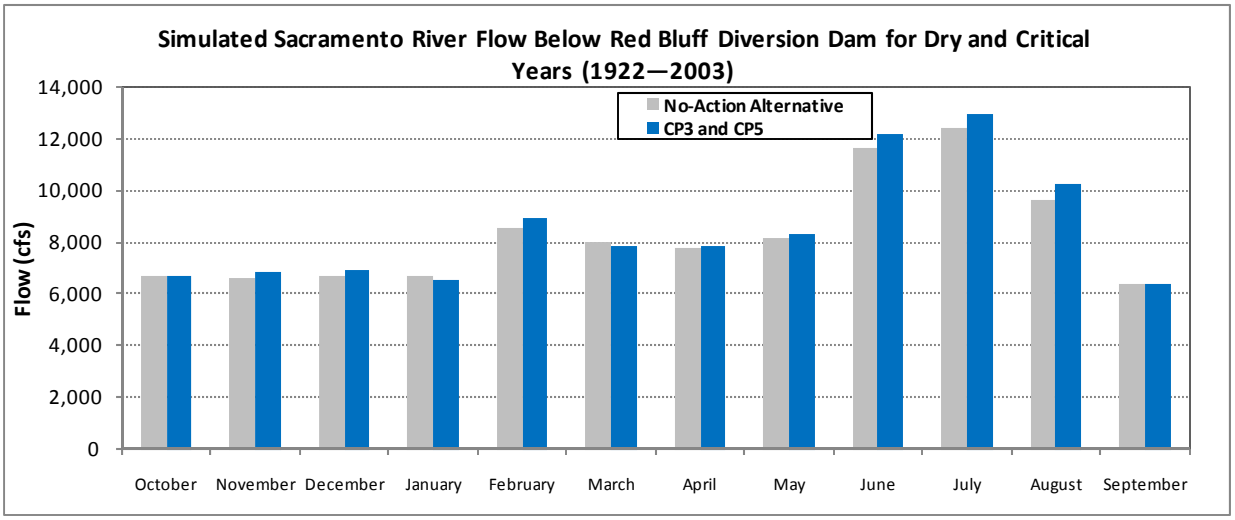


Figure 3-11. Simulated Sacramento River Flow Below Red Bluff Diversion Dam in Wet, Above- and Below- Normal, Dry and Critical Years for CP3 and CP5 (Water Year Types Based on the Sacramento Valley Water Year Hydrologic Classification)

Preliminary Economics Assessment of CP3

Estimated Costs Estimated construction cost and annual costs of CP3 are included in Table 3-15. As shown, the estimated construction cost is about $1,064 million. The estimated total annual cost of this plan is $53.7 million.

Estimated Economics Benefits As shown in Table 3-16, the estimated average annual monetary benefit of CP3, assuming the cost of water and energy supplies increases at the same rate as inflation, is about $65.4 million. Assuming the cost of water supplies and hydropower increases at 2 percent above inflation, to account for future diminishment of water and energy supplies and increasing demands, the average annual benefit could exceed about $88.7 million per year.

Comprehensive Plan 4 – 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 features of CP4 in the Shasta Lake area are shown in Figure 3-3.

Major Components of CP4

Major components of this plan include the following:

- Raising Shasta Dam and appurtenant facilities by 18.5 feet.
- Reserving 378,000 acre-feet of the increased storage in Shasta Lake for maintaining cold-water volume or augmenting flows as part of an adaptive management plan for anadromous fish survival.
- Augmenting spawning gravel in the upper Sacramento River.
- Restoring riparian, floodplain, and side channel habitat.
- Implementing the set of eight common management measures previously described.

As shown in Table 3-9, by raising Shasta Dam 18.5 feet, from a crest at elevation 1,077.5 to elevation 1,096.0, CP4 would increase the height of the reservoir full pool by 20.5 feet. The additional 2-foot increase in the height of the full pool above the dam raise height would result from spillway modifications similar to CP1. This increase in full pool height would add approximately 634,000 acre-feet of storage to the reservoir's capacity. Accordingly, storage in the overall full pool would be increased from 4.55 MAF to 5.19 MAF. The additional storage created by the 18.5-foot dam raise would be used to improve the ability to meet temperature objectives for winter-run Chinook salmon and to meet habitat requirements for other anadromous fish during drought years, while also increasing water supply reliability. Of the increased reservoir storage space, about 378,000 acre-feet would be dedicated to

increasing the cold-water supply for anadromous fish survival purposes. Figure 2-3 shows the increase in surface area and storage capacity for CP4.

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

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

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

Adaptive Management of Cold-Water Pool This alternative may also include development of an adaptive management plan for the additional 378,000 acre-feet of cold-water pool. The adaptive management plan may include operational changes to the timing and magnitude of releases from Shasta Dam to benefit anadromous fish, as long as there are no conflicts with current operational guidelines or adverse impacts to water supply reliability. 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 manage the cold-water pool each year in cooperation with the SRTTG. Because adaptive management is predicated on using best available science and new information to make decisions, a monitoring program would be implemented as part of the adaptive management plan. SRTTG would conduct monitoring, develop monitoring protocols, and set performance standards to determine the success of adaptive management actions.

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 2009b). Under CP4, spawning-sized gravel would be injected at multiple locations along the Sacramento River between Keswick Dam and the RBDD.

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

spawning gravel augmentation, and to identify opportunities for future actions or programs to do so.

On average, 5,000 to 10,000 tons of gravel would be placed each year, although the specific quantity of gravel placed in a given year may vary from that range. Gravel would be washed and sorted to meet specific size criteria, and would be applied to active river channels between August and September each year, consistent with the time frame for the ongoing CVPIA gravel augmentation program.

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

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

Restore Riparian, Floodplain, and Side Channel Habitat Under CP4, riparian, floodplain, and side channel habitat restoration would be constructed at a suitable location along the Sacramento River. The exact size, scope, and location of a suitable restoration site is still under development and will be provided in the Final Feasibility Report. A description of potential riparian, floodplain, and side channel habitat restoration at Reading Island is provided below as an example restoration project. Reading Island lies along the Sacramento River just north of Cottonwood Creek (Figure 3-12). Approximately 0.8 miles of side channel habitat would be restored by breaching the levee at the top end of the Reading Island side-channel to restore connectivity with the Sacramento River at flows greater than 4,000 to 6,000 cfs. Additionally, preliminary analysis indicates that side channel clearing and excavation may be necessary to restore flows capable of supporting a suitable spawning habitat. Restoration would also involve acquiring and revegetating floodplain terraces and adjacent riparian areas with native plants.

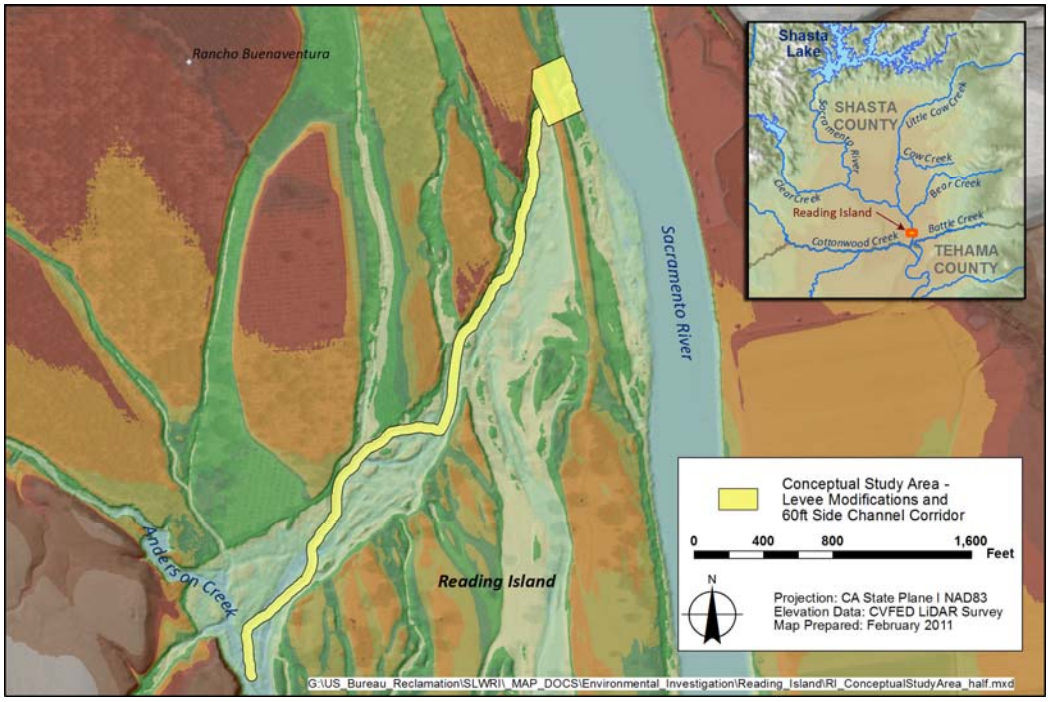
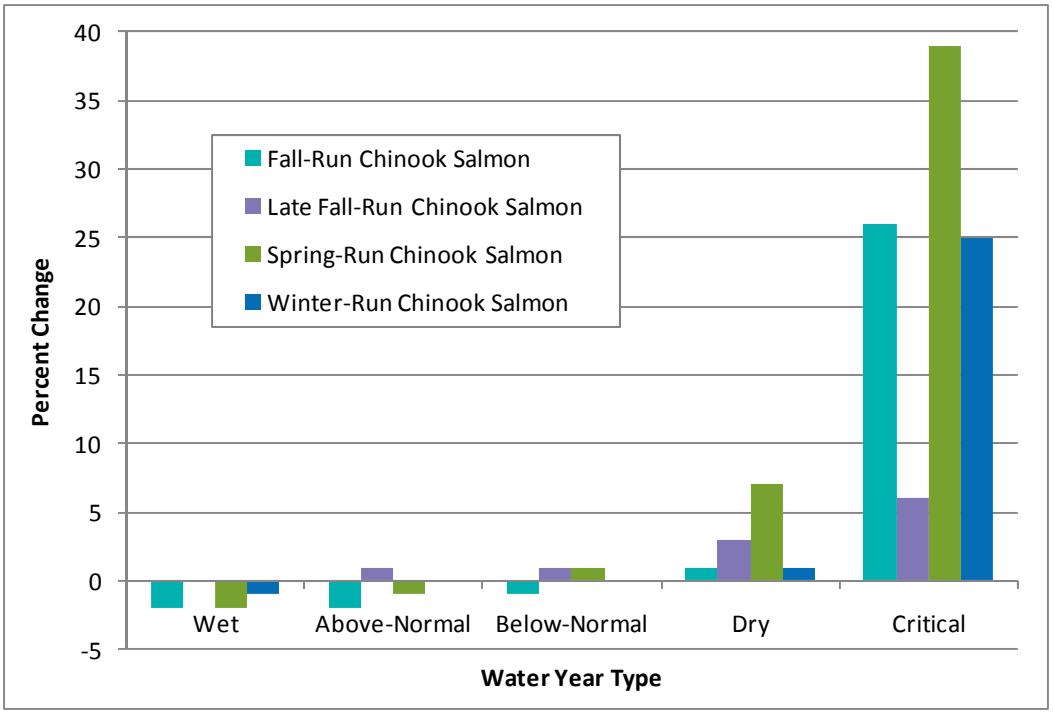


Figure 3-12. Reading Island Conceptual Study Area

Potential Benefits of CP4

Major potential benefits of CP4, related to the SLWRI planning objectives and broad public services, are summarized in Tables 3-10 and 3-11 and described below.

Increase Anadromous Fish Survival CP4 would significantly increase the ability of Shasta Dam to make cold-water releases and regulate water temperature in the upper Sacramento River, primarily in dry and critically dry water years. It is estimated that improved temperature conditions under CP4 could result in an average annual increase in Chinook salmon population of nearly 1,199,000 out-migrating juvenile fish. Under CP4, an increase in the cold-water pool would allow Reclamation to operate Shasta Reservoir to provide not only a more reliable source of water during dry and critical water years, but also to provide more cool water for release into the Sacramento River to improve conditions for anadromous fish. Of the increased storage space, about 378,000 acre-feet (60 percent) would be dedicated to increasing the cold-water supply for anadromous fish survival purposes. Reclamation would manage the cold-water pool each year based on recommendations from SRTTG. To assess the effects of operations on Chinook salmon in the upper Sacramento River, the computer model SALMOD was upgraded to evaluate changes in Chinook salmon population between Keswick Dam and the RBDD. In response to changes in Shasta Reservoir operations under CP4 during dry and critically dry water years – the years targeted for improving water reliability for both users and fish – modeling with SALMOD showed increases in production of Chinook salmon populations, especially winter-run and spring-run Chinook (Figure 3-13).



Note: Simulated Using SALMOD; Water Year Types Based on the Sacramento Valley Water Year Hydrologic Classification

Figure 3-13. Percent Change in Production for Chinook Salmon for CP4

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

Increase Water Supply Reliability CP4 would increase water supply reliability by increasing firm water supplies for irrigation and M&I deliveries primarily during drought periods. This action would contribute to replacement of supplies redirected to other purposes in the CVPIA, which would help reduce estimated future water shortages by increasing the reliability of firm water supplies for agricultural and M&I deliveries by at least 76,400 acre-feet per year, and average annual yield by about 46,400 acre-feet per year**.** As shown in Table 3-13, the majority of increased firm yield, 66,800 acre-feet, would be for south-of-Delta agricultural and M&I deliveries. In addition, water use efficiency could help reduce current and future water shortages by allowing a more effective use of existing supplies. Under CP4, approximately $2.3 million would be allocated over an initial 10-year period to fund agricultural and M&I water conservation programs, focused on agencies benefiting from increased reliability of project water supplies.

Develop Additional Hydropower Generation Higher water surface elevations in the reservoir would result in a net increase in power generation of about 138 GWh per year. This generation value is the expected increased generation from Shasta Dam and other CVP/SWP facilities.

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

Maintain and Increase Recreation Opportunities CP4 includes features to, at a minimum, maintain the existing recreation capacity at Shasta Lake. Potential recreation benefits would be as stated for CP3. The maximum surface area of the lake would increase by 2,500 acres (8 percent), from 29,600 acres to about 32,100 acres. There is also limited potential for reservoir reoperation to provide additional benefits to recreation by raising the bottom of flood control pool elevation and allowing more reliable filling of the reservoir during the spring.

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

Additional Broad Public Benefits Additional broad public benefits of CP4 obtained through pursuing project objectives are summarized in Table 3-11. Broad public benefits for CP4 are similar to those for CP3.

Potential Primary Effects of CP4

Anticipated inundation, construction, and relocation effects associated with CP4 are similar to those for CP3. Potential effects on flow and stages of the upper Sacramento River from CP4 are identical to those for CP1 (Figure 3-8). Proposed mitigation measures to address potential adverse impacts of CP4 are

summarized in Table 3-14. A detailed discussion of potential effects and proposed mitigation measures are included in Chapters 4 through 25 of the Preliminary Draft EIS.

Preliminary Economics Assessment of CP4

Estimated Costs The estimated construction cost and annual cost of CP4 are included in Table 3-15. As shown, the estimated construction cost is $1,070 million. The estimated total annual cost of this plan is $54.0 million.

Estimated Economic Benefits As shown in Table 3-16, the estimated average annual monetary benefit of CP4, assuming the cost of water and energy supplies increases at the same rate as inflation, is about $92.2 million. Assuming the cost of water supplies and hydropower increases at 2 percent above inflation, to account for future diminishment of water and energy supplies and increasing demands, the average annual benefit could exceed about $117.2 million per year.

Comprehensive Plan 5 – 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 features of CP5 in the Shasta Lake area are shown in Figure 3-3.

Major Components of CP5

Major components of this plan include the following:

- Raising Shasta Dam and appurtenant facilities by 18.5 feet.
- Constructing additional resident fish habitat in Shasta Lake and along the lower reaches of its tributaries (Sacramento River, McCloud River, and Squaw Creek).
- Constructing shoreline fish habitat around Shasta Lake.
- Augmenting spawning gravel in the upper Sacramento River.
- Restoring riparian, floodplain, and side channel habitat.
- Increasing recreation opportunities at Shasta Lake.
- Implementing the set of eight common management measures previously described.

As shown in Table 3-9, by raising Shasta Dam 18.5 feet, from a crest at elevation 1,077.5 to elevation 1,096.0, CP5 would increase the height of the reservoir full pool by 20.5 feet. The additional 2-foot increase in the height of the full pool above the dam raise height would result from spillway modifications similar to those described for 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. Figure 2-3 shows the increase in surface area and storage capacity for CP5.

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

As described for the above comprehensive plans, this plan would also include the potential to revise operational rules for flood control for Shasta Dam and Reservoir, which could reduce the potential for flood damage and benefit recreation. CP5 also includes (1) restoring resident fish habitat in Shasta Lake, (2) restoring fisheries and riparian habitat at several locations along the lower reaches of the tributaries to Shasta Lake, (3) augmenting spawning gravel in the upper Sacramento River, (4) restoring riparian, floodplain, and side channel habitat in the upper Sacramento River and (5) increasing recreation opportunities at Shasta Lake.

Constructing Fish Habitat This component includes improving shallow, warm-water fish habitat by using manzanita cleared from above the inundation zone to create structural enhancements, and planting cereal grains to treat shoreline areas. These improvements would help provide favorable spawning conditions, and juvenile fish leaving the tributaries would benefit from improved adjacent shoreline habitat. Establishing vegetation also could benefit terrestrial species that inhabit the shoreline of Shasta Lake. Aquatic habitat improvements include enhancing aquatic connectivity and reducing sediment related to roads constructed across intermittent streams.

Augment Spawning Gravel in Upper Sacramento River As part of CP5, spawning-sized gravel would be placed at multiple locations along the Sacramento River between Keswick Dam and the RBDD. Gravel augmentation under CP5 would be identical to the gravel augmentation measure of CP4.

Restore Riparian, Floodplain, and Side Channel Habitat CP5 would also include restoring riparian, floodplain, and side channel habitat along the upper Sacramento River. This measure is identical to that proposed under CP4.

Recreation Enhancements A total of 18 miles of new hiking trails and 6 trailheads would be constructed to enhance recreation under CP5. Descriptions have been developed for the trails and associated features, and are included in the Engineering Summary Appendix.

Potential Benefits of CP5

Major potential benefits of CP5, related to the SLWRI planning objectives and broad public services, are summarized in Tables 3-10 and 3-11 and described below.

Increase Anadromous Fish Survival CP5 would increase the ability of Shasta Dam to make cold-water releases and regulate water temperature in the upper Sacramento River, primarily in dry and critically dry water years. It is estimated that improved water temperature conditions under CP5 could result in an annual average increase in the Chinook salmon population of about 607,000 out-migrating juvenile fish.

Increase Water Supply Reliability CP5 would increase water supply reliability by increasing firm water supplies for irrigation and M&I deliveries primarily during drought periods. This action would contribute to replacement of supplies redirected to other purposes in the CVPIA, which would help reduce estimated future water shortages by increasing the reliability of firm water supplies for agricultural and M&I deliveries by at least 133,400 acre-feet per year, and average annual yield by about 75,800 acre-feet per year. As shown in Table 3-13, the majority of increased firm yield, 103,800 acre-feet, would be for south-of-Delta agricultural and M&I deliveries. In addition, increased water use efficiency could help reduce current and future water shortages by allowing a more effective use of existing supplies. Under CP5, approximately $3.8 million would be allocated over an initial 10-year period to fund agricultural and M&I water conservation programs, focused on agencies benefiting from increased reliability of project water supplies.

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

Conserve, Restore, and Enhance Ecosystem Resources This component includes improving shallow, warm-water fish habitat by using manzanita cleared from above the inundation zone to create structural enhancements, and planting cereal grains to treat shoreline areas. These improvements would help provide favorable spawning conditions, and juvenile fish leaving the tributaries would benefit from improved adjacent shoreline habitat. Placing manzanita brush structures near the Shasta Lake shoreline would enhance the diversity of structural habitat available for the warm-water fish species that occupy Shasta Lake. Establishing vegetation also could benefit terrestrial species that inhabit the shoreline of Shasta Lake.

The lower reaches of perennial tributaries to Shasta Lake would be targeted for aquatic restoration because they provide year-round fish habitat. Native fish species require connectivity to the full range of habitats offered by Shasta Lake and its tributaries. Improved fish passage addresses the requirement to provide

access and/or modify barriers to improve ecological conditions that support these native fish assemblages. Aquatic habitat improvements include enhancing aquatic connectivity and reducing sediment related to roads constructed across intermittent streams.

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

Maintain and Increase Recreation Opportunities CP5 includes features to, at a minimum, maintain the existing recreation capacity at Shasta Lake. In addition, this plan includes construction of 18 miles of new trails and 6 trailheads to enhance recreation opportunities at Shasta Lake. As with the other comprehensive plans, a small benefit would likely occur to the water-oriented recreation experience at Shasta Lake due to the increase in lake surface area and modernization of recreation facilities. The maximum surface area of the lake would increase by about 2,500 acres (8 percent), from 29,600 acres to about 32,100 acres. In addition, there is limited potential for reservoir reoperation to provide additional benefits to recreation by raising the bottom of the flood control pool elevation and allowing more reliable filling of the reservoir during the spring.

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

Additional Broad Public Benefits Additional broad public benefits of CP5 obtained through pursuing project objectives are summarized in Table 3-11. Broad public benefits for CP5 are similar to those for CP3.

Potential Primary Effects of CP5

Anticipated effects associated with CP5 are similar to those for CP3 and CP4. Potential effects on flow and stages of the upper Sacramento River from CP5 are identical to those for CP3 (Figure 3-11). Some potential exists for impacting existing habitat at ecosystem restoration sites, but these impacts would likely

result from converting present land use back to a more typical riverine environment. Proposed mitigation measures to address potential adverse impacts of CP5 are summarized in Table 3-14. A detailed discussion of potential effects and proposed mitigation measures are included in Chapters 4 through 25 of the Preliminary Draft EIS.

Preliminary Economics Assessment of CP5

Estimated Costs Estimated construction cost and annual cost of CP5 are included in Table 3-15. As shown, the estimated construction cost is $1,073 million. The estimated total annual cost of this plan is $54.1 million.

Estimated Economic Benefits As shown in Table 3-16, the estimated average annual monetary benefit of CP5, assuming the cost of water and energy supplies increases at the same rate as inflation, is about $65.5 million. Assuming the cost of water supplies and hydropower increases at 2 percent above inflation, to account for future diminishment of water and energy supplies and increasing demands, this benefit could exceed about $89.3 million per year. Added benefits for ecosystem restoration recreation enhancements in and around Shasta Lake are estimated to equal to their annual cost.

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Chapter 4
Plan Evaluation and Comparison

A critically important element of the plan formulation process is the evaluation and comparison of alternative plans. This chapter presents results of this evaluation and comparison for the comprehensive plans described in Chapter 3. The selected plan will be identified in the Final Feasibility Report.

Comprehensive Plan Evaluation

Four accounts are established to display, and facilitate evaluation of, the effects of alternative plans: NED, environmental quality (EQ), regional economic development (RED), and other social effects (OSE). These four accounts encompass all significant beneficial and adverse effects of a plan on the human environment, as required by NEPA (42 USC 4321 et seq.). Effects of comprehensive plans are to be displayed as the difference in conditions compared to the No-Action Alternative. Under the P&G (WRC 1983), the NED account is the only required account. The other accounts are only required if by law, or if they will have a material bearing on the decision-making process.

National Economic Development

The objective of NED analysis is to determine the change in net value of the Nation's output of goods and services that would result from implementing each project alternative. Beneficial and adverse effects are evaluated in monetary terms, and measured in terms of changes in national income among the No-Action and various action alternatives. The NED account describes the part of the NEPA human environment that identifies beneficial and adverse effects on the economy. Beneficial effects in the NED account are (1) increases in the economic value of the national output of goods and services from a plan, (2) the value of output resulting from external economies caused by a plan, and (3) the value associated with the use of otherwise unemployed or underemployed labor resources. Adverse effects in the NED account are the opportunity costs of resources used in implementing a plan. These adverse effects include (1) implementation outlays, (2) associated costs, and (3) other direct costs. Specific guidelines, standards, and procedures used in NED analysis are contained in the P&G (WRC 1983).

The NED account may include net benefits to the following categories: irrigation water supply for agriculture, M&I water supply, urban flood damage reduction, power (hydropower), transportation (inland navigation and deep draft navigation), recreation, commercial fishing, unemployed or underemployed labor resources, and other direct benefits. For this analysis, the NED account

would include the M&I water supply, irrigation water supply, hydropower, and recreation, as well as the other direct benefits category for anadromous fish survival.

Environmental benefits, including fisheries and ecosystem resources, are typically included in the EQ account if monetary units cannot be attributed to these benefits. However, for this analysis, fisheries benefits were developed as monetary units, and are included in the NED account. The contribution of the various alternatives to anadromous fish survival can be included in the NED account under the "other direct benefits" category.

Monetized Benefits

Estimating the economic benefits of potential effects is critical to establishing economic feasibility and identifying a corresponding NED plan. This section identifies valuation methods and valuation estimates for the benefit categories associated with the SLWRI planning objectives.

Increase Anadromous Fish Survival The method for assessing the economic value of contributions of the SLWRI to anadromous fish survival is through implementing a "cost of the most likely alternative" approach. The underlying premise for the valuation approach is that increasing salmon populations is a socially desirable goal, as indicated by the listing of several species as threatened or endangered and the demonstrated expenditures on salmon restoration projects.

Because the increased potential to reduce water temperatures during critical periods provided by additional surface storage is essential to increasing salmon production, the cost of the most likely alternative was based on the cost of various dam raises operated solely for the purpose of increasing the number of salmon smolt in the Sacramento River. Evaluating the cost of the most likely alternative included analysis of three separate dam raises operated solely for increased anadromous fish production, and was estimated using habitat units. Habitat units were based on 1,000 smolt passing downstream at the location of the RBDD. A cost-per-habitat-unit estimate was calculated for each alternative through dividing annual costs by the expected change in habitat units. The lowest cost-per-habitat-unit estimate was used as a per-habitat-unit benefit estimate. Anadromous fish benefits were computed though multiplying the per-habitat unit benefit estimate by the change in habitat units expected under each of the comprehensive plans (Table 4-1).

Increase Water Supply Reliability The CalSim-II model was used to estimate potential increases in water supply reliability to the CVP and SWP for the comprehensive plans. Table 4-2 shows results of the water operations modeling analyses to determine average year and dry/critically dry year conditions north and south of the Delta for the five comprehensive plans.

Table 4-1. Least Cost Alternative Estimates of Average Annual Salmon Production for Comprehensive Plans

Item	CP1 – 6.5-Foot Raise	CP2 – 12.5-Foot Raise	CP3 – 18.5-Foot Raise	CP4 – 18.5-Foot Raise – Anadromous Fish Focus, with Water Supply Reliability	CP5 – 18.5-Foot Raise – Combination Plan
Change in Average Annual Salmon Production Relative to No-Action Alternative (thousands of fish)	366.4	233.8	607.5	1,198.9	607.5
Total Benefits ($ millions)	15.1	9.6	25.0	49.2	25.0

Note:
[1] Dollar values are expressed in April 2010 price levels.

Key:
CP = comprehensive plan

Table 4-2. Increases in Irrigation and M&I Yield for Comprehensive Plans and Water Supply Reliability Benefits[1]

Item	CP1	CP2	CP3	CP4	CP5
CVP/SWP Irrigation Water Supply Reliability					
Dry/Critical Years NOD (acre-feet/year)[2]	7,800	17,100	25,300	7,800	25,300
Dry/Critical Years SOD (acre-feet/year)[2]	42,600	66,900	86,300	42,600	86,300
Average – All Years NOD (acre-feet/year)	5,200	11,500	16,100	5,200	16,100
Average – All Years SOD (acre-feet/year)	22,700	36,200	43,700	22,700	43,700
Benefit ($ millions)	***8.3***	***11.0***	***12.9***	***8.3***	***12.9***
CVP/SWP M&I Water Supply Reliability					
Dry/Critical Years NOD (acre-feet/year)[2]	1,800	2,700	4,300	1,800	4,300
Dry/Critical Years SOD (acre-feet/year)[2]	24,200	18,400	17,500	24,200	17,500
Average – All Years NOD (acre-feet/year)	1,000	1,600	2,300	1,000	2,300
Average – All Years SOD (acre-feet/year)	17,500	13,500	13,700	17,500	13,700
Benefit ($ millions)	***18.7***	***14.0***	***13.8***	***18.7***	***13.8***
Total Water Supply Reliability[3]					
Dry/Critical Years[2] (acre-feet/year)	76,400	105,100	133,400	76,400	133,400
Average – All Years (acre-feet/year)	46,400	62,800	75,800	46,400	75,800
Total Benefit					
Estimated Value – At Inflation ($ millions)[3 4]	***27.0***	***25.0***	***26.7***	***27.0***	***26.7***
Estimated Value – 2% Above Inflation ($millions)[3 5]	***46.5***	***43.1***	***46.1***	***46.5***	***46.1***

Notes:
[1] Dollar values are expressed in April 2010 price levels.
[2] Year-types as defined in the Sacramento Valley Water Year Hydrologic Classification Index.
[3] All numbers are rounded for display purposes; therefore, line items may not sum to totals.
[4] Assumes the costs of water supplies increases at the same rate as inflation.
[5] Includes increase of water supply costs at 2 percent above inflation to account for growing scarcity in the future. Sensitivity analyses for change in water supply benefits are included in the Economic Valuation Appendix.

Key:
CP = comprehensive plan
CVP = Central Valley Project
M&I = municipal and industrial
NOD = North of Delta
SOD = South of Delta
SWP = State Water Project

Irrigation Water Supply This analysis provides preliminary benefit estimates produced through applying the "change in net income," method as estimated by the CVPM. In the CVPM, parameters ranging from crop mixes, prices, and yields to irrigation efficiency are modeled for the entire CVP. Then a potential new increment, such as increased storage at Shasta Reservoir is added, and the net increase in the value of increased production is estimated.

Potential increases in water supply reliability developed for the SLWRI are primarily achieved during drought periods when new increments of reliable water supply would be most needed. This is because, under current conditions, there is an increased frequency of water supply shortages in dry and critical years. Similarly, under current conditions, there is greater Delta export capacity in dry years due to less water in the system. Because of data limitations, the CVPM is currently calibrated to a dry year as represented by 2001. The calibration year reflects only moderate drought conditions. As a result, the effects of dry years on cropping decisions and production costs may not be fully represented by the model. The CVPM is run for the long-term average water supply condition to establish the equilibrium crop and technology mix. The model is then run for dry years by considering fixed capital investments established in the long-term run, and allowing groundwater pumping and annual crop idling to occur as a result of reduced water supplies. This analysis uses results from both the long-term average and dry year runs to estimate the annual benefit associated with the SLWRI alternatives. The CVPM was run for the three dam raise scenarios. As can be seen in Table 4-2, average annual benefits ranged from about $8.3 million per year for CP1 to $12.9 million for CP3. Updated CVPM modeling results will be included in the Final Feasibility Report.

Municipal and Industrial Water Supply The SLWRI alternatives increase water supplies to M&I water users, especially during dry years. Estimates for dry year and average deliveries to M&I water users located north and south of the Delta for CP1 through CP5 are shown in Table 4-2. As shown in the table, M&I water supply benefits largely accrue to CVP and SWP contract holders located south of the Delta. M&I water users have increasingly participated in the water transfer market to augment supplies. M&I water supply reliability benefits were estimated based on the average annual deliveries shown in Table 4-2. This analysis assumes that the next increment of water supply to M&I users would likely be obtained through water transfers. The analysis also relies on values estimated through application of a water transfer pricing model, and through consideration of the costs associated with conveying the water to the M&I service areas. This method is consistent with the "actual or simulated market price" and the "cost of the most likely alternative" methods recommended by the P&G.

Uncertainty As described in Chapter 2, demands for water in California exceed available supplies. It is expected that the difference between available supplies and demands for water will increase significantly in the future, especially during

drought periods. Although recent facility improvements have improved delivery capability, no material increases in supply have been added to the CVP or the SWP for nearly 40 years. To date, increases in water demands have primarily been accommodated through operational changes in the existing system. The population of the Central Valley is expected to nearly triple, and that of the State is expected to increase by more than 60 percent by 2050. This rapid increase in population alone, coupled with lack of new sources of supply, is expected to appreciably transform the future of water in California. One of the expected results will be a significant shift in water deliveries from agricultural to urban uses. In addition, major declines are likely in otherwise available supplies for reasons ranging from increased local and regional needs for a number of purposes to ongoing climatic changes.

Certainly the traditional approaches, using the methods above, for estimating water benefits have been adequate as accounting tools and in estimating benefits for increases in reliability today. However, these methods do not account for the growing complexities resulting from increasing demands and dwindling supplies. Current models used to help estimate water benefits are static models and only useful for estimating the increase in production at one point in time, given numerous highly constrained assumptions.

To account for the significant uncertainties associated with adequately estimating the value of new supplies, a sensitivity analysis was performed assuming the value of water increases above the inflation rate (up to 2 percent above inflation). Accordingly, the benefit of the increased supplies resulting from each comprehensive plan, based on a 2 percent rate above inflation, is included in Table 4-2.

Develop Additional Hydropower Generation Increasing the size of Shasta Dam and Reservoir would also result in the ability to increase hydropower generation at Shasta Dam generating facilities. As can be seen in Table 4-3, raising Shasta Dam by 6.5 feet to 18.5 feet would result in increased power generation of 42 to 138 GWh per year. CP4 would result in the largest increase in generation capacity because of greater hydraulic head from more water being held in storage for anadromous fish purposes. In addition, there is a recognized benefit of hydropower generation because it lacks emissions associated with other forms of energy generation. Each unit of energy produced through traditional fossil fuel sources produces emissions, including carbon dioxide. Accordingly, Table 4-3 contains an estimate of the climate exchange market value associated with the increased generation of the five comprehensive plans; however, these values are not included in the NED account totals. As can be seen in Table 4-3, estimated average annual hydropower generation benefits of the five plans range from about $2.5 million for CP1 to about $8.1 million for CP4. In order to implement recent California renewable resources mandates, significant increases in non-dispatchable intermittent renewable resources, such as wind and solar generation, will need to be added to California's power system. This means that other significant flexible generation resources will be

needed to support and integrate renewable generation. The California Independent System Operator has an ongoing Renewables Integration Initiative to evaluate the changing resources needed to meet California's Renewable Portfolio Standard goals. These potentially costly mandates will likely influence the value of future hydropower supplies at Shasta Dam. To account for this uncertainty, a sensitivity analysis was performed assuming the value of hydropower increases at 2 percent above the inflation rate. Accordingly, the benefit of the increased supplies resulting from each comprehensive plan, based on a 2 percent rate above inflation, is included in Table 4-3.

Table 4-3. Summary of Hydropower Generation Benefits of Comprehensive Plans

Item	CP1	CP2	CP3	CP4	CP5
Increased Generation (GWh/year)	42.0	68.0	96.0	138.0	96.0
Value ($ millions)	2.4	3.9	5.4	7.6	5.4
CO_2 Displaced (1,000 metric tons)	37.2	60.1	84.9	122.1	84.9
Value ($ millions)[1]	0.1	0.2	0.3	0.4	0.3
Total Hydropower Benefit[2 3] ($ millions)	2.5	4.1	5.7	8.1	5.7
Total Hydropower Benefit [2 4] (2% above inflation) ($millions)	4.2	6.7	9.4	13.2	9.4

Notes:
[1] Based on a climate exchange market value of $4.30 per 1,000 metric tons of CO_2 equivalent.
[2] All numbers are rounded for display purposes; therefore, line items may not sum to totals.
[3] Total based on increased generation and CO_2 displacement reduction benefits. CO_2 displacement reduction benefits are not included in total for NED account.
[4] Includes increase of water supply and hydropower costs at 2 percent above inflation

Key:
CO_2 = carbon dioxide
CP = comprehensive plan
GWh/year = gigawatt-hours per year
NED = National Economic Development

Maintain and Increase Recreation Shasta Lake is a major recreational venue in California, and is the centerpiece of the Shasta Unit of the Shasta-Trinity NRA. The combination of large size, plentiful water-based recreation opportunities, favorable climate, and easy access make Shasta Lake one of the most visited recreation destinations in the State and region. A study of recreation sites in Northern California, performed by DWR as part of the Oroville Dam Relicensing project, places the estimated number of annual visitors at over 2.6 million (DWR 2004). Enlarging Shasta Dam alone, including relocating facilities to maintain at least the existing recreation opportunities, would affect recreation participation by providing modernized recreational facilities and increasing the reservoir surface area throughout the year. Table 4-4 compares user days (visitor days) and estimated recreation values for the No-Action Alternative and each of the comprehensive plans. The estimated resulting increase in user values is based on a recreation unit-day value of $37.00, the midpoint between the USFS Region 5 benefit estimate for a

unit-day engaged in water travel ($10.00 in 2010 dollars) and a unit-day engaged in fishing ($63.99). The estimated benefit to recreation due to a larger reservoir surface area ranges from about $3.1 million to $8.4 million per year.

Table 4-4. Average Annual Predicted Visitor Days and Recreational Values[1] [2]

Item	No- Action Alternative	CP1	CP2	CP3	CP4	CP5[4]
Visitor Days[3] (1,000)	2,584	2,667	2,725	2,808	2,808	2,808
Change in Visitor Days (1,000)	---	83	141	224	224	224
Total Recreation Value ($ millions)	95.58	98.66	100.79	103.87	103.87	103.87
Change in Value ($ millions)	---	3.1	5.2	8.3	8.3	8.4

Notes:
[1] Dollar values are expressed in April 2010 price levels.
[2] All alternatives include features to, at minimum, maintain the existing recreation capacity at Shasta Lake.
[3] Visitor days and recreation values are at least equal to numbers shown. These values do not reflect increased visitation due to increased annual water surface elevations and reduced water surface elevation fluctuations associated with these plans. These values also do not include increased visitation due to modernization of recreation facilities associated with all comprehensive plans.
[4] For CP5, recreation enhancement benefits are assumed equal to annual costs.

Key:
--- = not applicable
CP = comprehensive plan

Benefit Summary Table 4-5 summarizes the estimated annual average economic benefits from Tables 4-1 through 4-4 above.

Table 4-5. Summary of Comprehensive Plan Economic Benefits [1] [2]

Item	CP1 ($ millions)	CP2 ($ millions)	CP3 ($ millions)	CP4 ($ millions)	CP5 ($ millions)
Anadromous Fish Survival	15.1	9.6	25.0	49.2	25.0
Water Supply Reliability					
Estimated Benefit (at inflation)[3]	27.0	25.0	26.7	27.0	26.7
Estimated Benefit (2% above inflation)[4]	46.5	43.1	46.1	46.5	46.1
Hydropower					
Estimated Benefit (at inflation)[3]	2.4	3.9	5.4	7.6	5.4
Estimated Benefit (2% above inflation)[4]	4.2	6.7	9.4	13.2	9.4
Recreation	3.1	5.2	8.3	8.3	8.4
Flood Control[5]	Not quantified	Not quantified	Not quantified	Not quantified	Not quantified
Water Quality[5]	Not quantified	Not quantified	Not quantified	Not quantified	Not quantified
Total Benefits					
Estimated Value (at inflation)[3] [6]	***47.6***	***43.7***	***65.4***	***92.2***	***65.5***
Estimated Value (2% above inflation)[4] [6]	***68.8***	***64.6***	***88.7***	***117.2***	***89.3***

Notes:

[1] Any dam raise could provide incidental benefits to secondary objectives.

[2] Benefits have not been monetized for ecosystem restoration including (1) restoring resident fish habitat in Shasta Lake, (2) restoring fisheries and riparian habitat at several locations along the lower reaches of the upper Sacramento River and tributaries to Shasta Lake, (3) augmenting spawning gravel in the upper Sacramento River, and (4) restoring riparian, floodplain, and side channel habitat in the upper Sacramento River.

[3] Assumes the costs of water supplies and hydropower increase at the same rate as inflation.

[4] Includes increase of water supply and hydropower costs at 2 percent above inflation to account for growing scarcity in the future. Sensitivity analyses for change in water supply and hydropower benefits are included in the Economic Valuation Appendix.

[5] Benefits for flood control and water quality are minimal and have not been monetized.

[6] All numbers are rounded for display purposes; therefore, line items may not sum to totals.

Key:
CP = comprehensive plan

Cost Summary Table 4-6 summarizes estimated construction, investment, and annual costs for each of the comprehensive plans. Total investment cost is the sum of total construction costs and IDC cost. The IDC cost is computed using Reclamation-defined practices, and is based on an estimated construction period for all plans of approximately 4 years. Total investment cost is annualized over the project's assumed 100-year lifespan at the Federal interest rate of 4-1/8 percent to compute interest and amortization. Total annual cost is the sum of interest and amortization and estimated annual operations and maintenance (O&M) costs.

Table 4-6. Estimated Construction and Annual Costs of Comprehensive Plans[1]

Item	CP1 ($ millions)	CP2 ($ millions)	CP3 ($ millions)	CP4 ($ millions)	CP5 ($ millions)
Construction Cost					
Field Costs	$605	$658	$757	$763	$764
Noncontract Costs	$222	$255	$306	$307	$309
Total Construction Cost[2]	$827	$913	$1,064	$1,070	$1,073
Investment Cost					
Interest During Construction	$71	$78	$91	$91	$92
Total Investment Cost[2]	$898	$991	$1,154	$1,161	$1,165
Annual Cost					
Interest and Amortization	$38	$42	$48	$49	$49
Operations and Maintenance	$4.9	$4.8	$5.2	$5.2	$5.2
Total Annual Cost[2]	$42.6	$46.4	$53.7	$54.0	$54.1

Notes:
[1] Based on April 2010 price levels, 100-year period of analysis, and 4-1/8 percent interest rate.
[2] All numbers are rounded for display purposes; therefore, line items may not sum to totals.

Key:
CP = comprehensive plan

Net National Economic Development Benefits

The P&G state that the alternative that reasonably maximizes net NED benefits, consistent with the Federal objectives, is identified as the NED plan (WRC 1983). Net NED benefits are calculated by subtracting NED costs from NED benefits. The alternative that generates the maximum net NED benefit is CP4. (Table 4-7). Assuming the cost of water and energy supplies increases at the same rate as inflation, CP4 would generate net benefits of $38.2 million annually. Assuming an increase of water supply and hydropower costs at 2 percent above inflation to account for growing scarcity of available supplies in the future, CP4 would generate $63.3 million in net benefits.

Nonmonetized Benefits

Several potential benefit categories associated with comprehensive plans are not quantified under NED, including ecosystem restoration, flood damage reduction, and water quality. All comprehensive plans would provide an incidental increase in flood protection to areas along the upper Sacramento River. The associated economic benefits would, however, be small. Similarly, all plans would contribute to maintaining or improving water quality in the Sacramento River and the Delta; however, the associated economic benefits would be small and have not been quantified under NED. All comprehensive plans would also increase operational flexibility and improve Delta emergency response.

Ecosystem restoration benefits are not quantified under NED and are included in the EQ account, including (1) restoring resident fish habitat in Shasta Lake, (2) restoring fisheries and riparian habitat at several locations along the lower reaches of the upper Sacramento River and tributaries to Shasta Lake, (3) augmenting spawning gravel in the upper Sacramento River, and (4) restoring

riparian, floodplain, and side channel habitat in the upper Sacramento River. Implementing these ecosystem restoration measures does not require implementing other project features (e.g., dam raise, reservoir area relocations). Accordingly, the costs associated with these measures are considered separable from other project features.

Table 4-7. Summary of Annual Costs, Annual Benefits, and Net Benefits for Comprehensive Plans[1]

Item	CP1 ($ millions)	CP2 ($ millions)	CP3 ($ millions)	CP4 ($ millions)	CP5 ($ millions)
Annual Cost					
Total Annual Cost	42.6	46.4	53.7	54.0	54.1
Annual Benefits					
Estimated Value (at inflation)[2]	47.6	43.7	65.4	92.2	65.5
Estimated Value (2% above inflation)[3]	68.8	64.6	88.7	117.2	89.3
Benefit/Cost Ratio					
Estimated Value (at inflation)[2]	1.12	0.94	1.22	1.71	1.21
Estimated Value (2% above inflation)[3]	1.62	1.39	1.65	2.17	1.65
Net Benefits					
Estimated Value (at inflation)[2 4]	5.0	-2.7	11.7	38.2	11.4
Estimated Value (2% above inflation)[3 4]	26.2	18.1	35.1	63.3	35.2

Notes:
[1] April 2010 price levels, 100-year period of analysis, and 4-1/8 percent interest rate.
[2] Assumes the costs of water supplies and hydropower increases at the same rate as inflation.
[3] Includes increase of water supply and hydropower costs at 2 percent above inflation to account for growing scarcity in the future. Sensitivity analyses for change in water supply and hydropower benefits are included in the Economic Valuation Appendix.
[4] All numbers are rounded for display purposes; therefore, line items may not sum to totals.

Key:
CP = comprehensive plan

Environmental Quality

The EQ account is a means of integrating information about the EQ resource and NEPA human environment effects (as defined in 40 Code of Federal Regulations (CFR) 1507.14) of alternative plans into water resources planning. This is essential to a reasoned choice among alternative plans.

A thorough evaluation of the EQ accounts was performed as part of theNEPA environmental documentation process. Table S-1 in the Preliminary Draft EIS summarizes impacts and mitigation measures; Chapter 2, Section 2.4.3, of the Preliminary Draft EIS describes the environmental commitments common to comprehensive plans. Also, Chapter 26 of the Preliminary Draft EIS describes short-term use of the human environment and the maintenance and enhancement of long-term productivity. In addition, Chapter 26 of the Preliminary Draft EIS presents potential irreversible or irretrievable commitments of resources for the comprehensive plans.

Table 4-8 summarizes key effects for all resource categories for the EQ account. All comprehensive plans are similar in terms of their potential environmental effects, although some adverse effects would be exacerbated by larger dam raises and by the associated scale of the effects, such as expanded construction areas and increased area of inundation around Shasta Lake. Generally, the adverse effects would be mitigated to less-than-significant levels with prescribed mitigation measures. Some adverse effects for all of the action alternatives – the short-term generation of construction-generated emissions in excess of Shasta County Air Quality Management District (SCAQMD) thresholds, and the temporary exceedence of Shasta County noise level standards – would remain unavoidable despite mitigation measures. Altered flow regimes along the upper Sacramento River, changes to the areas inundated by Shasta Lake, and disturbances associated with construction activities have the potential to affect environmental resources. However, these adverse effects would be mitigated to the extent practicable.

CP1 and CP2 would have less of an adverse effect on land uses within the dam inundation area than the other comprehensive plans because CP1 and CP2 would raise the dam by 6.5 feet and 12.5 feet, respectively, compared to the 18.5-foot increase proposed for CP3, CP4, and CP5. However, a majority of the reservoir area relocations are required under any dam raise. The benefits associated with improved anadromous fish survival and increased water supply reliability would offset the localized adverse effects of the larger raise.

Table 4-8. Summary of Potential Environmental Effects Under Environmental Quality Account

Resource Area/ Alternatives	Primary Study Area		Extended Study Area			Key Considerations
	Shasta Lake & Vicinity	Sacramento River (Shasta Dam to RBDD)	Sacramento River (RBDD to Delta)	Delta	CVP/SWP Facilities and Water Service Areas	
Geology, Geomorphology, Minerals, and Soils CP1 – CP5						Short-term adverse effects due to construction in primary study area; adverse effects reduced through mitigation. Long -term adverse effects associated with operations reduced through mitigation.
Air Quality and Climate CP1 – CP5						Long-term benefits related to reduced emissions due to increased hydropower generation. Short-term unavoidable adverse effects due to construction in primary study area; adverse effects reduced through mitigation.
Hydrology, Hydraulics, and Water Management CP1-CP5						Beneficial effects to groundwater levels in CVP/SWP water service areas. Long-term beneficial effects related to water supply reliability and flood damage reduction included in NED account.
Water Quality CP1 – CP5						Long-term beneficial effects to reservoir water quality due to replacement of reservoir area septic systems with centralized wastewater treatment plants. Short-term adverse effects due to construction in primary study area; adverse effects reduced through mitigation. Long-term beneficial water quality effects in Sacramento River and Delta included in NED account.
Noise and Vibration CP1 – CP5						Short-term adverse effects due to construction in primary study area; adverse effects reduced through mitigation.
Hazards and Hazardous Materials and Waste CP1 – CP5						Short-term adverse effects due to construction in primary study area; adverse effects reduced through mitigation.
Agriculture and Important Farmland CP1 – CP5						Long-term beneficial effects from improved agricultural water supply reliability included in NED account. Long-term adverse effects due to conversion of forest lands.

Table 4-8. Summary of Potential Environmental Effects Under Environmental Quality Account (contd.)

Resource Area/ Alternatives	Primary Study Area		Extended Study Area			Key Considerations
	Shasta Lake & Vicinity	Sacramento River (Shasta Dam to RBDD)	Sacramento River (RBDD to Delta)	Delta	CVP/SWP Facilities and Water Service Areas	
Fisheries and Aquatic Ecosystems CP1 – CP5						Long-term beneficial effect on cold-water fisheries habitat in Shasta Lake. CP4 and CP5 provide ecosystem restoration benefits for fisheries and aquatic habitat through (1) augmenting spawning gravel in the upper Sacramento River, and (2) restoring riparian, floodplain, and side channel habitat in the upper Sacramento River. CP5 provides ecosystem restoration benefits for fisheries and aquatic habitat, including (1) restoring resident fish habitat in Shasta Lake, and (2) restoring fisheries and riparian habitat at several locations along the lower reaches of tributaries to Shasta Lake. Long-term beneficial effects on anadromous fisheries included in NED account.
Botanical Resources and Wetlands CP1 – CP5						CP4 and CP5 provide ecosystem restoration benefits for botanical resources through restoring riparian, floodplain, and side channel habitat in the upper Sacramento River. Short-term adverse effects due to construction in primary study area; adverse effects reduced through mitigation.
Wildlife Resources CP1 – CP5						CP4 and CP5 provide ecosystem restoration benefits for wildlife resources through restoring riparian, floodplain, and side channel habitat in the upper Sacramento River. Short-term adverse effects due to construction in primary study area; adverse effects reduced through mitigation.
Cultural Resources CP1 – CP5						Adverse effects due to construction in primary study area; adverse effects reduced through mitigation. Adverse effects due to operations in the primary study area are unavoidable.
Socioeconomics, Population, and Housing CP1 – CP5						Long-term beneficial effects from improved agricultural water supply reliability included in NED account. Short-term beneficial effects of construction activities included in RED account.
Land Use and Planning CP1 – CP5						Long-term adverse effects to land use in reservoir area are unavoidable; adverse effects reduced through mitigation.

Table 4-8. Summary of Potential Environmental Effects Under Environmental Quality Account (contd.)

Resource Area/ Alternatives	Primary Study Area		Extended Study Area			Key Considerations
	Shasta Lake & Vicinity	Sacramento River (Shasta Dam to RBDD)	Sacramento River (RBDD to Delta)	Delta	CVP/SWP Facilities and Water Service Areas	
Recreation and Public Access CP1 – CP5						Long-term beneficial effects on recreation included in NED account. Short-term adverse effects due to construction in primary study area; adverse effects reduced through mitigation.
Aesthetics and Visual Resources CP1 – CP5						Long-term adverse effects to aesthetics in reservoir area are unavoidable; adverse effects reduced through mitigation.
Transportation and Traffic CP1 – CP5						Long-term beneficial effects due to modernized roadway/bridge relocations. Short-term adverse effects due to construction in primary study area; adverse effects reduced through mitigation.
Utilities and Service Systems CP1 – CP5						Long-term beneficial effects due to replacing and modernizing utilities. Short-term adverse effects due to construction in primary study area; adverse effects reduced through mitigation.
Public Services CP1 – CP5						Short-term adverse effects due to construction in primary study area; adverse effects reduced through mitigation.
Power and Energy CP1 – CP5						Long-term beneficial effects from increased hydropower generation included in NED account.
Environmental Justice CP1 – CP5						Not disproportionately high and adverse effects to minority and low income populations in the vicinity of Shasta Lake and upper Sacramento River. Disproportionately high and adverse effects to Native American populations in vicinity of Shasta Lake. Not disproportionately high and adverse effects to Native American populations in the vicinity of the upper Sacramento River.

Table 4-8. Summary of Potential Environmental Effects Under Environmental Quality Account (contd.)

Resource Area/ Alternatives	Primary Study Area		Extended Study Area			Key Considerations
	Shasta Lake & Vicinity	Sacramento River (Shasta Dam to RBDD)	Sacramento River (RBDD to Delta)	Delta	CVP/SWP Facilities and Water Service Areas	
Wild and Scenic Rivers CP1 – CP5						Long-term adverse effects to McCloud River are unavoidable.

Key:

No effect, minimal effect, not disproportionately high and adverse (environmental justice), and/or minimal effect after mitigation.

Unavoidable and/or disproportionately high and adverse (environmental justice).

Beneficial effect.

Beneficial effects associated with anadromous fish survival, water supply reliability, flood damage reduction, hydropower, and recreation accounted for in NED. Beneficial effects to regional economics (including jobs and income) included in RED accounts.

CP = comprehensive plan
CVP = Central Valley Project
Delta = Sacramento-San Joaquin Delta
NED = National Economic Development
RBDD = Red Bluff Diversion Dam
RED = Regional Economic Development
SWP = State Water Project

Regional Economic Development

The RED account registers changes in the distribution of regional economic activity that result from each alternative plan considered in an implementation study. According to the P&G, two measures of regional effects are considered: regional income and regional employment. A region is generally defined as an area that encounters "significant" income and employment effects. Income and employment effects are further divided into "positive" and "negative" effects. Each of the four categories (positive income, positive employment, negative income, and negative employment) is equal to the sum of the NED effects that accrue in a region, plus transfers between the region and outside the region (i.e., positive income effects equal the NED benefits in the region plus the transfers of income to the region from outside the region). Transfers can come from implementation outlays, transfers of basic economic activity, indirect effects, and induced effects. The positive (and negative) effects on regional employment are directly parallel to effects on income; therefore, typically the analysis of regional employment effects is organized in the same categories as regional income effects. Regional employment effects are also analyzed according to relevant service, trade, industrial, and other sectors as well as skill levels (unskilled, semiskilled, and highly skilled).

Employment and income effects of the proposed alternatives were determined through the use of IMPLAN (IMpact analysis for PLANning) modeling. Reclamation economists completed this modeling, which was based on an input/output (I/O) analysis. I/O models are essentially accounting tables that trace the linkages of inter-industry purchase and sales within a given region and year. In addition to inter-industry data, the IMPLAN model used several assumptions to analyze the RED of all alternatives regarding construction duration, origin of the labor force, size of labor force, payroll costs as a percent of total construction costs, and origin of construction materials. For specific assumptions, see Chapter 7 of the Economic Valuation Appendix. The IMPLAN model yields "multipliers" that are used to calculate the total direct, indirect, and induced effects on employment and income, among other factors. The resulting benefits can be seen in Table 4-9.

Increased levels of income are expected to accompany the increase in employment (Table 4-10). The level of increased income is directly related to the quantity of employment opportunities and the duration of the project. Construction activity associated with each of the alternatives will take place over 3 to 5 years, depending on the alternative selected. Because economic impacts are typically measured and reported in annual terms, costs were converted to average annual expenditures for the duration of the construction period.

Table 4-9. Summary of Annual Employment Benefits for RED Account

Item	CP1	CP2	CP3	CP4	CP5
Construction Duration (years)	3	4	5	5	5
Short-Term Employment[1]					
New Direct Jobs	450	370	350	350	350
Local Labor Force	450	370	350	350	350
Construction	450	370	350	350	350
External Labor Force	0	0	0	0	0
Indirect and Induced Jobs	1,370	1,140	1,060	1,070	1,070
Construction Support	580	480	450	450	460
Total Direct, Indirect, and Induced Employment[2]	1,820	1,510	1,410	1,410	1,420
Long-Term Employment					
Long-Term Maintenance Positions	2	2	2	2	2

Notes:
[1] Results showing jobs per year for the construction duration are based on application of IMPLAN model.
[2] All numbers are rounded for display purposes; therefore, line items may not sum to totals.

Key:
CP = comprehensive plan
IMPLAN = IMpact analysis for PLANning
RED = Regional Economic Development

Table 4-10. Summary of Annual Income Effects for RED Account

Item	CP1	CP2	CP3	CP4	CP5
Construction Duration (years)	3	4	5	5	5
Income[1]					
Direct ($ millions)	126.1	104.4	97.4	97.9	98.2
Indirect/Induced ($ millions)	57.4	47.6	44.3	44.6	44.7
Total Income[2] ($ millions)	183.6	152.0	141.7	142.5	142.9

Notes:
[1] Results showing personal income per year for the construction duration are based on application of IMPLAN model and are expressed in April 2010 price levels.
[2] All numbers are rounded for display purposes; therefore, line items may not sum to totals.

Key:
CP = comprehensive plan
IMPLAN = IMpact analysis for PLANning
REC = Regional Economic Development

In addition to employment and income benefits, all comprehensive plans would also provide additional benefits due to implementation outlays for construction activities. Construction activities would primarily occur in the immediate vicinity of Shasta Lake in Shasta County. RED effects due to implementation outlays are estimated to affect primarily the four-county region surrounding Shasta Lake, including Shasta, Tehama, Trinity, and Siskiyou counties. Effects to both regional employment and regional income are expected to be beneficial during the project construction period and would be approximately proportional to construction costs of the comprehensive plans.

Other Social Effects

The OSE account is a means of displaying, and integrating into water resources planning, information on alternative plan effects from perspectives that are not reflected in the other three accounts. Categories of effects in the OSE account include the following: urban and community impacts; life, health, and safety factors; displacement; long-term productivity; and energy requirements and energy conservation. Both the beneficial and adverse effects in the OSE account are expected to be similar across all comprehensive plans, but generally proportional to the respective dam enlargement and newly inundated areas.

Threats to people, for loss of life and injury from flood events, must be addressed for public safety. Enlarging Shasta Dam and Reservoir has the potential to reduce flood flows in the upper Sacramento River. The comprehensive plans would reduce the frequency, magnitude, and duration of some potential future flood events, as for those that have affected structures and residents in this part of the primary study area in the past. As a result of greater reservoir capacity, the overall risk of flooding and its related consequences below Shasta Dam is expected to be reduced. The potential for loss of life would also be reduced. Flood control benefits of the dam enlargement would not be expected to change the existing floodplain or Federal Emergency Management Agency flood zone designations; therefore, the comprehensive plans would not remove an obstacle to development. Thus, flood protection benefits are not considered growth inducing.

Environmental justice review is required to determine if a disproportionate share of a proposed project's adverse socioeconomic and other environmental impacts are borne by low-income and minority communities. Analyses have shown the disturbance or loss of resources associated with locations considered by the Winnemem Wintu and Pit River Madesi Band members to have religious and cultural significance. These disturbances would result in an unmitigable, disproportionately high and adverse effect on Native American populations in the vicinity of Shasta Lake.

All comprehensive plans would provide beneficial effects on health and safety in the Shasta Lake area and downstream along the Sacramento River. Additionally, all comprehensive plans are estimated to displace people and businesses in the Shasta Lake area because of expanded reservoir inundation areas.

Comprehensive Plan Comparison

Four evaluation criteria based on the Federal P&G (WRC 1983) for water resources planning were introduced in Chapter 3: (1) completeness, (2) effectiveness, (3) efficiency, and (4) acceptability. The evaluation criteria are applied below to the comprehensive plans in Chapter 3, as summarized in Table 4-11.

Table 4-11. Summary Comparison of Comprehensive Plans

Comprehensive Plans	Comparison Criteria				Relative Ranking
	Completeness	**Effectiveness**	**Efficiency**	**Acceptability**	
No-Action Alternative	Although the No-Action Alternative requires no future action, it addresses none of the planning objectives.	Water supply reliability and hydropower needs will continue to increase. High survival, ecosystem restoration, and recreation needs will remain unchanged.	Highly cost inefficient. By taking no action, and as problems and needs continue and grow, either other significantly more costly actions will be undertaken, especially to address water supply and power needs, or problems and needs will continue unabated.	Neither addresses nor meets any CALFED or CVPIA goal.	*Very Low*
Relative Rank	*Very Low*	*None*	*None*	*Very Low*	
CP1 – 6.5-Foot Dam Raise, Anadromous Fish Survival and Water Supply Reliability	Can be implemented with minimum impact and would not require future elements. Does not preclude future action at Shasta Dam and Reservoir or elsewhere in CVP. Addresses primary planning objectives.	Relatively low potential to effectively increase water supply reliability and improve fish survival. Contributes to hydropower and recreation planning objectives.	Low cost efficiency. Unit cost for water supply reliability is likely superior to other new sources.	Meets goals of CALFED and consistent with plan in 2000 CALFED ROD. High potential for avoiding perceived impacts.	*Moderate*
Relative Rank	*Very High*	*Low*	*Low*	*High*	
CP2 – 12.5-Foot Dam Raise, Anadromous Fish Survival and Water Supply Reliability	Similar to CP1. Significant potential for avoiding/mitigating potential increased impacts.	Moderate potential to effectively address primary objectives. Significant contribution to water supply reliability. Contribution to hydropower and recreation planning objectives.	Moderate cost efficiency. Unit cost for water supply reliability is likely superior to other new sources.	Consistent with goals of CVPIA, CALFED, and other related programs. Significant potential for avoiding perceived impacts.	*Moderate to High*
Relative Rank	*Very High*	*Moderate*	*Low*	*Moderate*	

Table 4-11. Summary Comparison of Comprehensive Plans (contd.)

Comprehensive Plans	Comparison Criteria				Relative Ranking
	Completeness	**Effectiveness**	**Efficiency**	**Acceptability**	
CP3 – 18.5-Foot Dam Raise, Anadromous Fish Survival and Water Supply Reliability	Similar to CP1. Significant potential for avoiding/mitigating potential increased impacts.	High potential to effectively address primary planning objectives. Contribution to hydropower and recreation objectives.	High cost efficiency. Unit cost for water supply reliability is likely superior to other new sources.	Consistent with goals of CVPIA, CALFED, and other related programs. Significant potential for avoiding perceived impacts.	*High*
Relative Rank	*Very High*	*High*	*High*	*High*	
CP4 – 18.5-Foot Dam Raise, Anadromous Fish Focus with Water Supply Reliability	Significant potential for avoiding/mitigating potential increased impacts. Moderate degree of uncertainty about permanently implementing changed operation for anadromous fish.	Major increases in benefits to anadromous fish but relatively lower potential to effectively increase water supply reliability.	Overall cost efficiency very high. Moderate cost efficiency for water supply reliability.	Consistent with goals of CVPIA, CALFED, and other related programs. Higher acceptability by fishery resource agencies.	*High*
Relative Rank	*High*	*Moderate*	*Very High*	*Moderate to High*	
CP5 – 18.5-Foot Dam Raise, Combination Plan	Can be implemented with minimum impact and would not require future elements. Does not preclude future action at Shasta Dam and Reservoir or elsewhere in CVP. Addresses all planning objectives.	High potential to address primary planning objectives with emphasis on ecosystem restoration and recreation.	Similar to CP3. High potential for helping restore ecosystem resources and additional recreation at and near Shasta Lake.	Consistent with goals of CVPIA, CALFED, and other related programs. Consistent with the goals of CALFED for various programs, including water supply reliability and ecosystem restoration.	*High*
Relative Rank	*High*	*High*	*High*	*Moderate to High*	

Key:
CALFED = CALFED Bay-Delta Program
CP = comprehensive plan
CVP = Central Valley Project
CVPIA = Central Valley Project Improvement Act
ROD = Record of Decision

Completeness

Completeness is a determination of whether a plan includes all elements necessary to realize planned effects, and the degree that intended benefits of the plan depend on the actions of others. Several subfactors that are important in measuring this criterion include (1) authorization, (2) spectrum of objectives being addressed, (3) reliability, (4) physical implementability, and (5) environmental effects and mitigation.

The No-Action Alternative rates very low for completeness, and each of the comprehensive plans rates from high to very high. Two distinguishing subfactors are (1) objectives being addressed and (2) reliability. CP1, CP2, and CP3 primarily address anadromous fish survival and water supply reliability; however, each of these comprehensive plans indirectly contributes to each of the other planning objectives, with the exception of ecosystem restoration. Further, the likely reliability and certainty of each of these three comprehensive plans to meet its intended objectives is very high. These comprehensive plans do not significantly rely on any other actions. However, CP4 specifically focuses on anadromous fish through increasing the minimum carryover storage space in Shasta Reservoir each year, and CP5 focuses on additional ecosystem restoration and recreation. With both CP4 and CP5, O&M requirements would increase. Accordingly, overall reliability would be reduced for each alternative.

Another significant subfactor is environmental effects and mitigation. Anticipated impacts are generally comparable between alternatives; some impacts are exacerbated by larger dam raises and the associated scale of those impacts, such as a prolonged construction period and increased area of inundation around Shasta Lake. A detailed description and assessment of the impacts to environmental resources within the primary study area, and appropriate mitigation measures, are included in the Preliminary Draft EIS.

Effectiveness

Effectiveness is the extent to which an alternative alleviates problems and achieves objectives. For the primary planning objective of anadromous fish survival, two major relative ranking factors were considered: (1) increasing salmon survival (decreasing salmon mortality) and (2) increasing habitat for spawning. For the primary planning objective of increasing water supply reliability, ranking was based on the relative amount of new drought period (firm) yield that could be derived from each comprehensive plan. For the secondary planning objectives, four relative ranking factors were considered: (1) whether a comprehensive plan included ecosystem restoration, (2) potential to affect flood peaks downstream from Keswick Dam, (3) potential to increase net power generation, and (4) amount of increased recreation opportunities at Shasta Lake.

As indicated in Table 4-11, comprehensive plans with the greatest effectiveness in meeting planning objectives appear, at this time, to be CP3, CP4 and CP5.

This is primarily because CP3 and CP5 would provide the largest contribution toward water supply reliability and CP4 would provide the largest contribution toward anadromous fish survival. All three plans provide benefits to ecosystem restoration (via improved fisheries conditions), flood damage reduction, hydropower generation, recreation, and water quality.

Efficiency

Efficiency is the measure of how efficiently an alternative alleviates identified problems while realizing specified objectives consistent with protecting the Nation's environment. The relative rankings in Table 4-11 for efficiency are based primarily on likely net benefits obtained under each plan. Table 4-12 includes an estimate of the monetary costs and benefits as well as net benefits for each of the comprehensive plans, under conditions assuming (1) the cost of water supply and hydropower increases at the same rate as inflation and (2) the cost of water supply and hydropower increases at 2 above inflation to account for increasing value of water and energy supplies due to demand increases and supply reductions. As shown, assuming the cost of water and energy supplies increases at the same rate as inflation, CP1, CP3, CP4, and CP5 would be economically feasible, and assuming the cost of water and energy supplies increases at 2 percent above inflation, all plans would be economically feasible. At this stage of analysis under either condition, it appears that CP4 has the potential to provide the greatest net economic benefits. This is primarily because of the higher potential increase in anadromous fish survival.

Acceptability

Acceptability is the workability and viability of a plan with respect to its potential acceptance by other Federal agencies, State and local government agencies, and public interest groups and individuals. This evaluation criterion will be very important following completion of the Final Feasibility Report and endorsement by a non-Federal sponsor of the comprehensive plan recommended for implementation. It appears that all of the comprehensive plans would be similarly ranked for this criterion. Each of the plans needs to be coordinated with other agencies and public interests.

Summary of Comparisons

Each of the comprehensive plans is estimated to be complete and each appears to be effective in achieving its intended objectives. All comprehensive plans except CP2 are cost-efficient. Table 4-11 compares the No-Action Alternative and five comprehensive plans overall and Table 4-12 compares the costs and benefits for each of the comprehensive plans.

Table 4-12. Summary of Potential Benefits and Estimated Costs of Comprehensive Plans

Item	CP1	CP2	CP3	CP4	CP5
Raise Shasta Dam (feet)	**6.5**	**12.5**	**18.5**	**18.5**	**18.5**
Total Increased Storage (TAF)	256	443	634	634	634
Benefits					
Increase Anadromous Fish Survival					
Dedicated Storage (TAF)	-	-	-	378	-
Production Increase (thousand fish)[1]	366	234	607	1,199	607
Spawning Gravel Augmentation (tons)[2]				10,000	10,000
Side Channel Rearing Habitat Restoration (miles)				0.8	0.8
Increase Water Supply Reliability					
Total Increased Firm Water Supplies (TAF/year)[3]	76.4	105.1	133.4	76.4	133.4
Increased Firm Water Supplies NOD (TAF/year)[3]	9.6	19.8	29.6	9.6	29.6
Increased Firm Water Supplies SOD (TAF/year)[3]	66.8	85.3	103.8	66.8	103.8
Increased Water Use Efficiency Funding	Yes	Yes	Yes	Yes	Yes
Increased Emergency Water Supply Response Capability	Yes	Yes	Yes	Yes	Yes
Reduce Flood Damages					
Increased Reservoir Capacity for Capture of High Flows	Yes	Yes	Yes	Yes	Yes
Develop Additional Hydropower Generation					
Increased Hydropower Generation (GWh/year)	42	68	96	138	96
Conserve, Restore, and Enhance Ecosystem Resources					
Shoreline Enhancement (acres)	-	-	-	-	130
Tributary Aquatic Habitat Enhancement (miles)[4]	-	-	-	-	6
Riparian, Floodplain, and Side Channel Habitat Restoration (acres)	-	-	-	2.9	2.9
Increased Ability to Meet Flow and Temperature Requirements Along Upper Sacramento River	Yes	Yes	Yes	Yes	Yes
Maintain or Improve Water Quality					
Improved Delta Water Quality	Yes	Yes	Yes	Yes	Yes
Increased Delta Emergency Response Capability	Yes	Yes	Yes	Yes	Yes
Maintain and Increase Recreation					
Recreation (increased user days, thousands)[5]	83	141	224	224	224
Modernization of Relocated Recreation Facilities	Yes	Yes	Yes	Yes	Yes
Economics ($ millions)[6]					
Cost					
Construction Cost	827	913	1,064	1,070	1,073
Annual Cost	42.6	46.4	53.7	54.0	54.1
Annual Economic Benefits [7]					
Estimated Value (at inflation)[8]	47.6	43.7	65.4	92.2	65.5
Estimated Value (2% above inflation)[9]	68.8	64.6	88.7	117.2	89.3
Net Economic Benefits[7]					
Estimated Value (at inflation)[8]	5.0	- 2.7	11.7	38.2	11.4
Estimated Value (2% above inflation)[9]	26.2	18.1	35.1	63.3	35.2

Table 4-12. Summary of Potential Benefits and Estimated Costs of Comprehensive Plans (contd.)

Notes:

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

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

[3] Total increased deliveries during dry and critical years (based on the Sacramento Valley Water Year Hydrologic Water Classification) to CVP and SWP. Does not reflect benefits related to water use efficiency actions included in all comprehensive plans.

[4] Tributary aquatic enhancement provides for the connectivity of native fish species and other aquatic organisms between Shasta Lake and its tributaries. Estimates of benefits reflect only connectivity with perennial streams and do not reflect additional miles of connectivity with intermittent streams.

[5] These values do not account for increased visitation due to modernization of recreation facilities associated with all comprehensive plans.

[6] Based on April 2010 price levels, 4-1/8 discount rate, and 100-year period of analysis.

[7] Economic benefits reflect increases in anadromous fish production, firm water supplies, hydropower generation, and recreation (increased user days). Does not include monetized annual benefits for ecosystem restoration, flood damage reduction, or water quality.

[8] Assumes the costs of water supplies and hydropower increase at the same rate as inflation.

[9] Includes increase of water supply and hydropower costs at 2 percent above inflation to account for growing scarcity in the future. Sensitivity analyses for changes in water supply and hydropower benefits are included in Economic Valuation Appendix.

Key:
- = not applicable
CP = comprehensive plan
CVP = Central Valley Project
Delta = Sacramento-San Joaquin Delta
GWh/year = gigawatt-hours per year
NOD = north of Delta
SALMOD = Salmonid Population Model
SOD = south of Delta
SWP = State Water Project
TAF = thousand acre-feet

Comprehensive plans involving a 6.5-foot and 12.5-foot raise of Shasta Dam require the majority of the construction and annual costs associated with an 18.5-foot dam raise, as shown in Table 4-12, as well as a majority of the environmental effects from reservoir area relocations, but provide only a portion of the increased storage capacity of an 18.5-foot raise. Based on studies to date, the three comprehensive plans involving a dam raise of 18.5 feet (CP3, CP4, and CP5) best address the planning objectives. This is primarily because of (1) a high certainty (completeness) that the plans could achieve their intended benefits, and (2) relatively high effectiveness and economic efficiency.

Rationale for Selection of a Recommended Plan

A plan recommending Federal action is to be the plan that best addresses the targeted water resources problems considering public benefits relative to costs. The basis for selecting the recommended plan is to be fully reported and documented, including the criteria and considerations used in selecting a recommended course of action by the Federal Government. When the Feasibility Report and EIS are finalized, the Secretary of the Interior will use both documents and supporting information to provide a recommendation to Congress. This recommendation will be documented in a ROD and used by the

U.S. Congress, along with the finalized Feasibility Report and EIS, to determine interest in, and the form of, project authorization if a plan is recommended for implementation. It is recognized that most of the activities pursued by the Federal Government require an assessing trade-offs 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 well described by the 2009 *Draft Proposed National Objectives, Principles, and Standards for Water and Related Resources Implementation Studies* (CEQ):

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

At this stage of the Federal planning and NEPA processes (as described in this Draft Feasibility Report and the Preliminary Draft EIS), the potential effects of the comprehensive plans have been evaluated and compared based on established criteria. As a result, an 18.5-foot raise of Shasta Dam has been identified as the preliminary proposed plan at this time because it appears feasible under a variety of operations.

Operation of the existing CVP and SWP may change as a result of the ongoing OCAP reconsultation, and the proposed plan for reoperating Shasta Dam and Reservoir is uncertain at this time. Operations of the preliminary proposed plan are still being refined based on updates to modeling studies and input from agencies, stakeholders, and the public.

Major components, benefits, and effects of the preliminary proposed plan would be similar to CP3, CP4, and CP5, as described in Chapter 3, but it is recognized that changes may occur to the comprehensive plans with changes in water operations and other relevant water resources projects and programs, including, potentially, BDCP/DHCCP efforts. Ultimately, the alternative that best meets the stated planning objectives, maximizes net public benefits, and is determined to be technically, environmentally, economically, and financially feasible, will be identified in the Final Feasibility Report and Final EIS (FEIS) with supporting rationale and documentation.

Consistency of Comprehensive Plans with Other Programs

Comprehensive plans were evaluated on their consistency with the CVPIA and overall goals and objectives of the CALFED ROD. Potential contributions of the SLWRI toward the CVPIA and CALFED goals and objectives are described in this section.

Central Valley Project Improvement Act

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

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

Table 4-13 summarizes the potential contributions of the SLWRI toward CVPIA goals.

Table 4-13. Summary of Contributions of SLWRI to CVPIA and CALFED Bay-Delta Program Goals

Program	Potential Contributions of SLWRI Comprehensive Plans Toward Program Goals
CVPIA	
Anadromous Fish	• Would increase the ability of Shasta Dam to make cold-water releases and regulate water temperature in the upper Sacramento River • Could result in an average annual increase of up to 1,199,000 out-migrating juvenile Chinook salmon
Water Supply Replacement	• Could increase the reliability of firm water supplies by up to 133,400 acre-feet per year • Would contribute to replacement of supplies redirected to other purposes in the CVPIA
CALFED	
Water Supply Reliability	• Could increase the reliability of firm water supplies by up to 133,400 acre-feet per year • Further implement demand reduction practices
Water Quality	• Could contribute to improved operational flexibility and provide increased high-flow releases to reestablish Delta water quality • Could increase Delta outflow during drought years and reduce salinity during critical periods
Ecosystem Quality	• Could increase the ability of Shasta Dam to make cold-water releases and regulate water temperature in upper Sacramento River • Could result in an average annual increase of up to 1,199,000 out-migrating juvenile Chinook salmon • Could contribute to additional flow releases in Sacramento River and Delta during critical periods for fish species • Enlargement of Shasta Dam could support modified operations for geomorphic processes and related ecosystem purposes
Delta Levee Integrity	• Could provide greater flexibility in flood control releases, thereby reducing stress on Delta levees

Key:
CALFED = CALFED Bay-Delta Program
CVPIA = Central Valley Project Improvement Act
Delta = Sacramento – San Joaquin Delta
SLWRI = Shasta Lake Water Resources Investigation

Anadromous Fish

As part of the fish and wildlife restoration activities outlined by the CVPIA, a goal was to develop and implement a program that makes reasonable efforts to ensure that natural productions of anadromous fish in Central Valley rivers and streams will be sustainable, on a long-term basis. Water temperature has been identified as one of the most important factors in achieving recovery goals for anadromous fish in the Sacramento River. All comprehensive plans would increase the ability of Shasta Dam to make cold-water releases and regulate water temperature in the upper Sacramento River, primarily in dry and critically dry years. Raising Shasta Dam would increase the depth of the cold-water pool

in Shasta Reservoir, resulting in an increase in seasonal cold-water volume below the thermocline (layer of greatest water temperatures and density change).

Water Supply Replacement

Since the CVPIA was enacted, 1.2 million acre-feet of CVP yield have been dedicated and managed annually for the primary purpose of implementing the fish, wildlife, and habitat restoration purposes and measures authorized by the CVPIA. All alternatives would increase water supply reliability through increasing firm water supplies for agricultural and M&I purposes primarily during dry and critically dry years. This action would contribute to the replacement of supplies redirected to other purposes in the CVPIA.

CALFED Bay-Delta Program

CALFED, a coordinated Federal and State program, was established after the Bay-Delta Accord to address water quality, ecosystem quality, water supply reliability, and Delta levee system integrity. CALFED provides a programmatic framework to develop and implement a long-term comprehensive plan to restore ecological health and improve water management for beneficial uses of the Bay-Delta system. CALFED developed the following program objectives for a solution:

- **Water Supply Reliability** – Reduce the mismatch between Bay-Delta water supplies and the current and projected beneficial uses dependent on the Bay-Delta system.
- **Water Quality** – Provide good water quality for all beneficial uses.
- **Ecosystem Quality** – Improve and increase aquatic and terrestrial habitats and improve ecological functions in the Bay-Delta to support sustainable populations of diverse and valuable plant and animal species.
- **Delta Levee Integrity** – Reduce the risk to land use and associated economic activities, water supply, infrastructure, and the ecosystem from catastrophic breaching of Delta levees.

Expanding water storage capacity is critical to the successful implementation of all aspects of CALFED. Not only is additional storage needed to meet the needs of a growing population but, if strategically located, such storage will provide much needed flexibility in the system to improve water quality and support fish restoration efforts. Table 4-13 summarizes potential overall contributions of the SLWRI toward CALFED goals. Table 4-14 qualitatively compares anticipated contributions of the five comprehensive plans relative to CALFED goals and CALFED Storage Program objectives.

Table 4-14. Comparison of Comprehensive Plans Relative to CALFED Goals and CALFED Storage Program Objectives

Objectives	CP1	CP2	CP3	CP4	CP5
CALFED Bay-Delta Program Goals[1]					
Water Quality: Provide good water quality for all beneficial uses	+	++	+++	+++	+++
Ecosystem Quality: Improve and increase aquatic and terrestrial habitats and improve ecological functions in the Bay-Delta to support sustainable populations of diverse and valuable plant and animal species	++	++	+++	++++++	++++
Water Supply: Reduce the mismatch between Bay-Delta water supplies and current and projected beneficial uses that depend on the Bay-Delta system	+++	++++	+++++	+++	+++++
Delta Levee Integrity: Reduce the risk to land use and associated economic activities, water supply, infrastructure and the ecosystem from catastrophic breaching of Delta levees	+	+	+	+	+
CALFED Storage Program Element Objectives[2]					
Pursue specific opportunities for new off-stream storage sites and expansion of existing on-stream storage sites as identified in the Record of Decision	+	++	+++	+++	+++
Provide financial and technical assistance to implement 1/2 million to 1 million acre-feet of new, locally managed groundwater storage	0[3]	0[3]	0[3]	0[3]	0[3]

Notes:
[1] Source: *CALFED Bay-Delta Program Record of Decision* (CALFED 2000)
[2] Source: *CALFED Program Elements* (CALFED and DWR 2005)
[3] Although the SLWRI comprehensive plans do not include specific features to fund or assist groundwater storage, enlarging Shasta Reservoir could allow for additional system flexibility for surface water deliveries, decreasing reliance on groundwater pumping. This could reduce groundwater overdraft conditions in CVP and SWP service areas.

Key:
+ = net positive effect (benefit)
0 = no anticipated effect
CP = comprehensive plan
CALFED = CALFED Bay-Delta Program

Water Supply Reliability

One of the primary goals of CALFED is to improve the reliability of California's water supply within the context of unpredictable hydrology and the competing needs of fish and wildlife and water users. In addition to hydrology, the CALFED ROD assumes that water supply reliability is predicated partially on investment in infrastructure to improve storage and conveyance capacity. Included in the CALFED Storage Program Preferred Program Alternative is a

proposed raise of Shasta Dam. Water supply reliability depends on capturing water during peak flows and during wet years, as well as on more efficient water use through conservation and recycling. All alternatives identified in this Draft Feasibility Report would increase water supply reliability through increasing firm water supplies for agricultural and M&I purposes primarily during dry and critically dry years, as well as further implementing demand reduction practices identified by the Common Assumptions for Water Storage Projects work group.

Water Quality

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

Ecosystem Quality

Enlarging Shasta Dam and Reservoir can contribute to ecosystem restoration along the Sacramento River and within the Delta. Improvements to water temperature and flows for Sacramento River aquatic species could be accomplished through enlarging Shasta Dam and Reservoir. All alternatives would increase the ability of Shasta Dam to make cold-water releases and regulate water temperature in the upper Sacramento River, primarily in dry and critically dry years, through new storage that would create a larger cold-water pool, and through TCD modification at Shasta Dam.

Increased Shasta Reservoir storage could contribute to additional flow releases to the Sacramento River during critical periods for fish species. In addition, Shasta Dam and Reservoir enlargement could also support modified operations for geomorphic processes and cottonwood regeneration. Shasta Dam and Reservoir enlargement could also contribute to Delta species restoration through increased operational flexibility. Increased storage could allow CVP/SWP pumping operations to be shifted to times when fish are less vulnerable to the effects of these pumping operations.

Delta Levee Integrity

Enlarging Shasta Dam and Reservoir could provide greater flexibility in flood control releases in the CVP/SWP system because of the potential for additional flood control space within Shasta Reservoir. Improved operational flexibility in the timing of flood control releases associated with the proposed Shasta Dam raise could reduce stress on Delta levees, and could contribute to maintaining their stability.

CALFED "Beneficiary Pays" Principle

Federal cost allocation procedures and applicable cost-sharing laws/regulations govern how the costs of a project are allocated among project purposes, and apportioned to Federal and non-Federal project sponsors. Federal laws and regulations also determine which Federal costs are reimbursable (paid back to the Federal Government by beneficiaries, typically over time) and nonreimbursable (the burden of the Federal taxpayer). Should the project be authorized by Congress, the Federal authorizing language would likely specify any cost-sharing or financing arrangements that deviate from previously established Federal laws. Non-Federal sponsors would be responsible for determining how their share of project costs are financed (i.e., how these costs may be passed on to beneficiaries). It is believed that Federal cost allocation and cost-sharing practices are consistent with the CALFED "beneficiary pays" principle.

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Chapter 5
Preliminary Proposed Plan and Implementation Requirements

This chapter summarizes the preliminary proposed plan and the project implementation requirements. It includes a description and determination of feasibility of the preliminary proposed plan; identification of areas of risk and uncertainty; next steps for the Feasibility Report; implementation requirements; Federal and non-Federal responsibilities; project timeline; and status of the feasibility study.

Description of Preliminary Proposed Plan

Based on analyses and evaluations to date in accordance with the Federal planning and NEPA processes, the three comprehensive plans involving a dam raise of 18.5 feet (CP3, CP4, and CP5) best address the SLWRI planning objectives, have a high certainty of achieving their intended benefits, and have a relatively high economic efficiency, providing the greatest net benefits. However, CVP/SWP operational constraints, including those affecting operations at Shasta Dam and Reservoir, are uncertain, with current and future constraints governing water operations likely to change primarily due to the ongoing OCAP reconsultation.

Because of these uncertainties, an 18.5-foot raise of Shasta Dam has been identified as the preliminary proposed plan, but operations are still being refined based on updates to modeling studies and input from agencies, stakeholders, and the public. Major components, benefits, and effects of the preliminary proposed plan would be similar to CP3, CP4, and CP5, as described in Chapter 3, but it is recognized that changes may occur to the comprehensive plans with changes in water operations and other relevant water resources projects and programs, including, potentially, BDCP/DHCCP efforts. The following subsections summarize major components and benefits associated with raising Shasta Dam by 18.5 feet based on evaluations of CP3, CP4, and CP5.

Major Components

CP3, CP4, and CP5 primarily involve raising Shasta Dam by 18.5 feet. However, additional components to benefit anadromous fish survival along the upper Sacramento River are included in CP4 and CP5, and components to further benefit ecosystem resources and recreation are included in CP5.

Major components common to all 18.5-foot dam raise comprehensive plans include the following:

- Raising Shasta Dam and appurtenant facilities by 18.5 feet.
- Implementing the set of eight common management measures, described in Chapter 3:
  - **Enlarge Shasta Lake Cold-Water Pool –** Enlarge the cold-water pool by enlarging Shasta Dam and Reservoir.
  - **Modify TCD** – Raise the existing structure and modify the shutter control to increase the operating range or effectiveness of the structure.
  - **Increase Conservation Storage** – Increase the conservation storage space in Shasta Reservoir by raising Shasta Dam.
  - **Reduce Demand** – Implement a water conservation program for additional water supplies created by enlarging Shasta Dam and Reservoir, to augment current water use efficiency practices.
  - **Modify Flood Operations** – Modify existing flood operational guidelines or rule curves.
  - **Modify Hydropower Facilities** – Modify the existing hydropower facilities at the dam to enable their continued use.
  - **Maintain and Increase Recreation Opportunities –** Maintain and increase recreation opportunities at Shasta Lake.
  - **Maintain or Improve Water Quality** – Maintain or improve Delta water quality conditions and Delta emergency response capability.

Additional components evaluated only for CP4 and CP5 include the following:

- Augment spawning gravel in the upper Sacramento River (CP4 and CP5).
- Restore riparian, floodplain, and side channel habitat (CP4 and CP5).
- Reserve 378,000 acre-feet of the increased storage in Shasta Reservoir for maintaining cold-water volume or augmenting flows as part of an adaptive management plan for anadromous fish survival (CP4).
- Construct additional resident fish habitat in and around the shoreline of Shasta Lake and along the lower reaches of its tributaries (CP5).
- Increase recreation opportunities at Shasta Lake (CP5).

With a dam raise of 18.5 feet under the preliminary proposed plan, the full pool elevation in Shasta Reservoir would be raised by 20.5 feet. The capacity of the reservoir would be increased by 634,000 acre-feet to a total of 5.19 MAF. Main features of an 18.5-foot dam raise are summarized below:

- **Lands** – An 18.5-foot dam raise would result in an increase in a full pool area of about 2,500 acres. This amounts to an average increase in landward encroachment of water surface around the reservoir of about 50 feet at full pool. This distance would be greater along inflowing streams and creeks. Nearly all of the increased full pool area would be on Federal property. Approximately 202 residential and commercial parcels and 28 cabins on USFS land would be affected, with most of the parcels at the headwaters of several inflowing streams and in the Lakeshore and Sugarloaf areas.

- **Clearing of Reservoir Area** – Additional acreage that would be inundated within the new full pool would need to be cleared to reduce hazards to the public and provide access to the shoreline near high-use recreation areas. This would include removing trees and other vegetation from around the reservoir shoreline. Approximately 832 acres of the newly inundated area would need to be prescribed overstory or total vegetation removal.

- **Dam Crest Structure Removal** – Existing structures on the dam crest would need to be removed. These structures include the gantry crane, existing spillway drum gates and frames, spillway bridge, concrete in the spillway crest and abutments, parapet walls, sidewalks, curbing, crane rails, and control equipment.

- **Main Gravity Dam** – A raise of Shasta Dam would be accomplished 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).

- **Wing Dams** – The existing wing dams at Shasta would be raised to tie the concrete gravity section into the left and right abutments. The left wing dam would be composed of compacted core material and rockfill, similar to the material used in the original wing dam construction. The upstream face of the left wing dam would include a reinforced concrete or mechanically stabilized earth (MSE) wall, and a concrete parapet wall. The right wing dam would be composed of mass concrete, similar to the main gravity dam.

- **Spillway** – The three existing 110-foot-wide by 28-foot-high drum gates would be removed and replaced with six sloping, fixed-wheel gates. Four gates would be approximately 48 feet wide by 38 feet high

and two gates would be approximately 54 feet wide by 38 feet wide, sizes that could pass the probable maximum flood (PMF).

- **River Outlets** – Shasta Dam has 18 river outlets arranged in three tiers. The lower tier tube valves would require replacement because of operational limitations.

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

- **Reservoir Area Dikes** – With enlarged Shasta Dam scenarios, dikes in the Lakeshore and Bridge Bay areas would be required to protect California Department of Transportation (Caltrans) highways, the UPRR, and other infrastructure from inundation. All dike locations could consist of homogenous fill cross sections.

- **Pit 7 Dam and Powerplant** – Raising Shasta Dam would cause water to back up onto the downstream spillway flip bucket lip and the powerhouse wall. However, no revisions are recommended for the Pit 7 Dam spillway, provided operating procedures are developed that limit the Shasta Reservoir full pool to elevations below the existing bucket lip during periods of the year when discharges at Pit 7 Dam are great enough to cause sweep-out of the flip bucket. The overall powerhouse would not be inundated, but other effects would still need to be considered/addressed. With an increased tailwater elevation, it would be necessary to install a tailwater depression system to lower the water level in the draft tubes before the units could be switched to synchronous mode.

- **Railroad Bridge Relocations** – Three UPRR bridges would be relocated or modified: Doney Creek Bridge, Sacramento River Second Bridge Crossing, and Pit River Bridge.

- **Vehicle Bridge Relocations** – For an 18.5-foot raise of Shasta Dam, the following vehicle bridges would be relocated because of higher reservoir levels: Charlie Creek Bridge, Doney Creek Bridge, McCloud River Bridge, Didallas Creek Bridge, and Second Creek Bridge. Modifications to Fender's Ferry Bridge are also expected and would include enlarging and extending the existing reinforced-concrete footing and pier, and modifying the existing steel tower to prevent inundation.

- **Major Roads and Road Segments** – Approximately 30 segments of roadway would be relocated, including portions of Lakeshore Drive, Fender's Ferry Road, Gilman Road, and Silverthorn Road.

- **Recreation Facilities** – With an 18.5-foot dam raise, a number of recreation features would be impacted. These features include marinas/boat ramps, resorts, campgrounds/day-use areas, cabins, and USFS facilities. These facilities would be relocated and new facilities would be developed to meet current recreational facility standards. Reclamation and USFS would continue to work together to revise a recreation plan that is suitable for the Whiskeytown-Shasta-Trinity NRA.

- **Nonrecreation Structures** – Sugarloaf and Lakeshore are the main areas with buildings that would be affected by inundation from an 18.5-foot dam raise. These structures would need to be demolished according to requirements of the Shasta County Department of Resource Management Building Division.

- **Utilities and Miscellaneous Minor Infrastructure** – Raising Shasta Dam would include relocating various utility facilities, septic systems, and other miscellaneous minor infrastructure.

Potential Major Benefits

Following are potential major benefits of the preliminary proposed plan, raising Shasta Dam by 18.5 feet, based on evaluations of CP3, CP4, and CP5:

- **Anadromous Fish Survival** – All 18.5-foot dam raise comprehensive plans would increase the depth and volume of the cold-water pool in Shasta Reservoir. This would increase the ability of Shasta Dam to make cold-water releases and to regulate water temperatures for fish in the upper Sacramento River, particularly in dry and critically dry periods. It is estimated that improved water temperature conditions could result in an average increase in the salmon population ranging from about 607,000 to 1,199,000 out-migrating juvenile salmon per year, depending on operations of Shasta Dam and Reservoir.

  Under current CVP/SWP operational assumptions, CP4 operations provide the greatest benefits to anadromous fish survival. This is because CP4 would dedicate about 60 percent (378,000 acre-feet) of the increased storage to increasing the cold-water pool in Shasta Reservoir. Reclamation would manage the cold-water pool each year, under an adaptive management plan, in cooperation with the SRTTG. The adaptive management plan may include operational changes to the timing and magnitude of releases from Shasta Dam for the benefit of anadromous fish, as long as there are no conflicts with current operational guidelines or adverse impacts to water supply reliability.

Augmenting spawning gravel and restoring riparian, floodplain, and side channel habitat, as included in CP4 and CP5, would be expected to positively influence anadromous fish survival in the Sacramento River. Spawning-sized gravel would be applied for a 10-year period and would be placed at discrete locations in the Sacramento River between Keswick Dam and the RBDD. Approximately 0.8 miles of riparian, floodplain, and side channel habitat restoration would be constructed at a suitable location along the Sacramento River.

- **Water Supply Reliability** – All 18.5-foot dam raises would increase water supply reliability by adding to replacement of supplies redirected to other purposes by the CVPIA. This would help reduce estimated future water shortages by increasing dry and critically dry period supplies by a range of 76,400 acre-feet to 133,400 acre-feet per year, depending on operations of Shasta Dam and Reservoir. This increase in reliability would help reduce CVPIA-redirected supplies during drought years by a range of 15 percent to 26 percent.

- **Hydropower Generation** – Under an 18.5-foot dam raise, the higher water surface elevation in the reservoir would result in a net increase in power generation ranging from 96 GWh to 138 GWh to per year.

- **Recreation** – The preliminary proposed plan would include features to, at minimum, maintain the existing recreation capacity at Shasta Lake. All 18.5-foot dam raise plans would involve relocating/replacing recreation facilities and modernizing marinas, campgrounds, boat launches, and related recreation facilities. In addition, benefits would likely occur to the water-oriented recreation experience at Shasta Lake because of the increase in lake surface area. The maximum surface area of the lake would increase by about 2,500 acres (8 percent), from 29,600 acres to about 32,100 acres. Potential modification of the existing flood control diagram would help recreation resources at Shasta Lake by reducing the frequency of early season reservoir drawdown (USACE 1977). Also included under CP5, construction of 18 miles of new trails and 6 trailheads would increase recreation opportunities at Shasta Lake.

- **Benefits Related to Other SLWRI Planning Objectives** – Raising Shasta Dam by 18.5 feet 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. Spawning gravel augmentation and adaptive management of the cold-water pool are expected to provide incidental benefits to ecosystem restoration by improving the complexity of aquatic habitat and promoting more natural ecological processes within the Sacramento River. Furthermore, raising Shasta Dam 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. 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.

Economics

Following is a summary of the costs and benefits of the preliminary proposed plan:

- **Estimated Costs** – The estimated total construction cost of the preliminary proposed plan, based on evaluations of CP3, CP4, and CP5, ranges from about $1,064 million to $1,073 million. The estimated total annual costs range from $53.7 million to $54.1 million.

- **Estimated Benefits** – The total estimated average annual monetary benefit of the preliminary proposed plan, assuming the cost of water and energy supplies increases at the same rate as inflation, ranges from about about $65.4 million to $92.2 million, depending on operations of Shasta Dam and Reservoir. The resulting net economic benefit under the same conditions ranges from about $11.4 million to $38.2 million.

Determination of Feasibility of Preliminary Proposed Plan

This section summarizes the technical, environmental, economic, and financial feasibility of the preliminary proposed plan.

Project feasibility includes the following four elements:

- Technical feasibility, consisting of engineering, operations, and constructability analyses verifying that it is physically and technically possible to construct, operate, and maintain the project.

- Environmental feasibility, consisting of analyses verifying that constructing or operating the project will not result in unacceptable environmental consequences to endangered species, cultural, Indian trust, or other resources.

- Economic feasibility, consisting of analyses verifying that constructing the project is an economically sound investment of capital (i.e., that the project would result in positive net benefits or that the project's benefits would exceed the costs).

- Financial feasibility, consisting of examining and evaluating project beneficiaries' ability to repay their appropriate portion of the Federal investment in the project over a period of time, consistent with applicable law.

Technical Feasibility

The preliminary proposed plan is projected to be technically feasible, constructable, and can be operated and maintained. Designs and cost estimates for raising Shasta Dam by 18.5 feet have been developed to a feasibility level. A Design, Estimating, and Construction (DEC) Review was performed in August 2008 (Reclamation 2008e) for all of the 18.5-foot dam raise comprehensive plans (CP3, CP4, and CP5). Based on recommendations from the DEC review, designs and costs were refined to bring all construction features to a feasibility level. The DEC Review concluded that when the DEC recommendations were adequately addressed, all of the 18.5-foot dam raise alternatives would be at a level suitable (i.e., feasibility level) for use for congressional authorization and appropriation.

Operations of an enlarged Shasta Dam and other related CVP and SWP facilities under the preliminary proposed plan would be similar to existing operations. However, if the adaptive management plan included in CP4 was incorporated, 378,000 acre-feet of new storage would be dedicated for anadromous fish survival. Adaptive management may include operational changes to the timing and magnitude of releases from Shasta Dam for the benefit of anadromous fish, if there are no conflicts with current operational guidelines or adverse impacts to water supply reliability.

Operations of other project features for all 18.5-foot dam raise comprehensive plans, primarily including relocated infrastructure along the Shasta Lake shoreline, would also be similar to operations of existing facilities. Because the majority of project features include replacing or modifying existing facilities, minimal changes are expected in maintenance requirements for project features.

Environmental Feasibility

All of the comprehensive plans are included in the SLWRI Preliminary Draft EIS. Environmental effects were evaluated and mitigation measures for each of the comprehensive plans were identified. At this stage in the planning process, an environmentally preferable alternative has not been identified in the Preliminary Draft EIS. An "environmentally preferable alternative," consistent with NEPA, will be identified in future SLWRI documents. Based on current CVP/SWP operational assumptions and studies to date, CP4 appears to provide the greatest environmental benefits; however, it is recognized that further refinement and changes may occur to this and other alternatives after additional analyses and responses to comments by concerned agencies, stakeholders, and the public.

An 18.5-foot dam raise would affect environmental resources in the primary and extended study areas, as summarized in Table 4-8 for CP3, CP4, and CP5. Beneficial effects of enlarging Shasta Dam correspond to the following resource areas: air quality; aquatic resources; hydrology, hydraulics, and water management; agricultural and important farm lands; utilities and service systems; fisheries and aquatic resources; socioeconomics, population, and housing; transportation and circulation; power and energy; and environmental justice. Some of the adverse effects anticipated for raising Shasta Dam would be temporary, construction-related effects, that would be less than significant or would be reduced to less-than-significant levels through mitigation. Other adverse effects would be permanent, such as effects on botanical, wildlife, and cultural resources, within newly inundated areas of Shasta Lake. Some adverse effects – the short-term generation of construction-generated emissions in excess of SCAQMD thresholds and the temporary exceedence of Shasta County noise level standards – would remain significant and unavoidable despite mitigation measures. Representative environmental effects and proposed mitigation for an 18.5-foot raise of Shasta Dam are summarized for CP3, CP4, and CP5 in the Preliminary Draft EIS Summary in Table S-1.

As part of the project planning and environmental assessment process, Reclamation and the State CEQA lead agency would incorporate certain environmental commitments and best management practices into any plan recommended for implementation to avoid or minimize potential effects (see Chapter 2 of Preliminary Draft EIS). Reclamation has also committed, contingent on congressional authorization, to coordinate the planning, engineering, design and construction, and operations and maintenance phases of the project with applicable resource agencies.

Economic Feasibility

Based on evaluations of CP3, CP4, and CP5, the preliminary proposed plan is projected to be economically feasible, and would generate net positive NED benefits ranging from $11.4 million to $38.2 million annually, assuming water supply and hydropower costs increase at the same rate as inflation. Assuming an increase of water supply and hydropower costs at 2 percent above inflation to account for growing scarcity of water and energy supplies in the future and increasing demand, the project would generate net benefits ranging from $35.1 million to $63.3 million annually. At this time, based on analyses to date, operations under CP4 would provide the greatest net NED benefits of the alternatives evaluated.

Financial Feasibility

Financial feasibility determination during the planning stage consists of (1) an allocation of costs to project purposes, both reimbursable and nonreimbursable, (2) identification of potential project beneficiaries, and (3) determination of project beneficiaries' potential ability to pay the allocated costs, including capital and long-term operation, maintenance, and replacement costs. This

process informs the Federal decision maker of the appropriateness of the investment in individual components and the overall project.

Based on analysis to date, CP4 provides the greatest net NED benefits. For this reason, CP4 is used as an example in the following subsections to characterize the financial feasibility of the preliminary proposed plan.

Cost Allocation Reclamation law and policy require an allocation of costs to components or projects purposes to (1) test financial feasibility of reimbursable components or purposes by comparing estimated project costs with anticipated revenues during the feasibility study process, and (2) establish and measure compliance with project financial requirements after construction and determine the final cost allocation. The final cost allocation is performed when the project or significant portions of the project are deemed to be complete. The cost allocation for the Final Feasibility Report will be expanded to include all purposes for which the Enlarged Shasta Project provides benefits.

An initial cost allocation is made during plan formulation to estimate the financial feasibility of individual project elements, and the project as a whole. Project cost estimates are allocated to the various purposes. The costs assigned to reimbursable purposes are then assigned to the beneficiaries to establish the obligations in contracts with the beneficiaries.

Costs to be allocated include construction costs, other costs (sunk costs), interest during construction, annual O&M costs, and replacement costs. It should be noted that cost allocation is a financial exercise rather than an economic evaluation. Consequently, project costs may be presented differently in a cost allocation than in an economic analysis.

Once all project costs have been identified, they are allocated to the project purposes. On the basis of findings of this report, the example preliminary proposed plan (CP4) has four potential project purposes: irrigation water supply, M&I water supply, fish and wildlife enhancement (e.g., anadromous fish survival), and hydropower. Recreation is not currently a project purpose; however it may be added as the SLWRI continues. Project purposes for which benefits have not been monetized are not included in this cost allocation analysis.

Once costs are allocated to appropriate purposes, they can be assigned to the Federal Government and non-Federal sponsor(s) based on specific project authorization, established Federal cost-sharing laws and regulations, and laws and objectives of non-Federal entities, including States, counties, and non-profit organizations.

Based on existing legislation, costs allocated to irrigation water supply, M&I water supply, and hydropower purposes are either fully or partly reimbursable by project beneficiaries. Fish and wildlife enhancement is either fully or partly

nonreimbursable. Existing legislation that describes Federal financial participation for purposes that may be included in the preliminary proposed plan is summarized in Table 5-1.

Table 5-1. Existing Authorities for Federal Financial Participation in Multipurpose Water Resources Projects

Purpose	Pertinent Legislation	Description
Irrigation Water Supply	Reclamation Act of 1902, as amended	Reimbursable. This act allows for up-front Federal financing of irrigation water supply purposes, with 100% repayment of capital costs and O&M costs by non-Federal project sponsor.
M&I Water Supply	Reclamation Act of 1939, as amended	Reimbursable. This act allows for up-front Federal financing of M&I water supply purposes, with 100% repayment of capital costs (including IDC and interest over the repayment period); 100% of O&M costs are non-Federal.
Hydropower	Reclamation Act of 1906, as amended	Reimbursable. Similar to M&I Water Supply.
Fish and Wildlife Enhancement	Federal Water Project Recreation Act of 1965 (Public Law 89-72), as amended	Nonreimbursable; 100% Federal financing of all fish and wildlife enhancement areas or facilities within the Whiskeytown-Shasta-Trinity NRA.
	Federal Water Project Recreation Act of 1965 (Public Law 89-72), as amended	Public Law 89-72 allows Federal nonreimbursable share of up to 75% and non-Federal share of at least 25% for fish and wildlife enhancements outside of the NRA, including planning, design, and IDC. In addition, 50% of the annual O&M and replacement costs would be a non-Federal responsibility.
Recreation	Whiskeytown-Shasta-Trinity National Recreation Area (Public Law 89-336)	Provides authority for Federal development of recreation facilities in Whiskeytown-Shasta-Trinity NRA.

Key:
IDC = interest during construction
M&I = municipal and industrial
NRA = National Recreation Area
O&M = operations and maintenance

Preliminary Cost Allocation This preliminary analysis provides an initial indication of the cost implications of the approaches shown. It is not a detailed assessment of the economic effects of costs being borne by different Federal and non-Federal entities, and it does not identify a potential non-Federal sponsor.

The following provides an example of how costs for the preliminary proposed plan might be allocated to project purposes based on analyses for the example preliminary proposed plan, CP4. A separable costs-remaining benefits analysis was performed. It is important to note that the largest portion of CP4 costs (total construction cost of $1,070 million) would be expended to implement plan features required to accomplish the primary planning objectives.

Table 5-2 displays a step-by-step process for determining the construction cost to be allocated to each project purpose. The construction cost allocated to each project purpose is the total annual cost with O&M costs and IDC removed.

Annual Cost – O&M Cost – IDC Cost = Construction Cost

Specific costs are for project components that contribute to a single purpose; for example, the cost of recreation facilities around a multipurpose reservoir would be a single purpose. Separable costs are costs that are specifically necessary because a purpose is included in a multipurpose project. Separable costs include specific costs and may include a portion of joint costs; they are estimated as the reduction in financial costs that would result if a purpose were excluded from an alternative.

Separable costs are subtracted from the annual benefit of each project purpose to determine the total annual joint cost. The resulting allocated remaining cost is based on the percentage of the remaining benefits of each project purpose. Total allocated costs are the sum of the separable annual costs and allocated remaining costs.

O&M costs are then subtracted from the total cost to determine the capital cost allocated to each project purpose. A similar approach for developing the O&M costs was used to subtract the separable costs and allocate the remaining O&M costs based on the percentage of the remaining O&M costs. Subtracting the O&M costs from the annual costs leaves the capital costs to be allocated to each project purpose.

Finally, IDC is subtracted to determine the construction cost allocated to each project purpose. IDC is calculated as the percentage of the total capital cost multiplied by the total IDC. Subtracting IDC from the capital cost leaves the construction cost allocated to each project purpose.

Cost Assignment. Table 5-3 shows an estimate of the assignment of costs for the example preliminary proposed plan. The assignment percentages are based on those included in Table 5-2. As can be seen, the assignment of costs includes costs to accomplish the four purposes consistent with the planning objectives. These costs amount to $1,070 million. Also shown in Table 5-3, of the costs allocated to achieving CP4, approximately 61 percent are estimated to be nonreimbursable and about 39 percent are reimbursable.

Table 5-2. Example Construction Cost Allocation Summary ($ millions)[1 2]

	Item/Calculation	Irrigation Water Supply	M&I Water Supply	Fish and Wildlife Enhancement	Hydro-power	Total
Allocated Total Annual Costs						
1	Average Annual Benefits	8.3	18.7	49.2	7.7	83.9
2	Single-Purpose Projects	23.8	18.8	49.7	7.7	-
3	Justifiable Expenditure (Lessor of Benefits/Single Purpose Alt Costs)	8.3	18.7	49.2	7.7	83.9
4	Separable Annual Costs	4.8	6.2	11.4	0.0	22.5
5	Remaining Benefits/Justifiable Expenditure (3) - (4)	3.5	12.5	37.8	7.7	61.4
6	% Remaining Benefits (A5 to D5) ÷ (E5)	5.7%	20.3%	61.5%	12.5%	100.0%
7	Allocated Joint Cost (A6 to D6) x (E7)	1.8	6.4	19.4	3.9	31.5
8	Total Allocated Costs (4) + (7)	6.6	12.6	30.8	3.9	54.0
Allocated O&M Annual Costs[3]						
9	Separable O&M Cost	0.5	3.4	0.3	0.0	4.3
10	Allocated Joint Cost (A6 to D6) x (E10)	0.1	0.2	0.6	0.1	1.0
11	Total O&M Allocated (9) + (10)	0.6	3.6	0.9	0.1	5.2
Allocation of Capital Cost						
12	Annual Capital Cost (8) – (11)	6.0	9.1	29.8	3.8	48.8
13	% Annual Capital Cost (A12 to D12) ÷ (E12)	12.4%	18.6%	61.2%	7.9%	100.0%
14	Allocated Capital Cost (A13 to D13) x (E14)	143.8	215.6	710.9	91.2	1,161.5
Allocated Construction Costs						
15	Allocated IDC [(A15 to D15) ÷ (E15)] x (E14)	11.3	17.0	56.0	7.2	91.5
16	Construction Cost (14) – (15)	132.5	198.6	654.9	84.0	1,069.9
17	% of Total Construction Cost (A16 to D16) ÷ (E16)	12.4%	18.6%	61.2%	7.9%	100.0%

Notes:

[1] April 2010 price level, 4 1/8 percent interest rate, and 100-year period of analysis.

[2] All numbers are rounded for display purposes; therefore, line items may not sum to totals.

[3] Future allocation to include gravel augmentation; riparian, floodplain, and side channel habitat restoration; and water use efficiency.

Key:

IDC = interest during construction

M&I = municipal and industrial

O&M = operations and maintenance

Table 5-3. Example Construction Cost Assignment for CP4

Purpose /Action	Total		Cost Assignment			
			Nonreimbursable		Reimbursable	
	Percent	Cost ($ millions)	Percent	Cost ($ millions)	Percent	Cost ($ millions)
Irrigation Water Supply	12.4%	132.5	0%	0.0	100%	132.5
Municipal and Industrial Water Supply	18.6%	198.6	0%	0.0	100%	198.6
Fish and Wildlife Enhancement	61.2%	654.9	100%	654.9	0%	0.0
Hydropower	7.9%	84.0	0%	0.0	100%	84.0
Total	100.0%	1069.9	61.2%	100.0	38.8%	100.0

Notes:
[1] All numbers are rounded for display purposes; therefore, line items may not sum to totals.
[2] Subject to refinement/change during remainder of feasibility study.
Key:
CP = comprehensive plan

Preliminary Ability to Pay Determination The determination of project beneficiaries' ability to pay their allocated costs varies between irrigation water supply, M&I water supply, and hydropower; however, all include capital costs and long-term operation, maintenance, and replacement costs.

An initial analysis for irrigation, M&I, and hydropower beneficiaries has been developed. The cost allocation and analysis of the financial capability of project beneficiaries will be refined and presented in the Final Feasibility Study. If the beneficiaries cannot repay the project costs, an act of Congress would be required to move forward with the project.

For irrigation water supplies, an ability to pay analysis of the financial capability of an irrigation district or contracting entity to meet the repayment obligations is completed in two steps. First, the farm-level payment capacity is evaluated. Second, the farm-level payment capacity is aggregated to the entire district, and the existing obligations, O&M costs, power costs, and reserve fund requirements are subtracted. The remainder is the district's payment capacity.

The payment capacity is an irrigator's estimated residual net farm income available for payment of Federally assessed water costs after subtracting for on-farm production and investment expenses, and appropriate allowances for management, return on equity, and labor. The farm-level analysis for this report focused on the on-farm economic and financial conditions expected to occur in the next 5 years.

Of the 250 CVP contractors, 4 representative CVP agricultural water contractors were selected to represent all contractors' ability to repay the allocated costs. Contractor payment capacities were computed using existing enterprise farm budgets from previous economic projects, indexed to 2010 dollars. Contractor financial statements were averaged over the previous 5

years to compute each district's O&M costs. Water costs (O&M, repayment of construction, and current CVPIA restoration charges) were multiplied by 5-year average deliveries to compute the cost of water. The contractors' ability to pay per acre-foot is computed and presented in Table 5-4.

Table 5-4. Ability to Pay Results for Four Representative Contractors

	San Joaquin	Sacramento River	South of Delta	Northern Sacramento
Ability to Pay ($/acre-foot)	7.50	324.55	150.59	97.40

Key: Delta = Sacramento-San Joaquin Delta

Costs allocated to the irrigation water supply purpose using CP4 as an example are estimated to be $143.8 million, as shown in Table 5-2. Two repayment scenarios were evaluated. The first scenario is based on the assumption that the increment of agricultural water supply from CP4 is fully integrated into the CVP to meet existing contracts, with a 40-year repayment for construction costs. The CVP Irrigation Ratesetting Policy, established in 1988, would be used to recover O&M costs and provide repayment of construction costs through water service contracts.

The second scenario assumes the increment of water associated with CP4 would require new contracts with existing CVP and SWP contractors who are willing and able to pay the incremental costs in order to receive the incremental benefits. The incremental cost of the dam enlargement would be repaid over a 40-year period.

Financial feasibility is determined by comparing the beneficiaries' ability to pay with the annualized repayment of construction costs and recovery of O&M costs.

An increase in the annual cost of irrigation water of $3.9 million was allocated to CVP irrigation contractors. To derive the increase in the cost of water using Scenario 1, the $3.9 million in additional annual costs is divided by the 5-year average of annual water deliveries, 2.2 million acre-feet. This results in a marginal increase of $1.77 per acre-foot. The marginal increase would fall within the ability to pay for each of the four representative contractors.

For Scenario 2, financial feasibility was also determined by comparing the beneficiaries' ability to pay the annualized construction costs and O&M. At present, the specific contractors have not been identified. If new contracts were identified, the costs would be spread over an average annual increase of 27,900 acre-feet. Assuming the same 40-year repayment period, the cost per acre-foot is estimated at $140 for CVP irrigation contractors. If SWP contractors were willing and able to pay for irrigation water supply benefits of an enlarged Shasta dam, additional costs may be assessed. Specific analysis for any contractor would be required before a determination of financial feasibility could be

considered complete. This analysis indicates that the costs for this scenario would fall within the ability to pay for two of the representative CVP contractors.

Of the 250 CVP contractors, about 40 irrigation contractors receive relief from paying some or all of the CVPIA charges and the amount charged for existing CVP construction costs pursuant to Reclamation law. Of these contractors, some are able to pay a portion of the costs while a majority do not have the ability to pay even their allocated O&M costs, and are considered operating on a willing-to-pay basis. These few contractors would not have the ability to pay the additional costs resulting from the potential implementation of the example plan used (CP4). Aid to irrigation for these contractors is reviewed every 5 years, and recent studies indicate that CVP contractors' ability to pay current costs has significantly improved. However, it is likely that a number of contractors will continue to operate on a willing-to-pay basis.

Municipal and Industrial Water Supply Financial Feasibility The costs allocated to the M&I water service purpose from the example preliminary proposed plan are estimated to be $215.6 million, as shown in Table 5-2. The same two scenarios used for irrigation financial feasibility were used for M&I.

Current water rates were used as an estimate of the M&I contractors' ability to pay for additional water. It is assumed that a small change in the water rate will have little effect on a district's ability to pay the full cost of water. The M&I water rates for CVP contractors range from $15 – $61 per acre-foot (Reclamation 2011d); the M&I water rates for SWP contractors range from about $37 – $1,102 per acre-foot (DWR 2008). In evaluating Scenario 1, annual allocated costs to M&I are approximately $18.1 million, including interest on any unpaid balances. If these costs are spread over the average 5-year M&I deliveries of 335,217 acre-feet (Reclamation 2011d), plus the additional water supply reliability, 18,500 acre-feet, the marginal impact would be $51 per acre-foot.

Under Scenario 2, it is assumed that the costs of the project would be repaid separately from existing CVP costs. To determine the cost of water supply reliability, the total annual costs allocated to M&I water contractors are divided by the estimated average annual yield increase ($18.1 million/18,500 acre-feet), which equals $978 per acre-foot. This is well above the current water rates for CVP contractors and all but two SWP contractors. At this stage of analysis, applying the second repayment scenario is problematic because it results in a large increase in the rate for M&I water supply reliability relative to the existing rate. This large increase results in an inability to determine the M&I contractors' ability to pay.

During future analyses, other models and repayment scenarios may be used to refine the estimate of the value of water to M&I contractors, to sub-allocate costs between the CVP and SWP M&I contractors, to refine the estimate the

M&I contractors' willingness-to-pay, or to identify the least-cost alternative water supply for the proposed plan, once selected.

Hydropower Financial Feasibility Hydropower generated through CVP facilities is marketed by Western Area Power Administration (WAPA). WAPA's annual revenue requirements from generation are approximately $105 million annually. Rates are set to generate sufficient revenues to meet this requirement. Allocated annual costs for the example preliminary proposed plan are approximately $4.8 million, which is less than a 5 percent increase in revenue requirement. During the last several years, the rate that WAPA charges for electricity has exceeded market rates for short periods of time. Increases in rates during these periods would not be beneficial to contractors purchasing electricity. In general, it is expected that a 5 percent increase in rates would be supportable by those that purchase power from WAPA.

Risk and Uncertainty

With each aspect of this report, certain assumptions were made based on engineering and scientific judgment. Careful consideration was given to the methodologies and evaluations for hydrology and system operations, cost estimates, and biological analyses, as described in the Modeling Appendix and Engineering Summary Appendix. Analyses were developed with advanced modeling and estimating tools using historical data and trends. While this is effective in helping predict outcomes for future operations, costs, and biological conditions, many uncertainties could affect the findings of this Draft Feasibility Report. Various risks and uncertainties associated with the SLWRI and potential modification of Shasta Dam are discussed below.

Hydrology and Climate Change

Potential climate change could produce conditions that are different from those for which current water management operations were designed. The potential for, and magnitude of, climate change is widely debated. The State is investing significant resources in studying how global climate changes could affect the way California receives and stores water. Results indicate that climate changes in the State could affect hydrology, water temperatures for fish, and future operations for both flood management and water supply deliveries.

According to the 2009 *California Water Plan Update*, California could experience changes in temperature, precipitation, and snow level (DWR). Any measurable change in these climate indicators could affect future water operations in California. It is unlikely that changes in snow levels would significantly affect Shasta Reservoir because the reservoir is primarily filled by direct rainfall runoff, as opposed to snowmelt. However, changes in water management operations downstream and in the Delta could affect Shasta Reservoir operations. If precipitation increases, it may further enhance the benefits of increased reservoir capacity. According to the *California Water*

Plan Update (DWR 2005), more studies are needed before definitive answers can be given:

> *In general, while modeling of projected temperature changes is broadly consistent across most modeling efforts, there are disagreements about precipitation estimates. Considerable uncertainties about precise impacts of climate change on California hydrology and water resources will remain until we have more precise and consistent information about how precipitation patterns, timing, and intensity will change. Further work is in progress to extend and improve these modeling efforts, and to use watershed-scale hydrological models that will be of more direct value to planners.*

Water Supply Reliability and Demands

Water supplies and demand will continue to be subject to annual variability. Demands are expected to exceed supplies in the future, but predicting expected future water supply and/or shortages in the Central Valley of California can be challenging. There are numerous variables and, just as important, numerous opinions regarding these variables, depending on the growth scenarios anticipated. The *California Water Plan* (DWR 2009) estimates demand for different growth scenarios, ranging from "slow and strategic growth," that is slower than currently projected, to "expansive growth", which assumes that population growth will be faster than currently projected, with nearly 70 million people living in California in 2050.

Potential for an overall reduction in future demands for agricultural water supplies has been predicted. Reasons for this are conversion from agricultural to urban land uses and implementation of more efficient irrigation water applications.

Future Land Use

Population growth is a major factor in California's future water picture. California's population is expected to increase by just over 60 percent by 2050. Population growth could force some of the existing water supplies currently identified for agricultural uses to be redirected to urban uses. Certainly, some portion of increased population growth in the Central Valley would occur on lands currently used for irrigated agriculture. Therefore, water that would have been needed for these lands for irrigation would instead be used to serve replaced urban demands. However, this would only partially offset the required agricultural-to-urban water conversion, since much of the growth would occur on nonirrigated agricultural lands. If it was assumed that all of the urban growth in the Central Valley would occur on lands currently under irrigation, this would only account for up to about 40 percent of expected future conversion needs. The remainder of the agricultural-to-urban water conversion would be required to help sustain urban growth primarily in other areas of the State.

Efficiency in Water Use

While agricultural interests are ever improving in irrigation efficiencies, technology is also being used to be more efficient with all of the supplies that can be acquired. Challenges are greatest during dry years and droughts because in drier years, water dedicated to the environment is curtailed and less water is available for agriculture. Users who have already increased efficiency may find it more challenging to achieve additional water use reductions during droughts.

Anadromous Fish Populations

Anadromous fish are highly affected by changes in their surrounding conditions. Trying to predict fish survival is difficult because of the many influencing factors. The SALMOD model used to predict fish survival for this Draft Feasibility Report contains assumptions with varying levels of uncertainty. A key uncertainty stems from using the same number of returning spawners in each year of the SALMOD simulation. This does not allow for population growth over time; benefits are seen only in the number of survivors in a given year. Independent of the model, uncertainty is also related to water conditions outside the area of influence of the dam raise. These include conditions downstream from the modeled reach of the Sacramento River, in the Delta, and in the Pacific Ocean. Lastly, potential climate change could also influence fish survival. All models are subject to uncertainty; SALMOD was chosen as the best available model for performing population comparisons on the Sacramento River for two reasons. First, SALMOD has been applied previously on the Sacramento River (Kent 1999, Bartholow 2003, Reclamation 2008b). Second, the U.S. Geological Survey (USGS) has completed a thorough review and update of model parameters and techniques on the Klamath River, enabling a smooth transfer of relevant model parameters to Sacramento River modeling for the SLWRI (Bartholow and Henriksen 2006).

Adaptive Management

Adaptive management of system operations could reduce uncertainty in anadromous fish survival. Adaptive management is a deliberate, iterative, and scientific process of designing, implementing, monitoring, and adjusting an action, measure, or project to reduce uncertainty and maximize one or more goals over time. If applied appropriately, this approach would allow for flexible operations based on best available science and new information as it becomes available. For this project, an adaptive management plan may include operational changes to the timing and magnitude of releases from Shasta Dam primarily to improve the quality and quantity of aquatic habitat. These changes could include increasing minimum flows, timing releases from Shasta Dam to mimic more natural seasonal flows, meeting flow targets for side channels, or retaining additional storage to meet temperature requirements to improve conditions supporting anadromous fish survival.

Water System Operations Analysis

Water operations modeling performed for this Draft Feasibility Report was based primarily on operational constraints described in the 2004 OCAP BA

(Reclamation) and the Coordinated Operations Agreement between Reclamation and DWR for the CVP and SWP, as ratified by Congress. Federal planning policies were used to help estimate which future projects may or may not be implemented; projects were deliberately either included or excluded from water operations models and evaluations. Some of the projects included in the without-project condition, if not implemented, could influence the findings of this Draft Feasibility Report. Also, some projects not accounted for in the models could change the findings of this Draft Feasibility Report if they are implemented. Changes in Delta exports could also influence future water operations. In addition, changes in hydrology could produce conditions that are different than current water operations were designed for.

Although recent model upgrades have been made based on mandated operations changes due to species declines, drought conditions, and subsequent BOs, the SLWRI used existing modeling studies as the basis of the No-Action Alternative. These studies reflect water operations conditions described in the 2004 OCAP BA and the Coordinated Operations Agreement.

The legal challenges and changing environmental conditions result in uncertainty with regard to both current and future operations. These operational uncertainties are likely to continue, and current and future water operation conditions may be different because operational constraints governing water operations are likely to change with release of revised USFWS and NMFS BOs. The existing SLWRI modeling analysis is being used for comparison purposes, and reflects expected variation among the comprehensive plans, including the type and relative magnitude of anticipated impacts and benefits. Because of the lingering uncertainty about future water operations, the Draft Feasibility Report and Preliminary Draft EIS are based on existing studies.

Modeling studies will be updated to reflect changes in water operations resulting from ongoing OCAP reconsultation and other relevant water resources projects and programs, including, potentially, BDCP/DHCCP efforts. The results of these updated studies will be incorporated into future SLWRI documents.

Implementation of the 2008 USFWS and 2009 NMFS RPAs and/or a BDCP alternative could affect the estimated benefits of SLWRI comprehensive plans. The discussion below describes the nature of potential effects.

Analysis of 2008 USFWS BO and 2009 NMFS BO Reasonable and Prudent Alternatives

Several lawsuits were filed challenging the validity of the 2008 USFWS BO and 2009 NMFS BO and Reclamation's acceptance of the RPA included with each BO (*Consolidated Salmonid Cases*, *Delta Smelt Consolidated Cases*). Both BOs were found to be unlawful and were remanded to the respective resource agencies, leaving significant uncertainty in future water operations of the CVP and SWP. However, these BOs and associated RPAs contain the most recent

estimate of potential water operations changes that could occur in the near future, and it is anticipated that the final BOs issued by the resource agencies will contain similar RPAs. Implementation of the RPAs and potential effects on SLWRI comprehensive plans are discussed below.

If the RPAs associated with the 2008 USFWS BO and the 2009 NMFS BO were implemented, the following actions could affect water operations of the CVP and SWP and infrastructure at Shasta Dam:

- Maintenance of additional carryover storage in Shasta Reservoir for the cold-water pool, measured at the end of September and end of April
- Year-round management of Keswick Dam releases to meet temperature compliance points
- Seasonally reduced south-of-Delta exports, December through June
- Increased Delta outflow (September through October) for salinity management
- Studies to investigate fish passage above Shasta Dam

The following discussion describes how implementation of the RPAs could affect the existing system, and how the estimated benefits of comprehensive plans could change if the RPAs were in place.

Anadromous Fish Survival Certain RPA actions and all SLWRI comprehensive plans were formulated specifically to benefit anadromous fish in the upper Sacramento River. Implementing the RPAs is anticipated to increase survival of anadromous fish in the upper Sacramento River primarily through improved water temperature regimes. If an enlarged Shasta Dam and Reservoir were constructed in combination with implementation of the RPAs, it is anticipated that the combined fisheries benefits would be greater than those attributed to the RPAs alone, through both temperature management and changes in flow regimes associated with the SLWRI comprehensive plans. However, there is significant uncertainty related to the magnitude of the combined benefits. Some SLWRI comprehensive plans also include improvements to fisheries habitat along the upper Sacramento River, and could further increase anticipated RPA fisheries benefits.

Water Supply Reliability If implemented, the RPAs are anticipated to reduce CVP and SWP water deliveries, especially south-of-Delta, due to pumping restrictions and the commitment of water to environmental purposes (e.g., temperature management and Delta outflow). All SLWRI alternative plans were formulated specifically to increase CVP and SWP water deliveries and water supply reliability. Implementing an enlarged Shasta Dam and Reservoir in combination with implementation of the RPAs would provide net water

supply benefits, but because the RPAs would restrict Delta pumping, water supply benefits, especially south of the Delta, may be more limited than could be achieved without RPA implementation.

Secondary Planning Objectives Implementation of the RPAs and the comprehensive plans would affect benefits associated with the secondary planning objectives less than the primary planning objectives. Effects to hydropower as a result of RPA implementation are uncertain because the trade-off between increased head and flows through the powerhouse resulting from higher end-of-September storage is unknown. However, it is anticipated that hydropower generation would be similar for the SLWRI comprehensive plans with or without RPA implementation. As described under the primary planning objective of anadromous fish survival, ecosystem restoration along the upper Sacramento River with certain comprehensive plans could present synergistic benefits with the RPA implementation. SLWRI-related benefits for recreation, flood, water quality, and reservoir area ecosystem restoration would be similar for the SLWRI comprehensive plans with or without the RPA implementation.

Analysis of Potential BDCP Alternatives

The BDCP is being prepared collaboratively by Federal, State, and local agencies, environmental organizations, and other interested parties. The BDCP is intended as a comprehensive conservation strategy for the Delta, designed to advance the coequal planning goals of restoring ecological functions of the Delta and improving water supply reliability for large portions of the State of California. To provide support for the BDCP environmental review process, DWR formed the DHCCP in 2008 as a partnership with Reclamation.

A range of alternatives for providing species/habitat protection and improving water supply reliability as part of the BDCP are being evaluated through development of an EIS/EIR. Currently, several alternative Delta conveyance facilities are being evaluated. Among these alternatives is a through-Delta facility and an isolated facility that would convey water around the Delta for local supply and export through a hydraulically isolated channel or tunnel. Isolated facility capacities under consideration range from 3,000 cfs to 15,000 cfs.

The following discussion describes how implementation of the BDCP could affect the existing system, and how the estimated benefits of SLWRI comprehensive plans could change if a BDCP alternative was implemented.

Anadromous Fish Survival All BDCP alternatives are anticipated to improve habitat conditions in the Delta for anadromous fish species; however, effects of BDCP alternatives on habitat conditions and anadromous fish survival in the upper Sacramento River are uncertain at this time. All SLWRI comprehensive plans were formulated specifically to benefit to anadromous fish in the upper Sacramento River, with a specific focus on increasing out-migration of salmonids downstream of RBDD. Improved habitat conditions in the Delta

through implementation of any BDCP alternative are anticipated to further increase the survival in the Delta of out-migrating salmonids resulting from an enlarged Shasta Dam and Reservoir included in all SLWRI comprehensive plans. However, there is significant uncertainty related to the magnitude of these benefits.

Water Supply Reliability All SLWRI comprehensive plans were formulated specifically to increase CVP and SWP water deliveries and water supply reliability. An isolated facility implemented as part of the BDCP could increase water deliveries to CVP and SWP water users south of the Delta and improve water quality for urban and agricultural water users. Implementation of an enlarged Shasta Dam and Reservoir in combination with any BDCP alternative would likely provide greater water supply benefits than implementing either proposed project independently. If an enlarged Shasta were constructed in combination with any BDCP alternative, it is anticipated that the combined water supply benefits would be greater than those attributed to the BDCP alternative alone. Modifications of Shasta Dam and Reservoir could increase system flexibility and potential use of new Delta conveyance facilities, providing for even greater water supply reliability. However, the magnitude of the combined benefits is dependent upon type and size of conveyance facilities included in BDCP alternatives.

Secondary Planning Objectives SLWRI benefits for ecosystem restoration, hydropower generation, flood damage reduction, recreation and water quality are anticipated to be similar for the SLWRI comprehensive plans whether or not BDCP is implemented.

Cost Estimates

Cost estimates developed for comprehensive plans included in this report are based on April 2010 price levels and a 100-year period of analysis. Varying uncertainties are associated with the material and unit costs used to develop the estimates. Unknowns include the price of construction materials and labor costs. In particular, the construction market has experienced extreme price volatility in the last several years. A significant market anomaly occurring from 2002 to 2009 skews the calculation of forward cost trends using short-term linear regression techniques.

Although the recent economic downturn has resulted in price decreases, it is expected that prices will continue to escalate over the long term. While future inflation trends are difficult to predict, new market forces (e.g., higher material commodity pricing, energy costs, lack of competition) will likely continue to have significant impacts on heavy civil infrastructure construction costs for the foreseeable future. Because of uncertainty and variability among the short-term regressions, a longer view of the market is preferred. Consequently, while forward cost trends are always difficult to predict, there is some basis to believe that cost escalation is normalizing back to historical levels at approximately 3

percent per year. Future studies and coordination should be undertaken to determine an appropriate escalation factor to be used for budgetary approval.

Unresolved Issues

As the SLWRI progresses toward project implementation, issues will evolve that need to be addressed and resolved. Multiple subject areas need to be addressed during upcoming phases of the SLWRI, as described below. In addition, Chapter 1 of the Preliminary Draft EIS contains additional discussion related to areas of controversy and unresolved issues.

McCloud River

Although the McCloud River is not formally designated as a National or State wild and scenic river, Section 5093.542 of the California Public Resources Code specifies that the McCloud River should be maintained in its free-flowing condition, and its wild trout fishery protected from 0.25 miles below McCloud Dam downstream to the McCloud River Bridge. Section 5093.542 was established through enactment of the Wild and Scenic Rivers Act, as amended (Sections 5093.50 – 5093.70).

Section 5093.542(c) states the following:

> *Except for participation by the 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.*

Section 5093.542(d) states the following:

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

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

5093.542 sought to protect the free-flowing condition of the McCloud River, it also provided for investigations of enlarging Shasta Dam. Reclamation will continue to coordinate with the State and potential non-Federal sponsors to develop strategies to support State agency participation in the SLWRI and necessary permitting processes, such as those related to water rights and CEQA.

Non-Federal Sponsor

To date, interest has been expressed in a potential project implementation to address the identified SLWRI planning objectives. Support has been expressed by representatives of CVP contractors, and other water supply interests. In addition, interest has been identified for implementing environmental restoration features, especially projects to benefit anadromous fish survival.

If authorized for construction, a recommended plan would likely require a portion of its costs to be reimbursed by a non-Federal sponsor(s). Reimbursable costs include agricultural water supply, M&I water supply, and hydropower. In April 2009, Reclamation and Westlands Water District signed an *Agreement in Principle for the Potential Sharing of Costs of Enlarging Shasta Dam and Reservoir*. In this agreement, both parties indicate their willingness to enter into formal negotiations for sharing costs to enlarge Shasta Dam and Reservoir, contingent on a number of factors related to completing the Final Feasibility Report, FEIS, and ROD; findings that the proposed plan has technical, environmental, economic, and financial feasibility; enactment of Congressional legislation authorizing construction of the project; acquisition of water rights; and Final Feasibility Report findings that are acceptable to Westlands Water District.

Native American and Cultural Resources

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

Impacts on Biological Resources

The physical environment and associated landscapes within and adjacent to the primary study area contain a wide array of habitat used by a diverse assemblage of wildlife with varying habitat needs and home ranges. To date, species-specific surveys performed as part of the SLWRI have included focused

investigations for a number of special-status species in the inundation and relocation areas described previously. The scale of these surveys has been limited, and because of a variety of external factors, surveys have not addressed habitat for species with a large home range or at a watershed scale. Therefore, for species that have large home ranges (e.g., Pacific fisher), or that use a wide range of habitats for some aspect of their life history, analyses presented in this document assume presence over a conservatively large geographic area to cover the full range of impacts anticipated for these species.

Off-Site Mitigation for Impacts on Biological Resources

Details about off-site opportunities to mitigate impacts on biological resources in the primary study area are not yet available. Potential mitigation lands containing wetland and special-status species habitat comparable to habitat that would be affected by modifying Shasta Dam and Reservoir have been identified near the study area. How conservation and enhancement efforts on these lands may be applied for mitigation of loss of habitat will be discussed in more detail in future documents.

Water Rights

Improving the reliability of water supplies is a primary planning objective for the SLWRI. The water supply reliability benefits of the comprehensive plans are described in Chapters 3 and 4. Water rights for the expanded Shasta Reservoir, which are appropriated by the SWRCB, must be in place before the project can operate. Evaluation of water rights will remain a focus of the SLWRI.

Coordinated CVP and SWP Operational Conditions

Planning assumptions and information on water operations used to develop comprehensive plans for the SLWRI were developed in 2006, and reflect the coordinated CVP and SWP operational conditions and criteria described in the 2004 OCAP (Reclamation). In December 2008, USFWS issued the 2008 USFWS BO regarding delta smelt (USFWS 2008) and in June 2009, NMFS issued the 2009 NMFS BO (NMFS 2009a). Several lawsuits were filed challenging the validity of the 2008 USFWS BO and 2009 NMFS BO and Reclamation's acceptance of the RPA included with each BO (*Consolidated Salmonid Cases, Delta Smelt Consolidated Cases*). On December 14, 2010, the District Court found the 2008 USFWS BO to be unlawful and remanded the BO to USFWS. The District Court issued a similar ruling for the 2009 NMFS BO on September 20, 2011. On May 4, 2011, in the *Delta Smelt Consolidated Cases*, the District Court ordered USFWS to prepare a draft BO by October 1, 2011, which was subsequently extended to an unspecified date to be agreed upon by involved parties. USFWS and Reclamation must prepare a final BO and final NEPA document by November 1, 2013, and December 1, 2013, respectively.

The legal challenges and changing environmental conditions result in uncertainty with regard to both current and future operations. These operational

uncertainties are likely to continue, and current and future water operation conditions may be different because constraints governing water operations are likely to change with release of revised USFWS and NMFS BOs. Existing SLWRI modeling analyses are being used for comparison purposes, and reflect expected variation among the comprehensive plans, including the type and relative magnitude of anticipated impacts and benefits. Therefore, because of the lingering uncertainty about future water operations, this Draft Feasibility Report and Preliminary Draft EIS are based on existing studies.

Modeling studies will be updated to reflect changes in water operations resulting from ongoing OCAP reconsultation and other relevant water resources projects and programs, including, potentially, BDCP/DHCCP efforts. The results of these updated studies will be incorporated into future SLWRI documents.

Next Steps for the Feasibility Study

As the SLWRI progresses, Reclamation will continue to address unresolved issues and concerns, including issues related to comprehensive plan refinement, economic evaluations, Native American and cultural resources, and water rights. Additional refinement of the comprehensive plans is expected based on public and stakeholder input on the Draft Feasibility Report and Preliminary Draft EIS and updates to modeling studies.

Solicit Input on Draft Feasibility Report and Preliminary Draft EIS

Reclamation will solicit public input on the Draft Feasibility Report and Preliminary Draft EIS.

Comprehensive Plan Refinement

As the SLWRI progresses, Reclamation will continue to refine and evaluate comprehensive plans and identified measures to respond to public comments and reflect potential changes to existing and likely future conditions. Conditions in the Sacramento River basin and Delta are complex and subject to change, as described in the following subsections.

Revised Water Operations Modeling Analysis

Formulation efforts for the comprehensive plans are based on the CVP and SWP operational conditions described in the 2004 OCAP BA (Reclamation 2004c) and the Coordinated Operations Agreement between Reclamation and DWR for the CVP and SWP, as ratified by Congress. Operations studies will be updated to reflect water operations resulting from ongoing OCAP reconsultation and other relevant water resources projects and programs, including, potentially, BDCP/DHCCP efforts. The results of these updated studies will be incorporated into future SLWRI documents.

Future studies based on updated water operations will require revising several models and related analyses to reflect potential changes for each of the project resource areas. Figure 5-1 shows the numerical modeling that will need to be performed, and the order in which the modeling will take place. Revised water operations modeling results will be used as input for reservoir and river water temperature modeling to determine the potential impacts to fisheries, Delta water quality, CVP/SWP power operations, water supply reliability evaluations, and other potentially affected resource areas.

Climate Change

As the SLWRI progresses, a quantitative climate change analysis will be performed to describe potential effects of future climate change and revised operations on water supply, fisheries, water quality, and other resource areas. Current analysis is qualitative regarding the potential range of impacts California might face because of climate change (see Climate Change Projection Appendix).

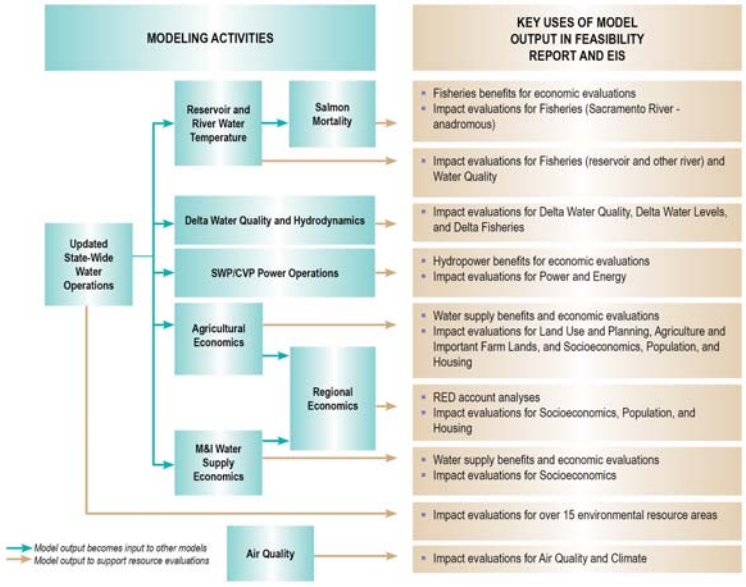


Figure 5-1. Future Modeling Analysis Process

Off-site Mitigation Development

Several areas around Shasta Reservoir have been identified for potential development to mitigate project-related impacts; however, specific details are not yet available about off-site opportunities to mitigate impacts on biological resources in the primary study area. Additional discussion of mitigation and associated mitigation ratios for lands around Shasta Reservoir will be developed in future SLWRI documents. Preliminary cost allowances have been prepared based on these initial investigations. As the SLWRI progresses, Reclamation anticipates developing more detailed plans and cost estimates for the specific mitigation activities and enhancement features.

Future Economic and Financial Evaluations

Future economic and financial evaluations will focus on reassessing benefits of alternative plans based on updated estimates of plan benefits, identification of a proposed plan (consistent with the P&G) and the environmentally preferable alternative (consistent with NEPA), and allocation of costs to project purposes. As stated above, Reclamation anticipates developing more detailed plans and cost estimates for specific mitigation activities and enhancement features before finalizing project costs. Accordingly, all economic analyses will be updated. Reclamation also plans to refine analyses for the financial capability of project beneficiaries. In addition, if the California Water Commission's 2012 Water Bond measure passes, Reclamation will investigate use of bond funding for the public benefits of raising Shasta Dam and Reservoir.

Non-Federal Sponsor

If authorized for construction, the proposed plan would require a portion of its costs to be reimbursed by a non-Federal sponsor(s). Reimbursable costs include the following: irrigation water supply, M&I water supply, and hydropower. To date, interest has been strong in potential SLWRI project implementation to address the identified planning objectives.

Continued Coordination and Evaluations

As the SLWRI progresses, Reclamation will continue to coordinate with stakeholders and other agencies to address and resolve issues related to Native American and cultural resources, water rights, ongoing biological investigations, and related projects and programs.

- Reclamation will continue to engage Federally recognized tribal governments and Native American tribal groups in planning and developing the SLWRI. The Draft Feasibility Report and accompanying Preliminary Draft EIS are consistent with the National Historic Preservation Act and Section 106, and describe supporting cultural resources analyses, studies, coordination, impacts, and mitigation, as appropriate.

- Reclamation may need to petition SWRCB for a new or amended water rights permit. To issue a permit, SWRCB must find that unappropriated water is available to supply the applicant, and that the applicant's appropriation is in the public interest. Evaluation of water rights will remain a focus of the SLWRI.

- To date, species-specific survey efforts as part of the SLWRI have only included focused investigations for a number of special-status species in the inundation and relocation areas. Additional surveys and analysis to refine effects on biological resources within the study area are anticipated before completion of the SLWRI feasibility study.

- Reclamation will continue to coordinate SLWRI activities with other relevant ongoing projects and programs, including BDCP and the RPAs in the OCAP reconsultation process. It is anticipated that the final RPAs will include actions such as fish passage and operational changes at Shasta Dam that would affect or be affected by the SLWRI comprehensive plans.

Selection of Proposed Plan/Preferred Alternative

At this stage of the Federal planning and NEPA processes, the potential effects of alternative plans have been evaluated and compared based on established criteria, and an 18.5-foot raise of Shasta Dam has been identified as the preliminary proposed plan. However, due to uncertainties affecting CVP/SWP operational constraints, operational parameters of the preliminary propose plan have not been specified. At this stage in the planning process, neither a preferred alternative nor an environmentally preferable alternative has been identified in the Preliminary Draft EIS. It is recognized that further refinement and changes may occur to the comprehensive plans after additional operational analyses considering changes in CVP/SWP operational conditions, and input from agencies, stakeholders, and public.

Implementation Requirements

After the feasibility study is completed and a plan has been identified for implementation, a number of requirements will remain before the project can be implemented. These requirements are described below.

Feasibility Report Approval

Reclamation's Final Feasibility Report will be submitted by the Commissioner of Reclamation to the Secretary of the Interior. The Secretary may accept or revise the Final Feasibility Report. After review by the Office of Management and Budget, in accordance with Executive Order 12322, the Secretary will transmit a Final Feasibility Report, FEIS, and ROD to the U.S. Congress to determine the type and extent of Federal interest in enlarging Shasta Dam and Reservoir if a plan is recommended for implementation.

Project Authorization and Funding

The proposed project would be considered for authorization by Congress and, if authorized, a separate appropriation authorization would be required. The project would be considered for inclusion in the President's budget based on (1) national priorities, (2) magnitude of the Federal commitment, (3) level of local support, (4) willingness of the non-Federal sponsor to fund its share of the project costs, and (5) budgetary constraints that may exist at the time of construction.

Regulatory and Related Requirements for Environmental Compliance

Potential modifications to Shasta Dam and Reservoir would be subject to the requirements of Federal, State, and local laws, policies, and environmental regulations, as described in this Draft Feasibility Report and accompanying Preliminary Draft EIS. Reclamation would need to obtain various permits and regulatory authorizations before any project construction could begin. In addition to NEPA requirements, major permits and approvals potentially required for project implementation are shown in Table 5-5. These would be in addition to compliance with a number of environmental regulatory requirements as part of the NEPA process.

Table 5-5. Summary of Major Permits and Approvals for Project Implementation

Agency Permit/Approval	Recommended Prerequisites for Submittal[1]	Estimated Processing Time[2]	Anticipated Fees
Federal			
USACE Clean Water Act Section 404	• Application • ESA compliance document for submittal to USFWS/NMFS/DFG • Section 401 Water Quality Certification permit or application • NEPA documentation (environmental compliance documents) • Section 106 compliance documentation • Wetland delineation • Section 404 (b)(1) evaluation and identification of the Least Environmentally Damaging Practical Alternative • Mitigation and monitoring plan	24 months	$100 for Individual permit
USFWS/NMFS Endangered Species Act Section 7 Consultation	• Regular informal technical consultation • ESA compliance document • Draft environmental compliance documents	12 months	None
USFWS/NMFS/DFG Fish and Wildlife Coordination Act	• Regular Informal technical consultation • ESA compliance document • Draft environmental compliance documents	12 months	None
SHPO[3]/ACHP National Historic Preservation Act, Section 106	• Historic Property Inventory Report • Native American consultation	24 months	None

Table 5-5. Summary of Major Permits and Approvals for Project Implementation (contd.)

Agency Permit /Approval	Recommended Prerequisites for Submittal[1]	Estimated Processing Time[2]	Anticipated Fees
State – PRC 5093.542 (c) and (d), pertaining to the McCloud River, may limit the ability of State agencies to review and process permits and related approvals for modifications of Shasta Dam and Reservoir.			
RWQCB Clean Water Act Section 401	• Application • Fish and Game Code Section 1602 application • CWA Section 404 permit or application • Draft environmental compliance documents • Mitigation and monitoring plan (if needed)	6 months	$500+
DFG California Endangered Species Act Section 2081— Incidental Take Permit or 2080.1 Consistency Determination	• Informal technical consultation • Application, if requesting a 2081 Incidental Take Permit • Biological opinion and incidental take statement, if requesting a consistency determination (preferred approach)	6 months after Biological Opinions issued	None
DFG Fish and Game Code Section 1600 Streambed Alteration Agreement	• Application • Section 401 Water Quality Certification permit or application • CWA Section 404 permit or application • Draft environmental compliance documents • Mitigation plan	9 months	$4,000
Central Valley Flood Protection Board California Code, Title 23: Encroachment Permit	• Application	9 months	None
SWRCB Amended Water Right	• Application • Draft (possibly final) environmental compliance documents	12 months	$440,000
State Lands Commission Land Use Lease	• Application • Draft environmental compliance documents	9 months	$25
State of California Department of Transportation Encroachment Permit	• Application • Permit Engineering Evaluation Report	60 days	None
Local			
SCAQMD Authority to Construct and Permit to Operate	• Application • Preapplication meeting (encouraged)	6 months	$75

Notes:
[1] All permit applications require detailed project description information.
[2] Anticipated processing time is estimated based on submittal of initial permit applications to permit issuance.
[3] PRC 5093.542 (c) and (d), pertaining to the McCloud River, may limit the ability of State agencies to review and process permits and related approvals for modifications of Shasta Dam and Reservoir.

Key:
ACHP = Advisory Council on Historic Preservation
CWA = Clean Water Act
DFG = California Department of Fish and Game
ESA = Endangered Species Act
NEPA = National Environmental Policy Act
NMFS = National Marine Fisheries Service
PRC = Public Resources Code
RWQCB = Regional Water Quality Control Board
SCAQMD = Shasta County Air Quality Management District
SHPO = State Historic Preservation Officer
State = State of California
SWRCB = State Water Resources Control Board
USACE = U.S. Army Corps of Engineers
USFWS = U.S. Fish and Wildlife Service

In addition to the major Federal, State, and local environmental requirements detailed in Table 5-5, the proposed plan considered may be subject to other laws, policies, or plans. Table 5-6 summarizes other laws, policies, and plans that may potentially affect the development of any comprehensive plan.

Two important examples of laws, policies, and plans not directly relating to typical environmental compliance and coordination activities include the *Whiskeytown-Shasta-Trinity NRA Management Guide* (USFS 1996) and STNF LRMP (USFS 1995). These plans prescribe management practices for much of the Shasta Lake area and are important in formulating and evaluating comprehensive plans for the SLWRI. Shasta Lake is located within the Whiskeytown-Shasta-Trinity NRA, which consists of the Shasta and Trinity units (managed by USFS) and the Whiskeytown Unit (managed by the National Park Service). The *Whiskeytown-Shasta-Trinity NRA Management Guide* (USFS 1996) addresses management of resources, changes in technology, and recreation trends in the Shasta-Trinity National Forest and vicinity and is subject to the STNF LRMP. It contains USFS goals and objectives, USFS standards and guidelines, management prescriptions to be applied to land areas, and management area direction.

Table 5-6. Summary of Applicable Laws, Policies, Plans, and Permits Potentially Required

Level	Laws, Policies, Plans, and Permits
Federal	Federal Endangered Species Act
	Section 404 of the Clean Water Act
	Rivers and Harbors Act Section 10
	National Historic Preservation Act, Section 106 (1966)
	Migratory Bird Treaty Act
	Fish and Wildlife Coordination Act
	Executive Orders 11990 (Wetlands Policy), 11988 (Flood Hazard Policy), and 12898 (Environmental Justice Policy)
	Indian Trust Assets
	Americans with Disabilities Act
	Rehabilitation Act
	Farmland Protection Policy
	Federal Transit Administration Activities and Programs
	Essential Fish Habitat
	Architectural Barriers Act
	Federal Cave Resources Protection Act (1988)
	Executive Order 11312 (National Invasive Species Management Plan)
	Magnuson-Stevens Fishery Conservation and Management Act
	National Wild and Scenic Rivers System
	Federal Land Use Policies
	Federal Water Project Recreation Act
	Whiskeytown-Shasta-Trinity National Recreation Area Management Guide
	Whiskeytown-Shasta-Trinity National Recreation Act
	Shasta-Trinity National Forest Management Plan
	Federal Energy Regulatory Commission Permitting Requirements
	U.S. Army Corps of Engineers – Shasta Dam and Reservoir Regulation Requirements
	U.S. Coast Guard Activities and Programs
	Uniform Relocations Assistance and Real Properties Acquisition Act of 1970, as amended (Public Law 91-646 and Public Law 100-17)

Table 5-6. Summary of Applicable Laws, Policies, Plans, and Permits Potentially Required (contd.)

Level	Laws, Policies, and Plans
State	California Public Resources Code
	Clean Water Act Section 401
	California Endangered Species Act
	California Fish and Game Code – Fully Protected Species
	California Fish and Game Code Section 1600 – Streambed Alteration
	Porter-Cologne Water Quality Control Act
	California Native Plant Society Species Designations
	Reclamation Board Encroachment Permit
	California Water Rights
	State Lands Commission Land Use Lease
	State of California General Plan Guidelines
	California Department of Transportation Encroachment Permit and Activities, Programs
	California Land Conservation Act of 1965 (Williamson Act)
	California Native Plant Protection Act
	California Department of Boating Activities and Programs
	California Scenic Highway Program
	California Wild and Scenic Rivers Act
Local	Shasta County Air Quality Management District Authority to Construct and Permit to Operate
	Shasta County Building Division Grading Permit
	Shasta County Zone Plan
	Shasta County Department of Public Works Encroachment Permit
	Shasta County General Plan
	Other Local Permits and Requirements

Advanced Planning and Design Activities

In addition to the environmental compliance efforts described above, other significant advanced planning and design activities would be required before implementation of the project. Several key activities include the following:

- Develop a Definite Plan Report and associated advanced planning studies, including preparing detailed plans, specifications, and bid packages
- Establish agreements for reimbursable project purposes, including repayment contracts
- Develop and/or revise operations, maintenance, and related plans
- Acquire required lands

Federal and Non-Federal Responsibilities

If the proposed plan is recommended for implementation, Federal and non-Federal obligations and requirements would be contained in a Project Cooperation Agreement (PCA).

Federal Responsibilities

If recommended for implementation, Reclamation and/or future project partners or beneficiaries would perform preconstruction and design studies for the recommended plan, which may require updated economic and/or environmental analyses and documentation. After PCAs are signed and non-Federal sponsors have provided any required financial contributions and assurances, the Federal Government would acquire real estate and/or relocate displaced parties according to Public Law 91-646 and construct the project modifications and related mitigation requirements. Reclamation and other Federal agencies (e.g., USFS) would be responsible for various O&M activities, as shown in Table 5-7.

Table 5-7. Potential Federal and Non-Federal Responsibilities for Various Project Component O&M

Facility	Responsibility
Shasta Dam and Powerplant	Reclamation
Reservoir Area Dikes	Reclamation
Railroad Bridges and Embankments	UPRR
Road Relocations (USFS facilities)	USFS
Road Relocation (Shasta County facilities)	Shasta County
Vehicular Bridges (Shasta County facilities)	Shasta County
Pit River Bridge Protection	Caltrans
Recreation Facilities (USFS facilities)	USFS
Pit 7 Dam Modifications	PG&E
Utilities	Various Non-Federal

Key:
Caltrans = California Department of Transportation
O&M = operations and maintenance
PG&E = Pacific Gas and Electric Company
Reclamation = U.S. Department of the Interior, Bureau of Reclamation
UPRR = Union Pacific Railroad
USFS = U.S. Forest Service

Non-Federal Responsibilities

Before implementation, the non-Federal sponsor(s) for both reimbursable and nonreimbursable costs would agree to perform items of local and state cooperation specific to the authorized purposes of the project. A non-Federal sponsor needs to be identified for each of the reimbursable project purposes. For most and possibly all of the reimbursable purposes, the non-Federal sponsor would need to share in the cost of the recommended plan.

Timeline and Status of Feasibility Study

Table 5-8 summarizes major activities that have either occurred, or are planned to occur, as a part of the SLWRI feasibility study. A timeline of major actions to complete the feasibility study and future milestones leading to project implementation are shown in Figure 5-2. If congressional authorization occurs, detailed project designs and any necessary real estate acquisitions could be

initiated, and project construction could begin approximately 2 years later. The initial phase of construction would include acquiring any necessary real estate interests and/or relocating displaced parties according to Public Law 91-646, acquiring necessary permits, continuing detailed design work, and relocating infrastructure. Construction activities would likely span 4 or more years.

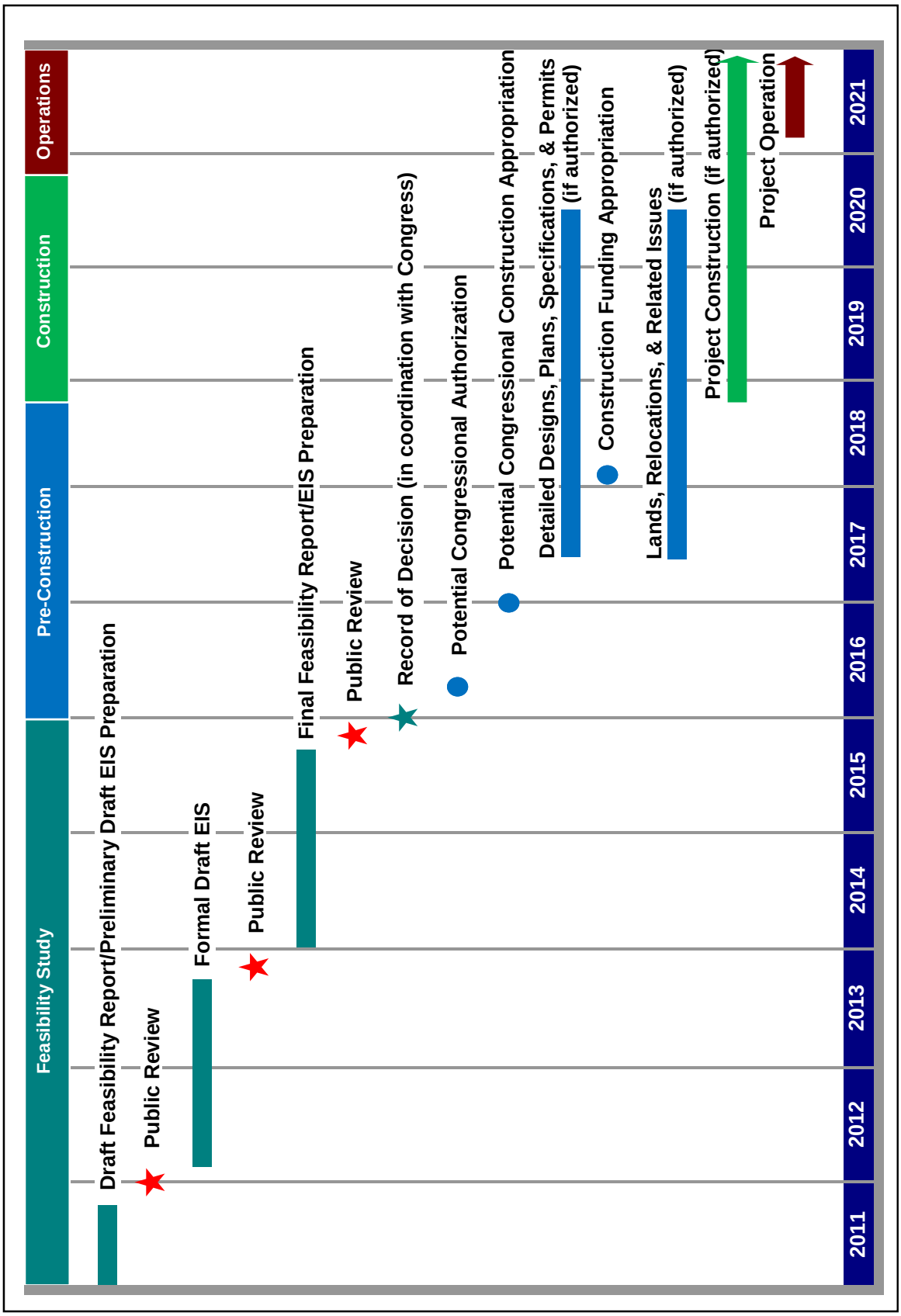
Table 5-8. Timeline and Status of Feasibility Study

Activity	Description
Completed and On-going Activities	
Appraisal Assessment for the Potential Enlargement of Shasta Dam and Reservoir	This appraisal-level study analyzes the range of enlargement options for the dam and reservoir and the potential costs. Report issued May 1999.
Feasibility Study Reinitiation	Based on the results of the Appraisal Assessment and completion of the CALFED ROD in 2000, Reclamation reinitiates feasibility-scope studies in mid-2000 on the potential to enlarge Shasta Dam and Reservoir.
Feasibility Investigation Plan Formulation Strategy Summary	This report outlines four phases of the plan formulation process, the various decision documents, and the subsequent Draft and Final Feasibility Reports. Report issued July 2002.
Shasta Reservoir Area Inventory	The primary purpose of this report is to identify major infrastructure that may be subject to modification or relocation if Shasta Dam were raised up to 30 feet. Report issued February 2003.
Mission Statement Milestone Report	As first of the four Plan Formulation Phase reports, this report describes existing and future conditions, problems, needs, and opportunities, project objectives and planning considerations, and baseline technical information, and develops a mission statement to guide the study process. Report issued March 2003.
Office Report: Breakpoint Analysis	This office report primarily describes results of an analysis to identify dam raise elevations for which project costs significantly change because of the need for relocation or modification of major project features. (Report issued June 2003)
Office Report: Ecosystem Restoration Opportunities in the Upper Sacramento River Region	This report highlights existing environmental conditions and problems, ongoing conservation and environmental restoration programs in the study area, potential ecosystem restoration opportunities, and potential ecosystem restoration plan components for consideration in future planning efforts. Report issued November 2003.
Initial Alternatives Information Report	As second of the four Plan Formulation Phase reports, this report describes the formulation of initial alternatives to address planning objectives of the SLWRI. (Report issued June 2004)
SLWRI Notice of Intent	Pursuant to the National Environmental Policy Act, Reclamation issues a Notice of Intent to prepare an EIS for the SLWRI. Published in the Federal Register Oct. 7, 2005.
Environmental Scoping Report	This document reports on comments from, responses to, and results from, a series of public scoping meetings held throughout California for the SLWRI. Report issued February 2006.
Plan Formulation Report	As third of the four Plan Formulation Phase reports, this report outlines the formulation, comparison, and evaluation of comprehensive alternative plans that address SLWRI planning objectives. Report issued December 2007.
Draft Feasibility Report and Accompanying Preliminary Draft EIS	The Draft Feasibility Report includes a Federal decision document and environmental compliance documentation by reference. The report will describe the study process, major results, preliminary proposed plan, Federal/non-Federal responsibilities and sponsorship, and future actions.

Table 5-8. Timeline and Status of Feasibility Study (contd.)

Activity	Description
Future Activities	
Draft EIS and Related Documents	The Draft EIS and related documents will be circulated for public review and comment. These documents will reflect updated water operations modeling and analyses.
Washington D.C.-level Review and Processing	The Final Feasibility Report, FEIS, and ROD will be reviewed and processed within the Department of the Interior and the President's Office of Management and Budget prior to public release.
Final Feasibility Report and Accompanying FEIS	Following public and agency review, the Final Feasibility Report will incorporate responses to comments made on the draft report and include a plan recommended for implementation.
Record of Decision	Reclamation staff will issue a ROD for the SLWRI, which will identify the Recommended Plan, identify alternatives considered, including the environmentally preferable alternative; and describe mitigation plans, including any enforcement and monitoring commitments.
Congressional Authorization	Congress will review and vote on whether to authorize the project. Legislation containing construction authorization would be sent to the President for approval.

Key:
CALFED = CALFED Bay-Delta Program
EIS = Environmental Impact Statement
FEIS = Final Environmental Impact Statement
Reclamation = U.S. Department of the Interior, Bureau of Reclamation
ROD = Record of Decision
SLWRI = Shasta Lake Water Resources Investigation



Note: Subject to refinement/change during remainder of feasibility study.

Figure 5-2. Shasta Lake Water Resources Investigation Project Timeline

Chapter 6
Coordination and Public Involvement

Efforts to engage the public, stakeholders, Federally recognized tribes, Native American tribal groups, and public agencies continue to play an important role in the SLWRI. These efforts are guided by the *Strategic Agency and Public Involvement Plan* (Reclamation 2003a), and include a broad range of activities designed to accomplish official and supplementary outreach goals.

In addition to ongoing public and stakeholder outreach, the Project Coordination Team (PCT) continues to facilitate participation by the SLWRI's numerous cooperating agencies.

This chapter describes the outreach and coordination approach for the SLWRI, progress of the investigation in executing the public involvement plan, and continuing PCT activities throughout the investigation in coordinating with stakeholders, Federally recognized tribes, Native American tribal groups, and cooperating agencies. Cooperating agencies for the SLWRI, pursuant to NEPA, include USFS, Colusa Indian Community Council of the Cachil Dehe Band of Wintu Indians, USACE, and U.S. Bureau of Indian Affairs.

Strategic Agency and Public Involvement Plan

The *Strategic Agency and Public Involvement Plan* (Reclamation 2003a) was designed to help the PCT effectively communicate with individuals, groups, and agencies that are affected by, or could benefit from, enlarging or modifying Shasta Dam and Reservoir. While the document is updated periodically to reflect the needs and objectives of the investigation, its critical components are compliance with the requirements of NEPA, Executive Order 12898 (Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations), and President Clinton's memorandum regarding the engagement of Federally recognized tribal governments (*Presidential Memorandum for the Heads of Executive Departments and Agencies, Subject: Government-to-Government Relations with Native American Tribal Governments*, published in the *Federal Register*, Vol. 59, No. 85, April 29, 1994).

The four objectives of the *Strategic Agency and Public Involvement Plan* are as follows:

- **Stakeholder Identification** – Identifying and involving individuals, groups, and other entities that have an expressed or implied interest in the SLWRI.

- **Project Transparency** – Informing stakeholders and the public of study results in a timely, unbiased fashion through a variety of methods, including stakeholder and/or public meetings, Web postings, and mailings.

- **Issues and Concerns Resolution** – Gaining awareness of the issues and concerns of stakeholders and the public early in the process, and responding to these issues in an effective and timely manner.

- **Project Implementation** – Assisting policy-makers in understanding project purposes and benefits, and demonstrating that the project has met all necessary requirements to be implemented.

The plan has two primary themes, outreach and information, as discussed in the following sections.

Outreach

The *Strategic Agency and Public Involvement Plan* has five main outreach elements to assist in coordinating SLWRI efforts: (1) stakeholder and public meetings and workshops, (2) tribal coordination, (3) environmental justice, (4) Technical Working Group (TWG) coordination, and (5) PCT and Study Management Team (SMT) activities. Outreach elements are described as follows:

- **Stakeholder/Public Meetings/Workshops** – Stakeholder and public meetings and workshops are important not only to enable the overall SLWRI to satisfy the public involvement requirements of NEPA and CEQA, but to afford stakeholders and the public the opportunity to effectively participate in development of the investigation. Specific outreach activities oriented toward stakeholders and the public are discussed later in this chapter.

- **Tribal Coordination** –The plan describes the intent of the SLWRI to consult with Federally recognized tribal governments, and outlines the investigation's overall strategy for communicating with Federally recognized tribes and Native American tribal groups. Specific outreach activities oriented toward tribal groups are discussed later in this chapter.

- **Environmental Justice** – Consistent with Executive Order 12898 (Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations), Reclamation has actively engaged minority populations and low-income populations in planning and developing the SLWRI. Outreach efforts for this component

mirrored outreach efforts developed under the plan, and were modified to meet any specific communication needs necessary to effectively communicate with minority populations.

- **Technical Working Groups** – The TWGs provided critical support in defining and clarifying comprehensive alternative plans. Resource areas of importance include water supply reliability, ecosystems and ecosystem restoration and enhancement, water marketing and exchange, water policy and legislation, local land and property rights, regional economic impacts, environmental justice, and recreation.

- **Project Coordination Team and Study Management Team Activities** – The PCT includes the Reclamation Project Manager and technical experts from various disciplines and organizations, while the SMT comprises key policy and decision makers with direct influence over policy guidance for the study. The SMT provides overall guidance, suggestions, and comments for the study, representing viewpoints from all participating agencies.

Information Dissemination

For project transparency and to inform stakeholders and the public, study-related information was disseminated in a number of ways:

- **Project Updates** – Project update notices were developed at major study milestones to keep stakeholders advised of the SLWRI status. The purpose of the updates was to inform stakeholders and the public of study progress and alert them to major upcoming events.

- **Project Information Papers** – Two project information papers have been prepared. One supported outreach efforts for the 2003 *Mission Statement Milestone Report* (Reclamation 2003b) and the second was released in summer 2004 to support the *Initial Alternatives Information Report* (Reclamation 2004a).

- **Web Site** – A comprehensive project Web site was created to provide information about stakeholder functions and project information, and includes a project photo tour, project calendar, project contact database, and stakeholder response forms. The address of the Web site is www.usbr.gov/mp/slwri (Reclamation 2011c).

- **Media Relations** – Media relations for the SLWRI have included news releases, media advisories, calendar advisories, editorial board visits, letters to the editor, and opinions/editorials. The media relations effort is flexible to facilitate prompt responses to comments, questions, or information regarding the study.

- **Stakeholder and Agency Briefings** – The SLWRI has employed speakers from the PCT at the request of stakeholder groups and

agencies to present information on study topics of interest. Numerous presentations have been made by the Reclamation Project Manager and others to date on various topics, including presentations to the California Water Commission in 2010 and 2011. The stakeholder briefing program will continue to serve as an outreach mechanism for disseminating information and gathering comments and providing responses.

Agency Coordination

The SLWRI study management structure includes the active participation of numerous cooperating agencies and other stakeholders, involving representatives from resources agencies in the PCT, SMT, and TWGs. Cooperating agencies for the SLWRI, pursuant to NEPA, include USFS, Colusa Indian Community Council of the Cachil Dehe Band of Wintu Indians, USACE, and U.S. Bureau of Indian Affairs. Other participants in the PCT include USFWS, NMFS, U.S. Bureau of Land Management, DWR, DFG, and other Federal and State agencies.

These groups were active contributors to development and/or review of the comprehensive plans. Key elements of these coordination activities are the *Planning Aid Memorandum* and *Coordination Act Report*, documents to be issued by USFWS. A draft *Planning Aid Memorandum* outlining areas of potential concern was circulated among the resource agencies in the first quarter of 2007. Development of the *Coordination Act Report* began in summer 2007, with circulation of a draft in 2008.

Stakeholder Outreach

Meetings and workshops with the stakeholder community play a major role in the SLWRI's overall study process. Each meeting or workshop has been scheduled at critical milestones of the investigation. However, between milestones, the PCT continues to conduct numerous focused meetings and presentations aimed at maintaining frequent stakeholder communication regarding study status, results to date, and direction.

Initial Stakeholder Engagement

One of the SLWRI's consistent activities is to conduct stakeholder briefings at various intervals during the investigation with groups ranging from governmental agencies to nongovernmental groups and coalitions.

Early in the SLWRI's development, a series of meetings was held with stakeholders and the public to provide information on the SLWRI and to support the completion and release of two documents: the *Mission Statement*

Milestone Report (Reclamation 2003b) and the *Initial Alternatives Information Report* (Reclamation 2004a).

In fall 2003, six TWG and tribal briefings were held:

- **Congressional Briefing** – This briefing was held on October 15, 2003, at the State Capitol Building in Sacramento, and focused on providing Federal and State legislators and their aides information about the SLWRI and its direction.

- **Local Elected Officials Briefing** – This briefing was held on October 16, 2003, in Redding and focused on providing information about the study to State, local, city, and county government representatives of Northern California.

- **Tribal Briefing** – This briefing was held on October 17, 2003, also in Redding, and focused on providing study information to representatives from local tribes.

- **Immediate Study Area Interests Briefing** – This briefing was held on October 22, 2003, at Shasta Lake. The goal of the meeting was to inform individuals, businesses, and groups around Shasta Lake about the study and its direction.

- **Water and Hydropower Interests Briefing** – This briefing was held on October 24, 2003, at the Reclamation office in Sacramento and focused on describing the SLWRI to representatives of water and hydropower interests.

- **Environmental Interests Briefing** – This briefing was held on November 5, 2004, in Willows with representatives from various Federal, State, and local environmental groups to inform them about the SLWRI feasibility study and future efforts.

Additionally, two stakeholder workshops were held to discuss results of SLWRI studies to date at that time, and gain input for future study efforts:

- **Workshop 1** – Held December 11, 2003, at the Red Bluff Community Center. The workshop presented information about the purpose and objectives of the SLWRI, status and current activities; identified water resources related problems and needs; and potential solutions to those problems. The workshop was also used to elicit input on management measures and review future actions and the SLWRI schedule.

- **Workshop 2** – Held August 11, 2004, at the Redding Convention Center. The primary purpose of the workshop was to coordinate with

stakeholders on the status of the investigation, initial alternatives being considered, and next steps in the feasibility study.

Environmental Scoping

Scoping allows agencies, stakeholders, and interested parties the opportunity to identify or suggest resources to be evaluated, issues that may require environmental review, reasonable alternatives to consider, and potential mitigation if significant adverse effects of a planned action are identified.

Consistent with NEPA, Reclamation completed scoping for the SLWRI feasibility study in fall 2005, with public scoping meetings held in Sacramento, Fresno, Los Angeles, Concord, Dunsmuir, Redding, and Red Bluff during October and November. The resulting *Environmental Scoping Report* (Reclamation 2006) describes the scoping process, comments received during scoping, and how these comments would be addressed.

More detailed information on the environmental scoping process is provided in Chapter 27 of the Preliminary Draft EIS.

Ongoing Stakeholder and Agency Briefings

Outreach for the SLWRI has employed speakers from the PCT, including the Reclamation Project Manager, at the request of agencies and stakeholder groups to present information on study topics of interest. The purpose of the briefings is to update stakeholders on completed analyses and evaluations, upcoming efforts and studies, and overall project status and schedule. This briefings program also serves as a mechanism for gathering comments and providing responses to interested parties.

Continued Coordination with Tribal Governments and Native American Tribal Groups

Regular engagement and consultations with California's tribal governments and Native American tribal groups is a vital component of the SLWRI. The investigation continues to seek active participation from and communicate with Federally recognized tribes and other Native American tribal groups. Tribal outreach efforts will mirror outreach efforts developed under the *Strategic Agency and Public Involvement Plan* (Reclamation 2003a).

Tribal Government Coordination

Consistent with a memorandum from the President on April 29, 1994, Reclamation will actively engage Federally recognized tribal governments in planning and developing the investigation, and will consult with each tribe on a government-to-government basis before taking actions that could affect such tribal governments. Under Federal Trust responsibility, Reclamation will provide full disclosure (benefits and negative impacts) of the project, allow time

for tribal review/consultation, and receive comments and/or suggestions for alternatives.

The PCT held several coordination meetings with Federally recognized tribes during 2007 and 2008. Tribes were invited to an informal meeting held on April 4, 2007, in Redding, California. The purpose of the meeting was to provide the tribes with general information about the SLWRI, and to determine tribal participation interests. Additionally, from August 2007 to November 2008, members of the PCT held six separate meetings with four Federally recognized tribes whose traditional territories overlap the SLWRI project area. The meetings were held to solicit, clarify, and document major concerns and issues regarding the SLWRI, and to establish a preferred method or approach for maintaining effective communication with each tribe during the remainder of the feasibility study and in future endeavors.

Native American Outreach

In accordance with Executive Order 12898, Native Americans — including Federally recognized and non-Federally recognized tribes — are considered minority populations, and are included as stakeholder groups. Several groups, such as the Winnemem Wintu and Shasta Nation, have expressed significant interest in the SLWRI. In response, the PCT conducted 10 meetings and dialogues in 2007 and 2008 with Native American groups whose traditional homelands overlap the SLWRI study area; four of these meetings engaged non-Federally recognized tribes. Groups were invited to the April 4, 2007, informal meeting to receive general information about the SLWRI and to identify their interests for project participation. As with Federally recognized tribes, the meetings held with Native American groups were to solicit, clarify, and document major concerns and issues regarding the SLWRI, and to establish each group's preferred method or approach for receiving communications about the SLWRI during the remainder of the study.

Public and Agency Review and Comment

Public and agency outreach and involvement in the SLWRI for this Draft Feasibility Report, the Preliminary Draft EIS, and their Appendices will include stakeholder workshops to brief attendees on key findings.

Once the Draft EIS is available, a NEPA Notice of Availability will be published by the U.S. Environmental Protection Agency, and formal public hearings will be held at that time to receive comments. The Feasibility Report and EIS will be finalized considering responses to public and agency comments.

Major Topics of Interest

The public, stakeholders, other Federal agencies, and State and local agencies identified several areas of concern during SLWRI meetings and workshops. The focus of interest varied among participants in the outreach activities, but a

common theme centered on potential impacts in the Shasta Lake area that could result from enlarging the dam and reservoir. Key topics of concern include potential adverse effects on cultural resources in the Shasta Lake area; recreation and recreation providers in the Whiskeytown-Shasta-Trinity NRA; special-status species around Shasta Lake, including terrestrial State-designated fully protected species and aquatic special-status species in the Sacramento River and Delta (including delta smelt); the lower McCloud River and its special designation under California PRC Section 5093.542; Delta water quality; south Delta water levels; potential effects on Central Valley hydrology below CVP and SWP facilities and resulting effects on water supplies for water contractors and other water users; and consistency with the CALFED ROD (CALFED 2000a). These topics are described in more detail in Section 1.6 of the Preliminary Draft EIS, “Areas of Controversy/Issues to Be Resolved.”

Chapter 7
Findings

The SLWRI is a feasibility study being conducted by Reclamation and includes development, evaluation, and comparison of alternatives consistent with the Federal P&G (WRC 1983). In coordination with this Draft Feasibility Report, a Preliminary Draft EIS is being prepared consistent with the NEPA. This chapter summarizes plan formulation and major findings of the Draft Feasibility Report.

Summary of Plan Formulation

A compelling need exists to implement actions to help increase survival of anadromous fish populations in the upper Sacramento River. In addition, demands for water in the Central Valley and elsewhere in the State of California exceed available supplies; this condition is expected to become more pronounced in the future. Developing projects to increase the reliability of water supplies for agricultural, M&I, and environmental purposes is necessary to meet future demands.

On the basis of identified water resources problems, needs, and opportunities, study authorities, and other pertinent direction, including information contained in the August 2000 CALFED ROD (CALFED 2000a), two primary and five secondary planning objectives were developed for the SLWRI:

- **Primary Planning Objectives**
  - Increase the survival of anadromous fish populations in the Sacramento River, primarily upstream from the RBDD.
  - Increase water supply and water supply reliability for agricultural, M&I, and environmental purposes to help meet current and future water demands, with a focus on enlarging Shasta Dam and Reservoir.
- **Secondary Planning 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.

Initial Federal planning phases of the SLWRI were documented in the 2003 *Mission Statement Milestone Report* (Reclamation 2003b), 2004 *Initial Alternatives Information Report* (Reclamation 2004a), the 2006 *Environmental Scoping Report* (Reclamation 2006), and the 2007 *Plan Formulation Report* (Reclamation 2007a). Based on the above planning objectives, coordination among study team members, and review of comments received during the public scoping process, five comprehensive plans were formulated for the SLWRI:

- **CP1 –** Increased water supply reliability and increased anadromous fish survival, with some benefits to other resources through a 6.5-foot raise of Shasta Dam and 256,000-acre-foot enlargement of Shasta Reservoir.

- **CP2 –** Increased water supply reliability and increased anadromous fish survival, with some benefits to other resources through a 12.5-foot raise of Shasta Dam and 443,000-acre-foot enlargement of Shasta Reservoir.

- **CP3** – Increased water supply reliability and increased anadromous fish survival, with some benefits to other resources through an 18.5-foot raise of Shasta Dam and 634,000-acre-foot enlargement of Shasta Reservoir.

- **CP4 –** Focus on increased anadromous fish survival, while increasing water supply reliability and providing some benefits to other resources through an 18.5-foot raise of Shasta Dam and 634,000-acre-foot enlargement of Shasta Reservoir.

- **CP5 –** Combined plan similar to CP3 that includes features for ecosystem restoration, and additional recreation facilities around Shasta Reservoir through an 18.5-foot raise of Shasta Dam and 634,000-acre-foot enlargement of Shasta Reservoir.

Findings

This section summarizes major findings of this feasibility study related to the four accounts established in the P&G (WRC 1983) (NED, RED, EQ, and OSE), as well as evaluations of the technical, environmental, economic, and financial feasibility of the preliminary proposed plan.

NED Account

The objective of NED analysis is to determine the change in net value of the Nation's output of goods and services that would result from implementing each comprehensive plan. The NED account is the only required account under the P&G (WRC 1983). For this analysis, the NED account would include agriculture, M&I water supply, hydropower, and recreation, as well as the other direct benefits category for anadromous fish survival. Findings of this Draft Feasibility Report as they relate to the NED are summarized below.

Total Estimated Construction Costs of Alternatives

Total estimated construction costs for the five comprehensive plans are shown in Table 7-1.

Table 7-1. Total Estimated Construction and Annual Costs for Comprehensive Plans ($ millions)

Item	CP1	CP2	CP3	CP4	CP5
Estimated Construction Cost	827	913	1,064	1,070	1,073
Annual Cost	42.6	46.4	53.7	54.0	54.1

Key:
CP = comprehensive plan

NED Benefits

The comprehensive plans would contribute to a wide range of anadromous fish survival, agricultural and M&I water supply reliability, recreation, and hydropower benefits that would vary in magnitude with each plan. Benefits for ecosystem restoration, flood damage reduction, and water quality were not monetized and are not included in NED benefits estimates. Total estimated annual benefits and annual net benefits for the five comprehensive plans are shown in Table 7-2. Four of the five comprehensive plans, CP1, CP3, CP4, and CP5, provide positive NED benefits. CP4 is estimated to provide the greatest net benefits.

Table 7-2. Total and Net Estimated Benefits for Comprehensive Plans ($ millions)

Item	CP1	CP2	CP3	CP4	CP5
Total Estimated Benefits	47.6	43.7	65.4	92.2	65.5
Annual Net Benefits	5.0	(2.7)	11.7	38.2	11.4

Key:
CP = comprehensive plan

Other Principles and Guidelines Accounts

The P&G RED, EQ, and OSE accounts are not estimated to have a material bearing on the plan selection process for the SLWRI.

Federal Interest

For an action to be implementable, there must be a Federal interest in the action and the action must be feasible, as defined by the P&G. Federal actions must contribute to the NED under the P&G. All of the comprehensive plans except CP2 provide positive NED benefits.

Feasibility of Preliminary Proposed Plan

Based on analyses and evaluations to date in accordance with the Federal planning and NEPA processes, an 18.5-foot raise of Shasta Dam has been identified as the preliminary proposed plan. However, CVP/SWP operational constraints, including those affecting operations at Shasta Dam and Reservoir, are uncertain, with current and future constraints governing water operations likely to change, primarily due to the ongoing OCAP reconsultation. Because of these uncertainties, operations are still being refined based on updates to modeling studies and input from agencies, stakeholders, and the public. Major components, benefits, and effects of the preliminary proposed plan would be similar to CP3, CP4, and CP5, but it is recognized that changes may occur to the comprehensive plans with changes in water operations and other relevant water resources projects and programs, including, potentially, BDCP/DHCCP efforts.

Evaluations of the technical, environmental, and economic feasibility of the preliminary proposed plan are based on evaluations of CP3, CP4, and CP5. For the purpose of illustrating financial feasibility, CP4 is used as an example to characterize cost allocation, cost assignment, and ability to pay analysis of the preliminary proposed plan. As discussed above, further refinements to the measures and comprehensive plans are expected after additional water operations and related analyses.

Technical Feasibility

The preliminary proposed plan is projected to be technically feasible, constructable, and can be operated and maintained. Designs and cost estimates for raising Shasta Dam by 18.5 feet have been developed to a feasibility level through a DEC Review performed by Reclamation in August 2008 for all of the 18.5-foot dam raise options (CP3, CP4, and CP5). Based on recommendations

from the DEC Review, designs and costs were refined to bring all features to a feasibility level.

Environmental Feasibility

All of the comprehensive plans are included in the SLWRI Preliminary Draft EIS. Environmental effects were evaluated and mitigation measures for each of the comprehensive plans were identified. An Environmentally Preferable Alternative, consistent with NEPA, will be identified in the Final Feasibility Report and FEIS. At this stage in the planning process, an Environmentally Preferable Alternative has not been identified in the Preliminary Draft EIS. Based on current CVP/SWP operational assumptions and studies to date, CP4 appears to provide the greatest environmental benefits; however, it is recognized that further refinement and changes may occur to this and other alternatives based on additional analyses and input from agencies, stakeholders, and the public.

Economic Feasibility

Based on evaluations of CP3, CP4, and CP5, the preliminary proposed plan is projected to be economically feasible, and would generate net positive NED benefits ranging from $11.4 million to $38.2 million annually. At this time, based on analyses to date, operations under CP4 would provide the greatest net NED benefits of the alternatives evaluated.

Financial Feasibility

Based on analysis to date, CP4 provides the greatest net NED benefits. For this reason, CP4 is used as an example in the following subsections to characterize the financial feasibility of the preliminary proposed plan. Table 7-3 illustrates assignment of costs of the preliminary proposed plan using CP4 as an example. As shown for the example plan, of the allocated costs, approximately 61 percent are estimated to be nonreimbursable and approximately 39 would be reimbursable.

Based on costs allocated to various project purposes, an assessment of financial repayment capability of project beneficiaries was conducted for two repayment approaches. For irrigation water supply, the marginal increase to CVP water rates is estimated to be either $1.77 or $140 per acre-foot, depending upon the approach. For M&I water supply, the marginal increase to CVP water rates is estimated to be either $51 or $978 per acre-foot, depending upon the approach. For hydropower, it is expected that a 5 percent increase in rates would be supportable by those that purchase power from WAPA.

Based on current CVP/SWP operational assumptions and studies to date, under CP4, beneficiaries have the ability to pay; however, it is recognized that further refinement and changes may occur to this and other alternatives after additional analyses and responses to comments by agencies, stakeholders, and the public.

Table 7-3. Example Construction Cost Assignment Using CP4

Purpose /Action	Total		Cost Assignment			
			Nonreimbursable		Reimbursable	
	Percent	Cost ($ millions)	Percent	Cost ($ millions)	Percent	Cost ($ millions)
Irrigation Water Supply	12.4%	132.5	0%	0.0	100%	132.5
Municipal and Industrial Water Supply	18.6%	198.6	0%	0.0	100%	198.6
Fish and Wildlife Enhancement	61.2%	654.9	100%	654.9	0%	0.0
Hydropower	7.9%	84.0	0%	0.0	100%	84.0
Total	100.0%	1069.9	61.2%	100.0	38.8%	100.0

Notes:
[1] All numbers are rounded for display purposes; therefore, line items may not sum to totals.
[2] Subject to refinement/change during remainder of feasibility study.

Key:
CP = comprehensive plan

Summary of Findings

Based on analyses to date, all comprehensive plans to enlarge Shasta Dam and Reservoir appear to be technically and environmentally feasible for implementation by the Federal Government.

Based on analyses to date, all 18.5 foot dam raise alternatives appear to be economically justified for implementation by the Federal Government. The 6.5 foot dam raise alternative is marginally justified.

To date, only one comprehensive plan (CP4) has been analyzed for financial feasibility. Based on costs allocated to various project purposes, and the preliminary financial analysis to date, CP4 appears to be financially justified for implementation by the Federal Government.

Next Steps for the Feasibility Study

Based on the findings of the SLWRI to date, the next steps recommended for the feasibility study are as follows:

- Solicit public input on the Draft Feasibility Report and Preliminary Draft EIS.
- Continue to refine and evaluate comprehensive plans and identified measures to respond to public comments and reflect potential changes to existing and likely future conditions. Future evaluations will include continued operations and related modeling to evaluate potential

changes to the Sacramento River basin and Delta existing and future conditions resulting from the ongoing OCAP reconsultation and other relevant water resources projects and programs, including, potentially, BDCP/DHCCP.

- Perform a quantitative climate change analysis to describe potential effects that future climate change and revised operations will have on fisheries, water supply, water quality, and other resource areas.

- Develop specific details about off-site opportunities to mitigate impacts on biological resources in the primary study area. Additional discussion of mitigation and associated mitigation ratios for lands around Shasta Reservoir will be developed, as well as detailed mitigation plans and accompanying cost estimates.

- Identify and confirm non-Federal sponsor(s).

- Update estimates of benefits of the comprehensive plans, identify the proposed plan (consistent with the P&G) and the environmentally preferable alternative (consistent with NEPA), and allocate costs to project purposes (e.g., cost allocation). Assess the financial capability of project beneficiaries. In addition, if the California Water Commission's 2012 Water Bond measure passes, investigate use of bond funding for the public benefits of raising Shasta Dam and Reservoir.

- Continue to coordinate with stakeholders and other agencies to address and resolve issues related to Native American and cultural resources, water rights, ongoing biological investigations, and related projects and programs.

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Chapter 8
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