Chapter 23
Power and Energy

23.1 Affected Environment

This chapter describes the affected environment related to hydropower generation and consumption for the dam and reservoir modifications proposed under the SLWRI. The affected environment includes the existing CVP and SWP generating and pumping plants. For a more in-depth description of the affected environment, see the *Power and Energy Technical Report*.

The CVP is a multipurpose project with 20 dams and reservoirs, 11 powerplants, and 500 miles of major canals, as well as conduits, tunnels, and related facilities. The power generated from these plants helps to meet California's energy needs. The Western Area Power Administration (Western), created in 1977 under the Department of Energy Organization Act, markets and transmits electric power throughout 15 western states. Western's Sierra Nevada Customer Service Region (Sierra Nevada Region) markets and transmits power generated from the CVP and the Washoe Project in excess of CVP use. Western follows a formal procedure for allocating CVP energy to "preference" customers. These customers have 20-year contracts for their share of CVP energy in excess of Reclamation's water pumping needs.

Major SWP facilities include 17 pumping plants, 8 hydroelectric powerplants, 32 storage facilities, and 660-plus miles of aqueducts and pipelines. The SWP is also a multipurpose project. The primary purpose of SWP power generation facilities is to meet energy requirements of the SWP pumping plants. To the extent possible, SWP pumping is scheduled during off-peak periods, and energy generation is scheduled during peak periods. Although the SWP uses more energy than it generates from its hydroelectric facilities, DWR has exchange agreements with other utility companies, and has developed other power resources. DWR sells surplus power, when it is available, to minimize the net cost of pumping energy.

23.1.1 Shasta Lake and Vicinity

The Shasta Division of the CVP contains Shasta Dam, Lake, and Powerplant, and Keswick Dam, Reservoir, and Powerplant; it captures water from the Sacramento River basin. Shasta Powerplant is located just below Shasta Dam as part of the Shasta Division. Water from the dam is released through five 15-foot penstocks leading to the five main generating units and two station service units with a maximum generation capacity of 715 megawatts (MW). Shasta Powerplant is a peaking plant and generally runs when demand for electricity is high. Its power is dedicated first to meeting the requirements of CVP facilities. The remaining energy is marketed to various preference customers in Northern California. The 2007 net annual generation of Shasta Powerplant was 1,914,175 megawatt-hours (MWh).

23.1.2 Upper Sacramento River (Shasta Dam to Red Bluff)

CVP powerplants located downstream from Shasta Reservoir, but upstream from the Red Bluff Diversion Dam are the Trinity, Lewiston, Judge Francis Carr, and Spring Creek powerplants of the Trinity River Division and the Keswick Powerplant of the Shasta Division. The Trinity River Division captures headwaters from the Trinity River basin and diverts surplus water to the Sacramento River.

Trinity Dam stores water from the Trinity River in Trinity Reservoir and makes releases to the Trinity River through the Trinity Powerplant. Downstream, Lewiston Dam diverts water from the Trinity River through the Lewiston Powerplant into the Clear Creek Tunnel and through Judge Francis Carr Powerplant to Whiskeytown Reservoir. Some Whiskeytown Reservoir releases are made through the Spring Creek Power Conduit and Powerplant into Keswick Reservoir in the Shasta Division. The remainder of the releases from Whiskeytown Reservoir are made to Clear Creek. Releases from Keswick Reservoir are made through the Keswick Powerplant to the Sacramento River.

Keswick Powerplant belongs to the Shasta Diversion, is located at Keswick Dam, and has three generating units with a total capacity of 105 MW. Keswick Powerplant is a run-of-the-river plant, creating Shasta Powerplant’s afterbay, and providing uniform flows to the Sacramento River.

23.1.3 Lower Sacramento River and Delta

Two CVP powerplants located between the Red Bluff Diversion Dam and Sacramento–San Joaquin River Delta (Delta) are the Folsom and Nimbus powerplants. Both powerplants belong to the Folsom Unit on the American River.

Folsom Powerplant is a peaking powerplant located at the foot of Folsom Dam on the north side of the American River. Water from the dam is released through three 15-foot-diameter penstocks to three generating units with a maximum capacity of 199 MW. Folsom Dam was constructed by the USACE and, on completion, was transferred to Reclamation for coordinated operation as an integral part of the CVP.

Nimbus Dam forms Lake Natoma to act as an afterbay for Folsom Powerplant. It allows dam operators to coordinate power generation and flows in the lower American River channel during normal reservoir operations. Nimbus Powerplant, with two units and a maximum capacity of 13.5 MW, is a run-of-the-river plant and provides station service backup for Folsom Powerplant.

23.1.4 CVP/SWP Service Areas

There are a number of generation facilities and pumping facilities in the greater CVP/SWP service areas, beyond the specific geographies discussed above. These facilities are discussed below.

Generation Facilities

The CVP powerplants located in the CVP south-of-Delta service area include New Melones Powerplant in the New Melones Unit of the CVP East Side Division, and the William R. Gianelli and O'Neill Pumping-Generating Plants in the San Luis Unit of the CVP West San Joaquin Division. The latter two, with dual functions of generating electricity and pumping water, are jointly owned by Reclamation and DWR.

New Melones Dam was completed in 1979, and inundated the original Melones Dam and created New Melones Reservoir on the Stanislaus River. New Melones Powerplant, located on the north bank immediately downstream from the dam, is a peaking plant. The powerplant contains two units and a maximum capacity of 300 MW.

The San Luis Unit, part of both the CVP and SWP, was authorized in 1960. Reclamation and the State of California constructed and operate this unit jointly; 45 percent of the total cost was contributed by the Federal Government and the remaining 55 percent by the State of California. The joint-use facilities are O'Neill Dam and Forebay, B.F. Sisk San Luis Dam, San Luis Reservoir, William R. Gianelli Pumping-Generating Plant, Dos Amigos Pumping Plant, Los Banos and Little Panoche Reservoirs, and San Luis Canal from O'Neill Forebay to Kettleman City, together with the necessary switchyard facilities. The Federal-only portion of the San Luis Unit includes the O'Neill Pumping-Generating Plant and Intake Canal, Coalinga Canal, Pleasant Valley Pumping Plant, and San Luis Drain.

San Luis Reservoir serves as the major storage reservoir, and O'Neill Forebay acts as an equalizing basin, for the upper stage dual-purpose pumping-generating plant. O’Neill Pumping-Generating Plant takes water from the Delta-Mendota Canal and discharges it into the O'Neill Forebay, where the California Aqueduct (SWP feature) flows directly. The William R. Gianelli Pumping-Generating Plant lifts water from O'Neill Forebay and discharges it into San Luis Reservoir. During releases from the reservoir, these plants generate electric power by reversing flow through the turbines. Water for irrigation is released into the San Luis Canal and flows by gravity to Dos Amigos Pumping Plant, where the water is lifted more than 100 feet to permit gravity flow to the canal terminus at Kettleman City. The SWP canal system continues to southern coastal areas.

The O'Neill Pumping-Generating Plant consists of an intake channel, leading off the Delta-Mendota Canal, and six pumping-generating units. Normally, these units operate as pumps to lift water from 45 to 53 feet into O'Neill

Forebay; each unit can discharge 700 cubic feet per second (cfs) and has a rating of 6,000 horsepower (hp). Water is occasionally released from the forebay to the Delta-Mendota Canal, and these units then operate as generators; each unit has a generating capacity of about 4.2 MW.

William R. Gianelli Pumping-Generating Plant, the joint Federal-State facility located at San Luis Dam, lifts water by pump-turbines from O'Neill Forebay into San Luis Reservoir. During the irrigation season, water is released from San Luis Reservoir back through the pump-turbines to the forebay and energy is reclaimed. Each of the eight pumping-generating units has a capacity of 63,000 hp as a motor and 53 MW as a generator. As a pumping plant to fill San Luis Reservoir, each unit lifts 1,375 cfs at a design dynamic head of 290 feet. As a generating plant, each unit passes 2,120 cfs at a design dynamic head of 197 feet.

Among the eight SWP hydroelectric powerplants, three powerplants are located in the Lake Oroville vicinity and the remaining in the south-of-Delta area.

Lake Oroville, the SWP’s largest reservoir, stores winter and spring runoff from the Feather River watershed, and releases water for SWP needs. These releases generate power at three powerplants: the Edward Hyatt Pumping-Generating Plant, Thermalito Diversion Dam Powerplant, and Thermalito Pumping-Generating Plants (Oroville Facilities). DWR schedules hourly releases through the Oroville Facilities to maximize the amount of energy produced when power values are highest. Because the downstream water supply does not depend on hourly releases, water released for power in excess of local and downstream requirements is conserved by pumpback operation during off-peak times into Lake Oroville. Energy prices primarily dictate hourly operations for the power generation facilities.

The remaining five SWP powerplants are the jointly owned William R. Gianelli Pumping-Generating Plant, Alamo Powerplant, Mojave Siphon Powerplant, Devil Canyon Powerplant, and Warne Powerplant. They generate about one sixth of the total energy used by the SWP. The Alamo Powerplant uses the 133 foot head between Tehachapi Afterbay and Pool 43 of the California Aqueduct to generate electricity. The Mojave Siphon Powerplant generates electricity from water flowing downhill after its 540-foot lift by the Pearblossom Pumping Plant. The Devil Canyon Powerplant generates electricity with water from Silverwood Lake with more than 1,300 feet of head, the highest water head[1] in a powerplant in the SWP system. The Warne Powerplant uses the 725-foot drop

[1] [1] Potential hydropower generation is a function of the hydraulic net head and rate of fluid flow. The net head is the actual head available for power generation and is used for computing the energy generated. The net head is the gross head minus the head losses due to intake structures, penstocks, and outlet works. The gross or static head is the vertical distance between the tailwater elevation and the forebay water surface elevation (i.e., the height of water in the reservoir relative to its height after discharge). The head losses are generally assumed 2 to 10 percent of the gross head, depending on the configuration of the powerhouse structure.

from the Peace Valley Pipeline to generate electricity with its Pelton wheel turbines.

Pumping Facilities

CVP pumping plants to move water from the Delta to CVP service areas in the Central Valley include C.W. "Bill" Jones Pumping Plant, O'Neill and William R. Gianelli Pumping-Generating Plants, Dos Amigo Pumping Plant, and SWP Banks Pumping Plant. Reclamation constructed and operates the C.W. "Bill" Jones Pumping Plant. Harvey O. Banks Pumping Plant is an SWP facility; however, Reclamation has access to its pumping capacity through use of the Joint Point of Diversion, described in State Water Resource Control Board Water Right Decision 1641. The remaining plants, described previously, are joint-use facilities between the two agencies under the San Luis Unit.

C.W. "Bill" Jones Pumping Plant, formerly Tracy Pumping Plant, is a component of the CVP Delta Division. Construction of the plant started in 1947 and was completed in 1951, with an inlet channel, pumping plant, and discharge pipes. Delta water is lifted 197 feet up and carried about 1 mile into the Delta-Mendota Canal. Each of the six pumps at C.W. "Bill" Jones Pumping Plant is powered by a 22,500 hp motor and is capable of pumping 767 cfs. The intake canal includes the C.W. "Bill" Jones Fish Screen, which was built to intercept downstream migrant fish to be returned to the main channel to resume their journey to the ocean.

Dos Amigo Pumping Plant is a joint CVP/SWP facility, located 17 miles south of O'Neill Forebay on the San Luis Canal. It lifts water 113 feet to permit gravity flow to the terminus of San Luis Canal at Kettleman City. The plant contains six pumping units, each capable of delivering 2,200 cfs at 125 feet of head.

Among the SWP pumping plants, plants that historically consumed most of the energy are William R. Gianelli Pumping-Generating Plant (SWP share), Harvey O. Banks Pumping Plant, Dos Amigos Pumping Plant (SWP share), Ira J. Chrisman Pumping Plant, and A.D. Edmonston Pumping Plant.

The Harvey O. Banks Pumping Plant is located 2.5 miles (4 kilometers) southwest of the Clifton Court Forebay on the California Aqueduct. The plant is the first pumping plant for the California Aqueduct and the South Bay Aqueduct. It provides the necessary head[2] for water in the California Aqueduct to flow for approximately 80 miles south past O'Neill Forebay and San Luis Reservoir to the Dos Amigos Pumping Plant (another jointly owned facility, as previously described). The Harvey O. Banks Pumping Plant initially flows into Bethany Reservoir, where the South Bay Aqueduct truly begins. The design head is 236 to 252 feet and installed capacity is 10,670 cfs with 333,000 hp.

[2] In pumping plants, the design head is the gross head plus the head losses due to intake structures.

Along the California Aqueduct, the Pearblossom, Chrisman, and Edmonston Pumping Plants historically consumed the highest amount of energy. The Pearblossom Pumping Plant lifts water about 540 feet and discharges the water 3,479 feet above mean sea level (msl), the highest point along the entire California Aqueduct. The Chrisman and Edmonston Pumping Plants provide 524 and 1,970 feet of lift, respectively, to convey California Aqueduct water across the Tehachapi Mountains.

23.2 Regulatory Framework

There are two categories of regulatory framework for hydropower: Federal regulations for CVP hydroelectric operations and State regulations for the SWP.

23.2.1 Federal

Reclamation operates the CVP hydroelectric generation facilities to manage and release water in accordance with various acts authorizing specific projects, and with other laws, permits, and enabling legislation (see the *Hydrology, Hydraulics, and Water Management Technical Report* in the Physical Resources Appendix for details). Western's capacity and energy sales must conform with the laws that govern its sale of electrical power. Hydropower operations at each facility comply with water flows and other constraints set by Reclamation, the USWFS, or other regulatory agencies, acting in accordance with laws, regulations, and policies.

Western announced its 2004 Power Marketing Plan (Marketing Plan) for the Sierra Nevada Region because all of the Sierra Nevada Region’s long-term firm CVP power sales contracts expired on December 31, 2004. The Marketing Plan specifies the terms and conditions under which Western markets power from the CVP and the Washoe Project, beginning January 1, 2005. This Marketing Plan supersedes all previous marketing plans for these projects.

23.2.2 State

DWR is currently seeking a new 50-year hydroelectric license from the Federal Energy Regulatory Commission to operate the existing Oroville Facilities. The DEIS is available for public review and comment. The initial Federal Energy Regulatory Commission license for the Oroville Facilities, issued on February 11, 1957, expired on January 31, 2007. The Oroville Facilities are currently operating under an annual license issued by Federal Energy Regulatory Commission effective February 1, 2007.

23.2.3 Regional and Local

There are no known regional or local regulations that would govern power and energy resources.

23.3 Environmental Consequences and Mitigation Measures

The purpose of this section is to provide information about hydropower generation, energy use, and impacts on existing hydropower facilities from the SLWRI study alternatives described in the PDEIS. Hydropower modeling for the PDEIS was conducted to identify potential impacts from the SLWRI on hydropower generation and consumption at CVP and SWP facilities, which are operated by Reclamation, and DWR, respectively. This section describes the analytical methodology used to calculate, for all alternatives, the hydropower generation and pumping energy required in CVP and SWP existing hydropower facilities. This chapter also describes criteria for determining significant impacts and mitigation measures associated with the SLWRI alternatives, and then lists the impacts and mitigation measures.

23.3.1 Methods and Assumptions

Several modeling tools were used for the SLWRI hydropower analysis. CalSim-II was used to determine project operations, and the Common Assumptions power tools were used to quantify the hydropower generation and pumping energy associated with each alternative. A spreadsheet postprocessor was used to evaluate impacts to the Pit 7 Powerplant.

Common Assumptions Power Tools

Energy estimates were made using the Common Assumptions power tools, LongTermGen (LTG) and SWP Power CA (SWP Power), for CVP and SWP facilities, respectively. LTG and SWP Power use operations data from CalSim-II simulations to predict energy generation and consumption throughout the CVP and SWP.

Methods applied to evaluate power generation are discussed below.

For each SLWRI alternative, outputs from CalSim-II simulation were inputs to LTG and SWP Power to simulate power generation and consumption throughout the CVP and SWP systems, respectively. These CalSim-II outputs include reservoir releases, conveyance flow rates, and end-of-month reservoir storages. Both LTG and SWP Power are monthly models. Their simulation periods are from October 31, 1921, to September 30, 2003.

In LTG and SWP Power, energy generation is a function of turbine configuration, reservoir release, net head, and duration of generation. Net head is the actual head available for power generation; it is reservoir water surface elevation (a function of storage) minus tailrace elevation (a function of release).

Similarly, the calculation of energy required for pumping in both models is a function of pump configuration, pumping rate, pumping head (i.e., net head with hydraulic losses), and duration of pumping. Detailed descriptions of LTG and SWP Power are included in Chapter 9 of the Modeling Appendix.

CalSim-II

CalSim-II is the application of the Water Resources Integrated Modeling System software to the CVP/SWP. This application was jointly developed by Reclamation and DWR for planning studies relating to CVP/SWP operations. The primary purpose of CalSim-II is to evaluate the water supply reliability of the CVP and SWP at current and/or future levels of development (e.g., 2005, 2030), with and without various assumed future facilities, and with different modes of facility operations. Geographically, the model covers the drainage basin of the Delta, and CVP/SWP exports to the San Francisco Bay Area, San Joaquin Valley, Central Coast, and Southern California.

CalSim-II typically simulates system operations for an 83-year period using a monthly time step. The model assumes that facilities, land use, water supply contracts, and regulatory requirements are constant over this period, representing a fixed level of development (e.g., 2005 or 2030). The historical flow record of October 1921 to September 2003, adjusted for the influences of land use changes and upstream flow regulation, is used to represent the possible range of water supply conditions. Major Central Valley rivers, reservoirs, and CVP/SWP facilities are represented by a network of arcs and nodes. CalSim-II uses a mass balance approach to route water through this network. Simulated flows are mean flows for the month; reservoir storage volumes correspond to end-of-month storage.

Monthly CalSim-II model results are intended to be used for comparative purposes. It is important to differentiate between “absolute” or “predictive” modeling applications and “comparative” applications. In “absolute” applications, the model is run once to predict a future outcome; errors or assumptions in formulation, system representation, data, operational criteria, etc., all contribute to total error or uncertainty in model results. In “comparative” applications, the model is run twice, once to represent a base condition (no project) and a second time with a specific change (project) to assess the change in the outcome due to the input change. In this comparative mode (the mode used for this PDEIS), the difference between the two simulations is of principal importance. Potential errors or uncertainties that exist in the “no project” simulation are also present in the “project” simulation such that their impacts are reduced when assessing the change in outcomes.

Spreadsheet Postprocessors For analysis of impacts from each alternative on generation from the Pit 7 Powerplant, a spreadsheet postprocessor was used in lieu of a model. Since no model was available for Pit 7 Powerplant operations, an evaluation of potential impacts of the SLWRI alternatives, as simulated using CalSim-II, on recent historical data was used instead.

The spreadsheet post-processor interpolated CalSim-II output for Shasta Reservoir storage to determine the reservoir water surface elevation. The Shasta Reservoir water surface elevations for each alternative were compared to historical Pit 7 Powerplant tailwater elevations to calculate the change in net head at the Pit 7 Powerplant. Changes in net head at the Pit 7 Powerplant were assumed to be small enough that turbine/generator efficiencies would be unaffected. For each alternative, the monthly generation was determined by multiplying historical average monthly generation by the ratio of the alternative-reduced net head compared to the historical net head (assumed to be 200 feet based on historical average) raised to the 1.5 power.

23.3.2 Criteria for Determining Significance of Effects

An environmental document prepared to comply with NEPA must consider the context and intensity of the environmental effects that would be caused by, or result from, the proposed action. Under the NEPA, the significance of an effect is used solely to determine whether an Environmental Impact Statement must be prepared. An environmental document prepared to comply with CEQA must identify the potentially significant environmental effects of a proposed project. A “[s]ignificant effect on the environment” means a substantial, or potentially substantial, adverse change in any of the physical conditions within the area affected by the project (State CEQA Guidelines, Section 15382). CEQA also requires that the environment document propose feasible measures to avoid or substantially reduce significant environmental effects (State and CEQA Guidelines, Section 15126.4(a).

The significance criteria presented in Table 23-1 were developed based on guidance provided by the State CEQA Guidelines and consider the context and intensity of the environmental effects as required under NEPA. Impacts of an alternative on power and energy would be significant if project implementation would have any of the results listed in the second column of the table.

Table 23-1. Impact Indicators and Significance Criteria for Energy Generation and Usage

Impact Indicator	Significance Criterion
Shasta Powerplant Energy Generation	Decrease in long-term average monthly hydropower generation of more than 5 percent, due to reduction in net head available for energy generation at Shasta Dam.
CVP and SWP Powerplants Energy Generation	Decrease in long-term average monthly hydropower generation of more than 5 percent, due to decrease in net head available for energy generation at various CVP and SWP powerplants.
CVP and SWP Pumping Plants Energy Consumption	Increase in long-term average monthly power requirement of more than 5 percent, due to increased pumping at various CVP and SWP pumping plants.
CVP and SWP Net Energy Generation	Decrease in long-term average monthly net energy generation, which is the difference between energy generation and energy consumption, of more than 5 percent at various CVP and SWP powerplants.
Pit 7 Powerplant Energy Generation	Decrease in long-term average annual hydropower generation of more than 5 percent, due to increase in Pit 7 tailwater elevation, resulting in reduced net head available for energy generation at Pit 7 Powerplant.

Key:
CVP = Central Valley Project
SWP = State Water Project

An alternative would be considered to have a potentially significant impact on hydropower production if the change in the average monthly energy generation or consumption over the 82-year period of simulation is greater than 5 percent.

A threshold of 5 percent was selected as the threshold of significance for hydroelectric generation for several reasons, including seasonal and annual hydrologic variability, short-term operations decisions that might affect water level in storage, and regional power market demands and prices that might dictate hydropower facilities operations. All these factors could contribute to potentially substantial variations in hydropower generation on a monthly or annual basis. As a result, generation variations of less than 5 percent are not considered significant.

Significance statements are relative to both existing conditions (2005) and future conditions (2030), unless stated, otherwise.

Shasta Powerplant Energy Generation

Shasta Powerplant energy generation would be directly affected by any potential enlargement. While long-term net releases are not likely to change under any enlargement scenario, the monthly pattern of releases could potentially be affected. Assuming there would be no corresponding reduction in power demand, a significant reduction in power production would require an increase in generation from another powerplant to meet any unmet demand.

An alternative would be considered to have a significant impact on Shasta Powerplant energy generation if its monthly average generation was reduced by more than 5 percent at a level of recurrence substantially affecting the power market.

CVP and SWP Powerplants Energy Generation

Changes in CVP operations due to any of the SLWRI alternatives could result in some reoperation of other CVP and SWP facilities, and could result in a decrease in generation at the various CVP and SWP powerplants. A decrease in generation from CVP and SWP powerplants could require an increase in generation in other parts of the generation market, even if the annual amount of generation did not change.

An alternative would be considered to have a significant impact on CVP/SWP powerplant energy generation if its monthly average generation was reduced by more than 5 percent at a level of recurrence substantially affecting the power market.

CVP and SWP Pumping Plants Energy Consumption

Changes in CVP operations due to any of the SLWRI alternatives could result in changes in operations of the CVP and SWP pumping plants. Changes in timing or volume of pumping could cause changes in energy consumption.

An alternative would be considered to have a significant impact on hydropower production if its monthly average pumping plant energy consumption would increase by more than 5 percent at a level of recurrence substantially affecting the power market.

CVP and SWP Net Energy Generation

While changes in CVP operations due to the SLWRI alternatives may increase generation at CVP and SWP powerplants, a similar increase in pumping could result in a net decrease in generation.

A decrease greater than 5 percent in net energy generation at hydropower facilities at a level of recurrence substantially affecting the power market would indicate a significant impact on hydropower production.

Pit 7 Powerplant Energy Generation

The Pit 7 Powerplant is owned and operated by the Pacific Gas and Electric Company. Increases in Shasta Lake water surface elevations could increase the tailwater elevation below the Pit 7 Powerplant, reducing the net head and decreasing generation. An alternative would be considered to have a significant impact on Pit 7 Powerplant energy generation if its monthly average generation was reduced by more than 5 percent at a level of recurrence substantially affecting the power market.

23.3.3 Direct and Indirect Effects

This section describes the environmental consequences of the SLWRI Comprehensive Plans, and proposed mitigation measures for any impacts determined to be significant or potentially significant. All Comprehensive Plans are compared to a basis of comparison; for the existing condition (2005 level of development), a CalSim-II simulation for the existing condition is used. Similarly, the future condition (2030 level of development) uses a CalSim-II simulation of the No-Action Alternative as a basis of comparison. Each of the Comprehensive Plans are simulated using the same level of development so that any changes from the basis of comparison hydropower generation or consumption can be attributed the alternative. Detailed tables of the monthly energy generation and energy consumption associated with each comprehensive plan are included in Attachment 1 of the *Power and Energy Technical Report*.

Modeling results for CP1, CP2, CP3, and CP4 are included below. The operation modeling results for CP5 are not included because they are identical to those of CP3.

The No-Action Alternative and five SLWRI Comprehensive Plans are described in the following subsections. Potential effects of the existing condition, No-Action Alternative, and various SLWRI Comprehensive Plans on energy generation and usage are also described.

No-Action Alternative

Under the No-Action Alternative, the Federal Government would take reasonably foreseeable actions, as defined above, but would take no additional action toward implementing a specific plan to help increase anadromous fish survival in the upper Sacramento River, nor help address the growing water reliability issues in California. Shasta Dam would not be modified, and the CVP would continue operating similar to the existing condition. Changes in regulatory conditions and water supply demands would result in differences in flows on the Sacramento River and at the Delta. Possible changes include the following:

- Firm Level 2 Federal refuge needs
- Implementation of the Sacramento Area Water Forum Agreement on the American River
- Increased Contra Costa Water District contract supply and water rights
- SWP deliveries based on full Table A[3] amounts
- Use of the Delta-Mendota Canal–California Aqueduct Intertie
- Implementation of the San Joaquin River Salinity Management Program
- CVP use of Banks Pumping Plant to move 50,000 acre-feet/year of Level 2 refuge water

This alternative is used as a basis of comparison for future condition comparisons.

In the impact analysis below, hydropower generation and consumption, and net energy generation at CVP and SWP facilities under the No-Action Alternative are compared with the existing condition.

Shasta Lake and Vicinity

Impact Hydro-1 (No-Action): Decrease in Shasta Powerplant Energy Generation Increasing the hydropower capabilities of Shasta Powerplant is a secondary planning objective of the SLWRI. An increase in Shasta Powerplant energy generation is one indicator of the project's beneficial impacts. Simulated monthly average Shasta Powerplant energy generation for the No-Action Alternative is shown in Table 23-2. The greatest decrease in long-term monthly average hydropower generation is more than 5 percent compared to the existing condition. In addition, monthly decreases in hydropower generation of greater

[3] The Monterey Agreement (DWR 2003) signed by 27 of the 29 SWP water contractors in 1995, restructured the SWP contracts to allocate water based on contractual Table A amounts instead of the amount of water requested for a given year.

than 5 percent were observed at a level of recurrence that would substantially affect the power market.

Consequently, this impact would be potentially significant. Mitigation is not required for the No-Action Alternative.

Table 23-2. Simulated Monthly Average Shasta Powerplant Energy Generation for No-Action Alternative

Month	Existing Condition (GWh)	No-Action Alternative Change (GWh (%))	
October	132	-9	-7%
November	120	-6	-5%
December	156	-4	-3%
January	160	2	1%
February	187	-4	-2%
March	180	-1	-1%
April	160	0	0%
May	200	2	1%
June	259	-2	-1%
July	275	5	2%
August	201	8	4%
September	116	8	7%
Total	2,146	-1	0%

Source: Common Assumptions Common Modeling Package Version 9 LongTermGen

Note:
Simulation period: 1922 – 2003
Key:
GWh = gigawatt-hour

Upper Sacramento River Negligible effects on Power and Energy are expected to occur in the Upper Sacramento River geographic region; therefore, potential effects in that geographic region are not discussed further in this PDEIS.

Lower Sacramento River and Delta Negligible effects on Power and Energy are expected to occur in the Lower Sacramento River and Delta geographic region; therefore, potential effects in that geographic region are not discussed further in this PDEIS.

CVP/SWP Service Areas

Impact Hydro-2 (No-Action): Decrease in CVP and SWP Powerplant Energy Generation Simulated monthly average CVP and SWP energy generation for the No-Action Alternative shown in Table 23-3 and Table 23-4, respectively. Hydropower generation at CVP powerplants under the No-Action Alternative is similar to that in the existing condition. However, the No-Action Alternative shows an overall beneficial impact from increases on hydropower generation at SWP powerplants compared to the existing condition. Monthly decreases greater than 5 percent were observed at both CVP and SWP powerplants at a level of recurrence that would substantially affect the power market.

Therefore, this impact would be potentially significant. Mitigation is not required for the No-Action Alternative.

Table 23-3. Simulated Monthly Average CVP Energy Generation for No-Action Alternative

Month	Existing Condition (GWh)	No-Action Alternative Change (GWh (%))	
October	304	-12	-4%
November	245	-11	-4%
December	294	-10	-3%
January	336	-4	-1%
February	353	-7	-2%
March	358	-1	0%
April	364	-2	-1%
May	511	-2	0%
June	587	-8	-1%
July	678	-7	-1%
August	533	13	2%
September	370	11	3%
Total	4,934	-41	-1%

Source: Common Assumptions Common Modeling Package Version 9, LongTermGen
Note:
Simulation period: 1922 – 2003
Key:
CVP = Central Valley Project
GWh = gigawatt-hour

Table 23-4. Simulated Monthly Average SWP Energy Generation for No-Action Alternative

Month	Existing Condition (GWh)	No-Action Alternative Change (GWh (%))	
October	325	19	6%
November	269	26	10%
December	322	11	3%
January	348	-1	0%
February	408	14	3%
March	460	5	1%
April	392	37	9%
May	475	39	8%
June	523	28	5%
July	508	55	11%
August	426	36	8%
September	341	32	9%
Total	4,798	299	6%

Source: Common Assumptions Common Modeling Package Version 9, SWP Power CA
Note:
Simulation period: 1922 – 2003
Key:
GWh = gigawatt-hour
SWP = State Water Project

Impact Hydro-3 (No-Action): Increase in CVP and SWP Pumping Plant Energy Consumption Simulated monthly average CVP and SWP energy consumption for the No-Action Alternative is shown in Table 23-5 and Table 23-6, respectively. The greatest increase in long-term monthly average energy consumption at CVP and SWP pumping plants for the No-Action Alternative is more than 5 percent compared to the existing condition, and would cause a potentially significant effect. In addition, monthly increases greater than 5 percent were observed at a level of recurrence that would substantially affect the power market.

Therefore, this impact would be potentially significant. Mitigation is not required for the No-Action Alternative.

Table 23-5. Simulated Monthly Average CVP Energy Consumption for No-Action Alternative

Month	Existing Condition (GWh)	No-Action Alternative Change (GWh (%))	
October	100	1	1%
November	116	7	6%
December	135	9	7%
January	145	6	4%
February	118	-9	-8%
March	104	-19	-18%
April	53	0	0%
May	57	2	4%
June	89	1	1%
July	116	9	8%
August	119	7	6%
September	90	8	9%
Total	1,243	21	2%

Source: Common Assumptions Common Modeling Package Version 9, LongTermGen

Note:
Simulation period: 1922 – 2003

Key:
CVP = Central Valley Project
GWh = gigawatt-hour

Table 23-6. Simulated Monthly Average SWP Energy Consumption for No-Action Alternative

Month	Existing Condition (GWh)	No-Action Alternative Change (GWh (%))	
October	685	94	14%
November	625	112	18%
December	673	93	14%
January	753	5	1%
February	750	41	5%
March	815	69	8%
April	700	123	18%
May	763	117	15%
June	801	79	10%
July	783	114	15%
August	803	102	13%
September	774	107	14%
Total	8,925	1056	12%

Source: Common Assumptions Common Modeling Package Version 9, SWP Power CA

Note:
Simulation period: 1922 – 2003
Key:
GWh = gigawatt-hour
SWP = State Water Project

Impact Hydro-4 (No-Action): Decrease in CVP and SWP Net Energy Generation Net energy generation is the difference between long-term monthly average energy generation and monthly average energy consumption. Simulated monthly average CVP and SWP net energy generation for the No-Action Alternative is depicted in Table 23-7 and Table 23-8, respectively. The greatest decrease in long-term monthly average net energy generation is more than 5 percent and would cause a potentially significant impact. In addition, monthly decreases greater than 5 percent were observed at a level of recurrence that would substantially affect the power market.

Therefore, this impact would be potentially significant. Mitigation is not required for the No-Action Alternative.

Impact Hydro-5 (No-Action): Decrease in Pit 7 Powerplant Net Energy Generation Simulated monthly average Pit 7 Powerplant energy generation for the No-Action Alternative is depicted in Table 23-9. Total Pit 7 Powerplant energy production for the No-Action Alternative would be similar to that of the existing condition.

Therefore, there would be no impacts. Mitigation is not required for the No-Action Alternative.

Table 23-7. Simulated Monthly Average CVP Net Energy Generation for No-Action Alternative

Month	Existing Condition (GWh)	No-Action Alternative Change (GWh (%))	
October	204	-13	-6%
November	129	-18	-14%
December	159	-18	-11%
January	191	-10	-5%
February	235	2	1%
March	254	18	7%
April	311	-1	0%
May	454	-5	-1%
June	497	-9	-2%
July	562	-17	-3%
August	414	6	1%
September	280	3	1%
Total	3,691	-62	-2%

Source: Common Assumptions Common Modeling Package Version 9, LongTermGen.

Note:
Simulation period: 1922 – 2003
Key:
CVP = Central Valley Project
GWh = gigawatt-hour

Table 23-8. Simulated Monthly Average SWP Net Energy Generation for No-Action Alternative

Month	Existing Condition (GWh)	No-Action Alternative Change (GWh (%))	
October	-360	-75	21%
November	-356	-85	24%
December	-351	-82	23%
January	-405	-6	1%
February	-342	-27	8%
March	-355	-64	18%
April	-308	-86	28%
May	-288	-78	27%
June	-278	-51	18%
July	-275	-60	22%
August	-378	-65	17%
September	-433	-75	17%
Total	-4,128	-756	18%

Source: Common Assumptions Common Modeling Package Version 9, SWP Power CA

Note:
Simulation period: 1922 – 2003
Key:
GWh = gigawatt-hour
SWP = State Water Project

Table 23-9. Simulated Monthly Average Pit 7 Powerplant Energy Generation for No-Action Alternative

Month	Existing Condition (GWh)	No-Action Alternative Change (GWh (%))	
October	52.6	0	0%
November	52.6	0	0%
December	64.6	0	0%
January	57.8	0	0%
February	52.1	0	0%
March	38.5	0	0%
April	33.2	0	0%
May	31.2	0	0%
June	30.9	0	0%
July	33.6	0	0%
August	36.7	0	0%
September	45.1	0	0%
Total	528.9	0	0%

Source: Spreadsheet model, Pit 7 Dam MONTHLY AVG.xls,2007
Note:
Simulation period: 1922 – 2003
Key:
GWh = gigawatt-hour

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

CP1 focuses on increasing water supply reliability while contributing to increased anadromous fish survival, actions that are consistent with the 2000 CALFED Bay-Delta Program (CALFED) Record of Decision (ROD). In addition to the common features above, CP1 primarily consists of raising Shasta Dam 6.5 feet, an elevation change that increases the reservoir's full pool by 8.5 feet, and enlarges the total storage space in the reservoir by 256,000 acre-feet. Under this plan, Shasta Dam normal operational guidelines would continue essentially unchanged, with the additional storage retained for water supply reliability. This scenario helps to reduce future water shortages through increasing drought and average-year water supply reliability. This plan would also include the potential to revise the operational rules for flood control for Shasta Dam and Reservoir, which could benefit flood damage reduction and recreation. Reservoir reoperation would likely include increasing the bottom of the flood control pool elevation based on increased dam height and reservoir capacity. The increased Shasta Reservoir pool depth and volume would also contribute to maintaining lower seasonal water temperatures for anadromous fish on the upper Sacramento River.

This section describes the environmental consequences of CP1. Impacts discussed include the following:

- Decrease in Shasta Powerplant energy generation
- Decrease in CVP and SWP powerplant energy generation
- Increase in CVP and SWP pumping plant energy consumption
- Decrease in CVP and SWP net energy generation
- Decrease in Pit 7 Powerplant energy generation

Shasta Lake and Vicinity

Impact Hydro-1 (CP1): Decrease in Shasta Powerplant Energy Generation

Increasing the hydropower capabilities of Shasta Powerplant is one of the secondary objectives of the study. An increase in Shasta Powerplant energy generation is one indicator of the project's beneficial impacts. This impact would be potentially significant.

Table 23-10 shows an overall increase in monthly generation of 1 to 4 percent at Shasta Powerplant for CP1 compared to the existing condition. Similarly, CP1 shows an overall beneficial impact on hydropower generation from increases of 1 to 5 percent compared to the future condition. Although CP1 indicates an overall beneficial impact, monthly decreases in hydropower generation greater than 5 percent were observed 63 times in the existing condition level of development and 95 times in the future condition level of development out of 984 occurrences.

Consequently, this impact would be potentially significant. Mitigation for this impact is not proposed because reductions in power generation from Shasta Powerplant would be offset by increased generation from other sources.

Table 23-10. Simulated Monthly Average Shasta Powerplant Energy Generation for CP1

Month	Existing Condition (2005)			Future Condition (2030)		
	Existing Condition (GWh)	CP1 Change (GWh (%))		No-Action Alternative (GWh)	CP1 Change (GWh (%))	
October	132	1	(1%)	123	1	(1%)
November	120	0	(0%)	114	1	(1%)
December	156	-1	(0%)	152	-1	(0%)
January	160	2	(1%)	162	0	(0%)
February	187	3	(2%)	183	9	(5%)
March	180	4	(2%)	179	1	(0%)
April	160	5	(3%)	160	5	(3%)
May	200	2	(1%)	202	1	(1%)
June	259	4	(2%)	257	3	(1%)
July	275	7	(2%)	280	7	(2%)
August	201	7	(4%)	209	6	(3%)
September	116	4	(3%)	124	3	(3%)
Total	2,146	39	(2%)	2,145	37	(2%)

Source: Common Assumptions Common Modeling Package Version 9 LongTermGen
Note:
Simulation period: 1922 – 2003
Key:
CP = Comprehensive Plan
GWh = gigawatt-hour

Upper Sacramento River Negligible effects on Power and Energy are expected to occur in the Upper Sacramento River geographic region; therefore, potential effects in that geographic region are not discussed further in this PDEIS.

Lower Sacramento River and Delta Negligible effects on Power and Energy are expected to occur in the Lower Sacramento River and Delta geographic region; therefore, potential effects in that geographic region are not discussed further in this PDEIS.

CVP/SWP Service Areas

Impact Hydro-2 (CP1): Decrease in CVP and SWP Powerplant Energy Generation Table 23-11 shows a beneficial impact from an overall increase in monthly generation at CVP powerplants of 1 to 2 percent for CP1 compared to the existing condition. A decrease in long-term monthly generation of 1 percent, observed for January and September, would be a less than significant impact. Similarly, CP1 shows an overall beneficial impact on hydropower generation from increases of 1 to 2 percent compared to the future condition. A decrease in long-term monthly average generation of 1 percent, in January, April, and September, would be a less than significant impact. However, when considering the maximum monthly for CP1 on hydropower generation, decreases greater than 5 percent were observed 75 times in the existing condition level of development and 93 times in the future condition level of development out of 984 occurrences. Consequently, there would be a potentially significant impact on CVP energy generation.

Table 23-11. Simulated Monthly Average CVP Energy Generation for CP1

Month	Existing Condition (2005)			Future Condition (2030)		
	Existing Condition (GWh)	CP1 Change (GWh (%))		No-Action Alternative (GWh)	CP1 Change (GWh (%))	
October	304	2	(1%)	292	3	(1%)
November	245	5	(2%)	234	4	(2%)
December	294	2	(1%)	284	4	(1%)
January	336	-3	(-1%)	332	-4	(-1%)
February	353	2	(0%)	346	7	(2%)
March	358	7	(2%)	357	2	(1%)
April	364	-2	(0%)	362	-2	(-1%)
May	511	2	(0%)	509	1	(0%)
June	587	7	(1%)	579	9	(1%)
July	678	11	(2%)	671	14	(2%)
August	533	5	(1%)	546	0	(0%)
September	370	-3	(-1%)	381	-4	(-1%)
Total	4,934	35	(1%)	4,893	34	(1%)

Source: Common Assumptions Common Modeling Package Version 9 LongTermGen

Note:
Simulation period: 1922 – 2003
Key:
CP = Comprehensive Plan
CVP = Central Valley Project
GWh = gigawatt-hour

Table 23-12 shows a beneficial impact from an overall increase in monthly generation at SWP powerplants of 1 percent for CP1 compared to the existing condition. A decrease in long-term monthly generation of 1 percent, observed for November, January and March, would be a less than significant impact. Similarly, CP1 shows an overall beneficial impact on hydropower generation from increases of 1 percent compared to the future condition. A decrease in long-term monthly average generation of 1 percent, in June, would be a less than significant impact. However, when considering the maximum monthly impact for CP1 on hydropower generation, decreases greater than 5 percent were observed 60 times in the existing condition level of development and 88 times in the future condition level of development out of 984 occurrences. Consequently, there would be a potentially significant impact on SWP energy generation.

Table 23-12. Simulated Monthly Average SWP Energy Generation for CP1

Month	Existing Condition (2005)			Future Condition (2030)		
	Existing Condition (GWh)	CP1 Change (GWh (%))		No-Action Alternative (GWh)	CP1 Change (GWh (%))	
October	325	2	(1%)	344	2	(1%)
November	269	-2	(-1%)	295	0	(0%)
December	322	0	(0%)	333	4	(1%)
January	348	-3	(-1%)	347	4	(1%)
February	408	-2	(0%)	422	1	(0%)
March	460	-4	(-1%)	465	-2	(0%)
April	392	2	(1%)	429	1	(0%)
May	475	3	(1%)	514	1	(0%)
June	523	3	(1%)	551	-3	(-1%)
July	508	6	(1%)	563	-1	(0%)
August	426	6	(1%)	462	-1	(0%)
September	341	2	(0%)	373	2	(0%)
Total	4,798	12	(0%)	5,097	9	(0%)

Source: Common Assumptions Common Modeling Package Version 9, SWP Power CA

Note:

Simulation period: 1922 – 2003

Key:

CP = Comprehensive Plan

SWP = State Water Project

GWh = gigawatt-hour

Therefore, this impact would be potentially significant. Mitigation for this impact is not proposed because reductions in power generation would be offset by increased generation from other sources.

Impact Hydro-3 (CP1): Increase in CVP and SWP Pumping Plant Energy Consumption Table 23-13 shows the change in monthly energy consumption at CVP pumping plants for CP1, compared to the existing condition that would result from additional pumping to accommodate the primary planning objectives of the study, increasing water supply reliability and anadromous fish survival. The greatest increase in long-term monthly average energy consumption, 3 percent, observed for March and July, would be a less than significant impact. Similar operations criteria governing CP1, compared to the future condition, resulted in a maximum increase of 2 percent in long-term average March energy consumption, which would also be a less than significant impact. However, when considering the maximum monthly impact for CP1 on energy consumption, increases greater than 5 percent were observed 97 times in the existing condition level of development and 104 times in the future condition level of development out of 984 occurrences. Consequently, there would be a potentially significant impact on CVP energy consumption.

Table 23-13. Simulated Monthly Average CVP Energy Consumption for CP1

Month	Existing Condition (2005)			Future Condition (2030)		
	Existing Condition (GWh)	CP1 Change (GWh (%))		No-Action Alternative (GWh)	CP1 Change (GWh (%))	
October	100	0	(0%)	101	1	(1%)
November	116	0	(0%)	123	1	(1%)
December	135	0	(0%)	144	0	(0%)
January	145	1	(0%)	151	-2	(-1%)
February	118	2	(2%)	109	1	(1%)
March	104	3	(3%)	85	2	(2%)
April	53	0	(0%)	53	0	(1%)
May	57	1	(1%)	59	1	(1%)
June	89	1	(1%)	90	0	(0%)
July	116	3	(3%)	125	2	(1%)
August	119	1	(1%)	126	0	(0%)
September	90	0	(0%)	98	1	(1%)
Total	1,243	11	(1%)	1,264	7	(1%)

Source: Common Assumptions Common Modeling Package Version 9 LongTermGen

Note:
Simulation period: 1922 – 2003
Key:
CP = Comprehensive Plan
CVP = Central Valley Project
GWh = gigawatt-hour

Table 23-14 shows the change in monthly energy consumption at SWP pumping plants for CP1, compared to the existing condition, resulting from additional pumping. The greatest increase in long-term monthly average energy consumption, 2 percent, observed for February, would be a less than significant impact. Similar operations criteria governing CP1, compared to the future condition, resulted in a maximum increase of 3 percent in long-term average January energy consumption, which would also be a less than significant impact. However, when considering the maximum monthly impact for CP1 on energy consumption, increases greater than 5 percent were observed 125 times in the existing condition level of development and 102 times in the future condition level of development out of 984 occurrences. Consequently, there would be a potentially significant impact on SWP energy consumption.

Therefore, this impact would be potentially significant. Mitigation for this impact is not proposed because increases in energy consumption would be offset by increased generation from other sources.

Table 23-14. Simulated Monthly Average SWP Energy Consumption for CP1

Month	Existing Condition (2005)			Future Condition (2030)		
	Existing Condition (GWh)	CP1 Change (GWh (%))		No-Action Alternative (GWh)	CP1 Change (GWh (%))	
October	685	6	(1%)	779	4	(1%)
November	625	8	(1%)	737	4	(1%)
December	673	5	(1%)	766	7	(1%)
January	753	9	(1%)	758	25	(3%)
February	750	12	(2%)	791	7	(1%)
March	815	0	(0%)	884	1	(0%)
April	700	8	(1%)	823	8	(1%)
May	763	6	(1%)	880	3	(0%)
June	801	8	(1%)	880	-2	(0%)
July	783	9	(1%)	897	3	(0%)
August	803	9	(1%)	905	1	(0%)
September	774	6	(1%)	881	0	(0%)
Total	8,925	86	(1%)	9,981	60	(1%)

Source: Common Assumptions Common Modeling Package Version 9, SWP Power CA
Note:
Simulation period: 1922 – 2003
Key:
CP = Comprehensive Plan
GWh = gigawatt-hour
SWP = State Water Project

Impact Hydro-4 (CP1): Decrease in CVP and SWP Net Energy Generation
Table 23-15 shows the change in net energy generation, which is the difference between the long-term monthly average energy generation and monthly average energy consumption, at all CVP plants for CP1, compared to the existing condition. Overall, CP1 shows a beneficial impact in the form of increased long-term monthly net energy generation. The greatest decrease in long-term monthly average net energy generation, 2 percent, observed for January, would be a less than significant impact. Similarly, an overall beneficial impact from increase in net energy generation was observed for CP1, compared to the future condition. A maximum decrease in net energy generation of 2 percent, observed for September, would also be a less than significant impact. However, when considering the maximum monthly impact for CP1 on net energy generation, decreases greater than 5 percent were observed 128 times in the existing condition level of development and 158 times in the future condition level of development out of 984 occurrences. Consequently, there would be a potentially significant impact on CVP net energy generation.

Table 23-15. Simulated Monthly Average CVP Net Energy Generation for CP1

Month	Existing Condition (2005)			Future Condition (2030)		
	Existing Condition (GWh)	CP1 Change (GWh (%))		No-Action Alternative (GWh)	CP1 Change (GWh (%))	
October	204	2	(1%)	191	2	(1%)
November	129	5	(4%)	111	3	(3%)
December	159	1	(1%)	141	4	(3%)
January	191	-4	(-2%)	181	-2	(-1%)
February	235	0	(0%)	237	6	(3%)
March	254	4	(2%)	272	1	(0%)
April	311	-1	(0%)	310	-2	(-1%)
May	454	2	(0%)	449	1	(0%)
June	497	6	(1%)	488	8	(2%)
July	562	8	(1%)	545	13	(2%)
August	414	3	(1%)	420	0	(0%)
September	280	-3	(-1%)	283	-5	(-2%)
Total	3,691	24	(1%)	3,629	27	(1%)

Source: Common Assumptions Common Modeling Package Version 9 LongTermGen

Note:
Simulation period: 1922 – 2003
Key:
CP = Comprehensive Plan
CVP = Central Valley Project
GWh = gigawatt-hour

Table 23-16 shows the change in net energy generation, which is the difference between the long-term monthly average energy generation and monthly average energy consumption, at all SWP plants for CP1 compared to the existing condition. CP1 shows an overall decrease in long-term monthly net energy generation; the greatest decrease, 4 percent, occurring in February, would be a less than significant impact. Similarly, an overall decrease in net energy generation was observed for CP1 compared to the future condition; the greatest decrease, 5 percent, observed for January, would also be a less than significant impact. However, when considering the maximum monthly impact for CP1 on net energy generation, decreases greater than 5 percent were observed 54 times in the existing condition level of development and 84 times in the future condition level of development out of 984 occurrences. Consequently, there would be a potentially significant impact on SWP net energy generation.

Therefore, this impact would be potentially significant. Mitigation for this impact is not proposed because reductions in power generation would be offset by increased generation from other sources.

Table 23-16. Simulated Monthly Average SWP Net Energy Generation for CP1

Month	Existing Condition (2005)			Future Condition (2030)		
	Existing Condition (GWh)	CP1 Change (GWh (%))		No-Action Alternative (GWh)	CP1 Change (GWh (%))	
October	-360	-4	(1%)	-435	-2	(1%)
November	-356	-10	(3%)	-441	-4	(1%)
December	-351	-5	(1%)	-433	-3	(1%)
January	-405	-12	(3%)	-411	-21	(5%)
February	-342	-13	(4%)	-369	-5	(1%)
March	-355	-5	(1%)	-419	-2	(1%)
April	-308	-6	(2%)	-394	-7	(2%)
May	-288	-3	(1%)	-366	-2	(1%)
June	-278	-4	(2%)	-329	-1	(0%)
July	-275	-3	(1%)	-335	-4	(1%)
August	-378	-3	(1%)	-443	-1	(0%)
September	-433	-5	(1%)	-508	2	(0%)
Total	-4,128	-74	(2%)	-4,884	-51	(1%)

Source: Common Assumptions Common Modeling Package Version 9, SWP Power CA

Note:
Simulation period: 1922 – 2003
Key:
CP = Comprehensive Plan
GWh = megawatt-hour
SWP = State Water Project

Impact Hydro-5 (CP1): Decrease in Pit 7 Powerplant Net Energy Generation
Table 23-17 shows the estimate of decreased energy production on Pit 7 Details

are included in Attachment 1 of the Power and Energy Technical Report, on energy generation, consumption, and change for CP1 compared to the existing condition and No-Action Alternative for all CVP and SWP powerplants and pumping plants.

Powerplant under CP1. Pit 7 Powerplant energy production would generally decrease only when the raised Shasta pool is higher than the normal Pit 7 tailwater elevation of 1,067 feet above msl based on National Geodetic Vertical Datum of 1929 (NGVD29). Assuming that the historic annual pattern of Shasta pool levels would be maintained with the higher maximum pool, in an average year, Pit 7 Powerplant energy production would decrease from March through July. These 5 months typically provide roughly 47 percent of the total average annual energy production. Taking these factors into account, total Pit 7 Powerplant average annual energy production for CP1 could decrease by roughly 4 gigawatt-hours (GWh) (1 percent) from the existing condition and future condition. Looking at maximum monthly impact for CP1, the decrease in net energy generation is less than 5 percent, which is a less than significant impact.

Table 23-17. Simulated Monthly Average Pit 7 Powerplant Energy Generation for CP1

Month	Existing Condition (2005)			Future Condition (2030)		
	Existing Condition (GWh)	CP1 Change (GWh (%))		No-Action Alternative (GWh)	CP1 Change (GWh (%))	
January	52.6	0.0	(0%)	52.6	0.0	(0%)
February	52.6	0.0	(0%)	52.6	0.0	(0%)
March	64.6	-0.2	(0%)	64.6	-0.2	(0%)
April	57.8	-1.4	(-2%)	57.8	-1.4	(-2%)
May	52.1	-1.5	(-3%)	52.1	-1.5	(-3%)
June	38.5	-0.7	(-2%)	38.5	-0.7	(-2%)
July	33.2	-0.1	(0%)	33.2	-0.1	(0%)
August	31.2	0.0	(0%)	31.2	0.0	(0%)
September	30.9	0.0	(0%)	30.9	0.0	(0%)
October	33.6	0.0	(0%)	33.6	0.0	(0%)
November	36.7	0.0	(0%)	36.7	0.0	(0%)
December	45.1	0.0	(0%)	45.1	0.0	(0%)
Total	528.9	-4.0	(-1%)	528.9	-4.0	(-1%)

Source: Spreadsheet model, *Pit 7 Dam MONTHLY AVG.xls,2007*
Note:
Simulation period: 1922 – 2003
Key:
CP = Comprehensive Plan
GWh = gigawatt-hour

Under the existing condition, the turbines operate over a net head range of approximately 173 to 204 feet. Under the 6.5-foot Shasta Dam raise option, the operating range of net head would decrease to about 168 to 193 feet, an approximately 4 percent decrease in net head. Assuming peak turbine efficiency is approximately 204 feet net head, the potential future minimum net head of 168 feet would be about 82 percent of the peak efficiency net head, which would still be an acceptable range for continuous operation. A decrease in maximum net head from 204 feet to 193 feet would reduce each unit's generating capacity by approximately 5 percent, from the current 56 MWh to approximately 53 MWh.

For these reasons, this impact would be less than significant. Mitigation for this impact is not needed, and thus not proposed.

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

As with CP1, this Comprehensive Plan focuses on enlargement of Shasta Dam and Reservoir consistent with the goals of the 2000 CALFED ROD, and was formulated for the primary purposes of increased water supply reliability and increased anadromous fish survival. In addition to the common features above, CP2 consists of raising Shasta Dam 12.5 feet, an elevation change that increases the full pool by 14.5 feet, and enlarges the total storage space in the reservoir by 443,000 acre-feet. This alternative would help reduce future shortages by increasing drought and average year water supply reliability. The increased cold-water pool also would contribute to improved seasonal water temperatures for anadromous fish on the upper Sacramento River.

Simulations of CP2 did not involve any changes to the modeling logic for deliveries or flow requirements; all benchmark rules were updated to include the new storage, but were not otherwise changed.

Shasta Lake and Vicinity

Impact Hydro-1 (CP2): Decrease in Shasta Powerplant Energy Generation A decrease in Shasta Dam energy generation is one indicator of project impacts because increasing the hydropower capabilities of Shasta Powerplant is one of the secondary planning objectives of the study. This impact would be potentially significant.

Table 23-18 shows an overall beneficial impact from increase in monthly generation at Shasta Powerplant for CP2 of 38 percent in December to 157 percent in April, compared to the existing condition. Similarly, CP2 shows an overall beneficial impact from increase in hydropower generation of 2 to 5 percent compared to the future condition. A decrease of 2 percent in long-term average energy generation, observed for December, would be a less than significant impact. The increase in power generation is due to raising Shasta Dam by 14.5 feet, which would increase the available head for power generation. However, when considering the maximum monthly impact for CP2 in hydropower generation, decreases greater than 5 percent were observed 9 times in the existing condition level of development and 88 times in the future condition level of development out of 984 occurrences.

Therefore, this impact would be potentially significant. Mitigation for this impact is not proposed because reductions in power generation would be offset by increased generation from other sources.

Upper Sacramento River Negligible effects on Power and Energy are expected to occur in the Upper Sacramento River geographic region; therefore, potential effects in that geographic region are not discussed further in this PDEIS.

Lower Sacramento River and Delta Negligible effects on Power and Energy are expected to occur in the Lower Sacramento River and Delta geographic region; therefore, potential effects in that geographic region are not discussed further in this PDEIS.

Table 23-18. Simulated Monthly Average Shasta Powerplant Energy Generation for CP2

Month	Existing Condition (2005)			Future Condition (2030)		
	Existing Condition (GWh)	CP2 Change (GWh (%))		No-Action Alternative (GWh)	CP2 Change (GWh (%))	
October	132	66	(50%)	123	4	(3%)
November	120	53	(44%)	114	3	(3%)
December	156	59	(38%)	152	-2	(-2%)
January	160	79	(50%)	162	3	(2%)
February	187	106	(57%)	183	9	(5%)
March	180	168	(94%)	179	3	(2%)
April	160	251	(157%)	160	7	(4%)
May	200	261	(131%)	202	4	(2%)
June	259	214	(83%)	257	9	(4%)
July	275	189	(69%)	280	12	(4%)
August	201	155	(77%)	209	9	(4%)
September	116	85	(73%)	124	4	(3%)
Total	2,146	1687	(79%)	2,145	64	(3%)

Source: Common Assumptions Common Modeling Package Version 9 LongTermGen

Note:
Simulation period: 1922 – 2003

Key:
CP = Comprehensive Plan
GWh = gigawatt-hour

CVP/SWP Service Areas

Impact Hydro-2 (CP2): Decrease in CVP and SWP Powerplant Energy Generation Table 23-19 shows an overall beneficial impact from an increase in monthly generation of 21 to 67 percent at CVP powerplants for CP2, compared to the existing condition. Similarly, CP2 shows an overall beneficial impact from increases on hydropower generation of 1 to 3 percent compared to the future condition. A decrease in long-term monthly average energy generation of 1 percent, observed for January, would be a less than significant impact. However, when considering the maximum monthly impact for CP2 on hydropower generation, decreases greater than 5 percent were observed 79 times in the existing condition level of development and 93 times in the future condition level of development out of 984 occurrences. Consequently, there would be a potentially significant impact on CVP energy generation.

Table 23-19. Simulated Monthly Average CVP Energy Generation for CP2

Month	Existing Condition (2005)			Future Condition (2030)		
	Existing Condition (GWh)	CP2 Change (GWh (%))		No-Action Alternative (GWh)	CP2 Change (GWh (%))	
October	304	65	(21%)	292	3	(1%)
November	245	56	(23%)	234	3	(1%)
December	294	62	(21%)	284	4	(1%)
January	336	72	(21%)	332	-3	(-1%)
February	353	105	(30%)	346	8	(2%)
March	358	171	(48%)	357	3	(1%)
April	364	244	(67%)	362	0	(0%)
May	511	261	(51%)	509	3	(1%)
June	587	218	(37%)	579	12	(2%)
July	678	192	(28%)	671	22	(3%)
August	533	154	(29%)	546	7	(1%)
September	370	82	(22%)	381	0	(0%)
Total	4,934	1681	(34%)	4,893	62	(1%)

Source: Common Assumptions Common Modeling Package Version 9 LongTermGen
Note:
Simulation period: 1922 – 2003
Key:
CP = Comprehensive Plan
CVP= Central Valley Project
GWh = gigawatt-hour

Table 23-20 shows an overall beneficial impact from an increase in monthly generation at SWP powerplants of 1 to 2 percent for CP2, compared to the existing condition. A decrease in long-term monthly generation of 1 percent, observed for November, January, February, and March, would be a less than significant impact. Similarly, CP2 shows an overall beneficial impact from increases of approximately 1 percent in hydropower generation compared to the future condition. A decrease of long-term monthly average energy generation of less than 1 percent, observed for June, would be a less than significant impact. However, when considering the maximum monthly impact for CP2 on hydropower generation, decreases greater than 5 percent were observed 61 times in the existing condition level of development and 100 times in the future condition level of development out of 984 occurrences. Consequently, there would be a potentially significant impact on SWP energy generation.

For these reasons, this impact would be potentially significant. Mitigation for this impact is not proposed because reductions in power generation would be offset by increased generation from other sources.

Table 23-20. Simulated Monthly Average SWP Energy Generation for CP2

Month	Existing Condition (2005)			Future Condition (2030)		
	Existing Condition (GWh)	CP2 Change (GWh (%))		No-Action Alternative (GWh)	CP2 Change (GWh (%))	
October	325	3	(1%)	344	2	(1%)
November	269	-2	(-1%)	295	0	(0%)
December	322	2	(1%)	333	3	(1%)
January	348	-4	(-1%)	347	4	(1%)
February	408	-2	(-1%)	422	0	(0%)
March	460	-5	(-1%)	465	0	(0%)
April	392	3	(1%)	429	2	(1%)
May	475	3	(1%)	514	0	(0%)
June	523	4	(1%)	551	-5	(-1%)
July	508	6	(1%)	563	-2	(0%)
August	426	7	(2%)	462	-1	(0%)
September	341	1	(0%)	373	3	(1%)
Total	4,798	16	(0%)	5,097	6	(0%)

Source: Common Assumptions Common Modeling Package Version 9, SWP Power CA
Note:
Simulation period: 1922 – 2003
Key:
CP = Comprehensive Plan
GWh = gigawatt-hour
SWP = State Water Project

Impact Hydro-3 (CP2): Increase in CVP and SWP Pumping Plant Energy Consumption Table 23-21 shows the change in monthly energy consumption at CVP pumping plants for CP2, compared to the existing condition, resulting from additional pumping to accommodate the primary planning objectives of the study, increasing water supply reliability and anadromous fish survival. The greatest increase in long-term monthly average energy consumption, 3 percent, observed for July, would be a less than significant impact. Similar operations criteria governing CP2 compared to the future condition resulted in a maximum increase of 3 percent in long-term February average energy consumption, which also would be a less than significant impact. However, when considering the maximum monthly impact for CP2 on energy consumption, increases greater than 5 percent were observed 99 times in the existing condition level of development and 124 times in the future condition level of development out of 984 occurrences. Consequently, there would be a potentially significant impact

Table 23-21. Simulated Monthly Average CVP Energy Consumption for CP2

Month	Existing Condition (2005)			Future Condition (2030)		
	Existing Condition (GWh)	CP2 Change (GWh (%))		No-Action Alternative (GWh)	CP2 Change (GWh (%))	
October	100	-1	(-1%)	101	2	(2%)
November	116	0	(0%)	123	2	(1%)
December	135	0	(0%)	144	1	(1%)
January	145	1	(1%)	151	-1	(-1%)
February	118	2	(1%)	109	3	(3%)
March	104	2	(2%)	85	0	(0%)
April	53	0	(0%)	53	0	(1%)
May	57	1	(1%)	59	1	(1%)
June	89	1	(1%)	90	1	(1%)
July	116	3	(3%)	125	3	(2%)
August	119	2	(2%)	126	2	(1%)
September	90	0	(0%)	98	2	(2%)
Total	1,243	11	(1%)	1,264	14	(1%)

Source: Common Assumptions Common Modeling Package Version 9 LongTermGen

Note:
Simulation period: 1922 – 2003
Key:
CP = Comprehensive Plan
CVP = Central Valley Project
GWh = gigawatt-hour

Table 23-22 shows the change in monthly energy consumption at SWP pumping plants for CP2, compared to the existing condition, resulting from additional pumping. The greatest increase in long-term monthly average energy consumption, 2 percent, observed for November, would be a less than significant impact. Similar operations criteria governing CP2 compared to the future condition resulted in a maximum increase of 3 percent in long-term January average energy consumption, which would also be a less than significant impact. However, when considering the maximum monthly impact for CP2 in energy consumption, increases greater than 5 percent were observed 134 times in the existing condition level of development and 95 times in the future condition level of development out of 984 occurrences. Consequently, there would be a potentially significant impact on SWP energy consumption.

For these reasons, this impact would be potentially significant. Mitigation for this impact is not proposed because increases in energy consumption would be offset by increased generation from other sources.

Table 23-22. Simulated Monthly Average SWP Energy Consumption for CP2

Month	Existing Condition (2005)			Future Condition (2030)		
	Existing Condition (GWh)	CP2 Change (GWh (%))		No-Action Alternative (GWh)	CP2 Change (GWh (%))	
October	685	8	(1%)	779	3	(0%)
November	625	10	(2%)	737	3	(0%)
December	673	8	(1%)	766	6	(1%)
January	753	7	(1%)	758	24	(3%)
February	750	11	(1%)	791	6	(1%)
March	815	-2	(0%)	884	3	(0%)
April	700	10	(1%)	823	9	(1%)
May	763	7	(1%)	880	1	(0%)
June	801	9	(1%)	880	-4	(0%)
July	783	10	(1%)	897	1	(0%)
August	803	10	(1%)	905	-1	(0%)
September	774	7	(1%)	881	-2	(0%)
Total	8,925	92	(1%)	9,981	49	(0%)

Source: Common Assumptions Common Modeling Package Version 9, SWP Power CA
Note:
Simulation period: 1922 – 2003

Key:
CP = Comprehensive Plan
GWh = gigawatt-hour
SWP = State Water Project

Impact Hydro-4 (CP2): Decrease in CVP and SWP Net Energy Generation

Table 23-23 shows the change in net energy generation, which is the difference between long-term monthly average energy generation and monthly average energy consumption, at all CVP plants for CP2 compared to the existing condition. Overall, CP2 shows a beneficial impact in the form of increased long-term monthly net energy generation, ranging from 29 percent in September to 78 percent in April. No decrease in long-term monthly average net energy generation was observed. Similarly, an overall beneficial impact from increase in net energy generation was observed for CP2 compared to the future condition. A maximum decrease in net energy generation of 1 percent, observed for January and September, would be a less than significant impact. However, when considering the maximum monthly impact for CP2 on net energy generation, decreases greater than 5 percent were observed 127 times in the existing condition level of development and 150 times in future condition out of 984 occurrences. Consequently, there would be a potentially significant impact on CVP net energy generation.

Table 23-23. Simulated Monthly Average CVP Net Energy Generation for CP2

Month	Existing Condition (2005)			Future Condition (2030)		
	Existing Condition (GWh)	CP2 Change (GWh (%))		No-Action Alternative (GWh)	CP2 Change (GWh (%))	
October	204	66	(32%)	191	1	(1%)
November	129	56	(43%)	111	2	(2%)
December	159	62	(39%)	141	2	(2%)
January	191	71	(37%)	181	-2	(-1%)
February	235	103	(44%)	237	6	(2%)
March	254	169	(67%)	272	3	(1%)
April	311	244	(78%)	310	-1	(0%)
May	454	260	(57%)	449	2	(0%)
June	497	217	(44%)	488	11	(2%)
July	562	189	(34%)	545	19	(3%)
August	414	152	(37%)	420	5	(1%)
September	280	82	(29%)	283	-2	(-1%)
Total	3,691	1670	(45%)	3,629	47	(1%)

Source: Common Assumptions Common Modeling Package Version 9 LongTermGen

Note:

Simulation period: 1922 – 2003

Key:

CP = Comprehensive Plan

CVP = Central Valley Project

GWh = gigawatt-hour

Table 23-24 shows the change in net energy generation, which is the difference between long-term monthly average energy generation and monthly average energy consumption, all SWP plants for CP2 compared to the existing condition. Table 23-16 also shows a decrease in net energy generation in all months. The decrease of 1 to 4 percent, with an annual decrease of 2 percent, would be a less than significant impact. Similarly, an overall decrease in net energy generation was observed for CP2 compared to the future condition. The decrease, ranging from 1 percent to 5 percent, would be a less than significant impact. The only beneficial impact from increase in net generation of 1 percent was observed for September. However, when considering the maximum monthly impact for CP2 on net energy generation, decreases greater than 5 percent were observed 58 times in the existing condition level of development and 99 times in the future condition level of development out of 984 occurrences. Consequently, there would be a potentially significant impact on SWP net energy generation.

For these reasons, this impact would be potentially significant. Mitigation for this impact is not proposed because reductions in power generation would be offset by increased generation from other sources.

Table 23-24. Simulated Monthly Average SWP Average Net Energy Generation for CP2

Month	Existing Condition (2005)			Future Condition (2030)		
	Existing Condition (GWh)	CP2 Change (GWh (%))		No-Action Alternative (GWh)	CP2 Change (GWh (%))	
October	-360	-5	(1%)	-435	-1	(0%)
November	-356	-11	(3%)	-441	-4	(1%)
December	-351	-6	(2%)	-433	-3	(1%)
January	-405	-10	(3%)	-411	-20	(5%)
February	-342	-13	(4%)	-369	-6	(2%)
March	-355	-4	(1%)	-419	-3	(1%)
April	-308	-7	(2%)	-394	-7	(2%)
May	-288	-3	(1%)	-366	-1	(0%)
June	-278	-5	(2%)	-329	-1	(0%)
July	-275	-4	(1%)	-335	-2	(1%)
August	-378	-3	(1%)	-443	0	(0%)
September	-433	-5	(1%)	-508	5	(-1%)
Total	-4,128	-76	(2%)	-4,884	-43	(1%)

Source: Common Assumptions Common Modeling Package Version 9, SWP Power CA
Note:
Simulation period: 1922 – 2003
Key:
CP = Comprehensive Plan
GWh = gigawatt-hour
SWP = State Water Project

Details are included in Attachment 1 of the Power and Energy Technical Report, for energy generation, consumption, and change for CP2 compared to the existing condition and No-Action Alternative for all CVP and SWP powerplants and pumping plants.

Impact Hydro-5 (CP2): Decrease in Pit 7 Powerplant Net Energy Generation
Table 23-25 shows an estimate of reduced energy production for the Pit 7 Powerplant under CP2. Energy production for the Pit 7 Powerplant would generally decrease only when the raised Shasta pool is higher than the normal Pit 7 tailwater elevation of 1,067 feet above msl (NGVD29). Assuming that the historic annual pattern of Shasta pool level is maintained with the higher maximum pool, in an average year, Pit 7 Powerplant energy production would decrease from February through July. These 6 months typically provide roughly 56 percent of the total average annual energy production. Therefore, total average annual energy production for the Pit 7 Powerplant for CP2 could decrease by roughly 8.3 GWh (2 percent) from the existing condition and 8.2 GWh (2 percent) from the future condition. Considering the maximum monthly impact for CP2, decreases in net energy generation greater than 5 percent were observed in several instances, particularly in March through June, which could be a potentially significant impact on Pit 7 Powerplant net energy generation.

Table 23-25. Simulated Monthly Average Pit 7 Powerplant Energy Generation for CP2

Month	Existing Condition (2005)			Future Condition (2030)		
	Existing Condition (GWh)	CP2 Change (GWh (%))		No-Action Alternative (GWh)	CP2 Change (GWh (%))	
January	52.6	0.0	(0%)	52.6	0.0	(0%)
February	52.6	-0.1	(0%)	52.6	-0.1	(0%)
March	64.6	-1.1	(-2%)	64.6	-1.1	(-2%)
April	57.8	-2.7	(-5%)	57.8	-2.7	(-5%)
May	52.1	-2.7	(-5%)	52.1	-2.7	(-5%)
June	38.5	-1.4	(-4%)	38.5	-1.4	(-4%)
July	33.2	-0.4	(-1%)	33.2	-0.3	(-1%)
August	31.2	0.0	(0%)	31.2	0.0	(0%)
September	30.9	0.0	(0%)	30.9	0.0	(0%)
October	33.6	0.0	(0%)	33.6	0.0	(0%)
November	36.7	0.0	(0%)	36.7	0.0	(0%)
December	45.1	0.0	(0%)	45.1	0.0	(0%)
Total	528.9	-8.3	(-2%)	528.9	-8.2	(-2%)

Source: Spreadsheet model, Pit 7 Dam MONTHLY AVG.xls,2007
Note:
Simulation period: 1922 – 2003
Key:
CP = Comprehensive Plan
GWh = gigawatt-hour

Under the existing condition, the turbines operate over a net head range of approximately 173 to 204 feet. Under the 12.5-foot Shasta Dam raise option, the operating range of net head would decrease to about 162 to 187 feet, an approximate 7 percent reduction in net head. Assuming peak turbine efficiency is approximately 204 feet of net head, the potential future minimum net head of 162 feet would be about 79 percent of the peak efficiency net head, which should be an acceptable range for continuous operation. A reduction in maximum net head from 204 feet to 187 feet would reduce each unit's generating capacity by approximately 8 percent, from the current 56 MW to approximately 51 MW.

For these reasons, this impact would be potentially significant. Mitigation for this impact is not proposed because reductions in power generation would be offset by increased generation from other sources.

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

CP3 is similar to CP1 and CP2. It focuses on the greatest practical enlargement of Shasta Dam and Reservoir consistent with the goals of the 2000 CALFED ROD, and was formulated for the primary purposes of increased water supply reliability and increased anadromous fish survival. In addition to the common features above, CP3 consists of raising Shasta Dam 18.5 feet, an elevation change that increases the full pool by 20.5 feet, and enlarges the total storage space in the reservoir by 634,000 acre-feet to 5.19 million acre-feet. This Comprehensive Plan would help reduce future shortages by increasing drought and average year water supply reliability. The increased pool depth and volume would also contribute to improving seasonal water temperatures for anadromous fish on the upper Sacramento River.

Simulations of CP3 did not involve any changes to the modeling logic for deliveries or flow requirements; all benchmark rules were updated to include the new storage, but were not otherwise changed.

Shasta Lake and Vicinity

Impact Hydro-1 (CP3): Decrease in Shasta Powerplant Energy Generation A decrease in Shasta Dam energy generation is one indicator of project impacts because increasing the hydropower capabilities of the Shasta Powerplant is a secondary planning objective of the study. This impact would be potentially significant.

Table 23-26 shows a large beneficial impact from increase in monthly generation at the Shasta Powerplant, ranging from 37 percent in December to 159 percent in April, for CP3 compared to the existing condition. No decrease in long-term monthly generation was observed. Similarly, CP3 shows an overall beneficial impact from increases on hydropower generation, ranging from 2 percent in January to 7 percent in August, compared to the future condition. A decrease in long-term average energy generation of 2 percent, observed for

December, would be a less than significant impact. However, when considering the maximum monthly impact for CP3 on hydropower generation, decreases greater than 5 percent were observed 11 times in the existing condition level of development and 84 times in the future condition level of development out of 984 occurrences.

For these reasons, this impact would be potentially significant. Mitigation for this impact is not proposed because reductions in power generation would be offset by increased generation from other sources.

Upper Sacramento River Negligible effects on Power and Energy are expected to occur in the Upper Sacramento River geographic region; therefore, potential effects in that geographic region are not discussed further in this PDEIS.

Lower Sacramento River and Delta Negligible effects on Power and Energy are expected to occur in the Lower Sacramento River and Delta geographic region; therefore, potential effects in that geographic region are not discussed further in this PDEIS.

Table 23-26. Simulated Monthly Average Shasta Powerplant Energy for Generation for CP3 and CP5

Month	Existing Condition (2005)			Future Condition (2030)		
	Existing Condition (GWh)	CP3 /CP5 Change (GWh (%))		No-Action Alternative (GWh)	CP3/CP5 Change (GWh (%))	
October	132	69	(52%)	123	7	(5%)
November	120	56	(47%)	114	6	(5%)
December	156	58	(37%)	152	-3	(-2%)
January	160	80	(50%)	162	4	(2%)
February	187	108	(57%)	183	10	(6%)
March	180	178	(99%)	179	7	(4%)
April	160	255	(159%)	160	9	(6%)
May	200	265	(132%)	202	7	(4%)
June	259	216	(84%)	257	12	(5%)
July	275	193	(70%)	280	14	(5%)
August	201	163	(81%)	209	14	(7%)
September	116	87	(75%)	124	6	(5%)
Total	2,146	1,726	(80%)	2,145	92	(4%)

Source: Common Assumptions Common Modeling Package Version 9 LongTermGen
Note:
Simulation period: 1922 – 2003
Key:
CP = Comprehensive Plan
GWh = gigawatt-hour

CVP/SWP Service Areas

Impact Hydro-2 (CP3): Decrease in CVP and SWP Powerplant Energy Generation Table 23-27 shows large increases in monthly generation of 21 to 68 percent at CVP powerplants for CP3 compared to the existing condition. No decrease in long-term monthly generation was observed. Similarly, CP3 shows an overall beneficial impact from increases on hydropower generation of 1 to 4 percent compared to the future condition. A decrease in long-term monthly average energy generation of 1 percent, observed for January, would be a less than significant impact. However, when considering the maximum monthly impact for CP3 on hydropower generation, decreases greater than 5 percent were observed 96 times in the existing condition level of development and 101 times in the future condition level of development out of 984 occurrences. Consequently, there would be a potentially significant impact on CVP energy generation.

Table 23-27. Simulated Monthly Average CVP Energy Generation for CP3 and CP5

Month	Existing Condition (2005)			Future Condition (2030)		
	Existing Condition (GWh)	CP3/CP5 Change (GWh (%))		No-Action Alternative (GWh)	CP3/CP5 Change (GWh (%))	
October	304	67	(22%)	292	3	(1%)
November	245	57	(23%)	234	2	(1%)
December	294	61	(21%)	284	3	(1%)
January	336	71	(21%)	332	-2	(-1%)
February	353	107	(30%)	346	10	(3%)
March	358	181	(51%)	357	6	(2%)
April	364	248	(68%)	362	3	(1%)
May	511	264	(52%)	509	7	(1%)
June	587	219	(37%)	579	17	(3%)
July	678	199	(29%)	671	29	(4%)
August	533	160	(30%)	546	11	(2%)
September	370	84	(23%)	381	0	(0%)
Total	4,934	1,718	(35%)	4,893	88	(2%)

Source: Common Assumptions Common Modeling Package Version 9 LongTermGen
Note:
Simulation period: 1922 – 2003
Key:
CP = Comprehensive Plan
CVP = Central Valley Project
GWh = gigawatt-hour

Table 23-28 shows an overall beneficial impact from increases on monthly generation of 1 to 2 percent at SWP powerplants for CP3 compared to the existing condition. A decrease in long-term monthly generation of 1 percent, observed for January, March, and November, would be a less than significant impact. Similarly, CP3 shows a less than significant impact from decreases in hydropower generation compared to the future condition. A decrease in long-term monthly generation of 1 percent was observed for June. However, when considering the maximum monthly impact for CP3 on hydropower generation, decreases greater than 5 percent were observed 56 times in the existing condition level of development and 98 times in the future condition level of development out of 984 occurrences. Consequently, there would be a potentially significant impact on SWP energy generation.

For these reasons, this impact would be potentially significant. Mitigation for this impact is not proposed because reductions in power generation would be offset by increased generation from other sources.

Table 23-28. Simulated Monthly Average SWP Energy Generation for CP3 and CP5

Month	Existing Condition (2005)			Future Condition (2030)		
	Existing Condition (GWh)	CP3 Change (GWh (%))		No-Action Alternative (GWh)	CP3 Change (GWh (%))	
October	325	3	(1%)	344	2	(1%)
November	269	-3	(-1%)	295	0	(0%)
December	322	2	(1%)	333	4	(1%)
January	348	-3	(-1%)	347	4	(1%)
February	408	-1	(0%)	422	0	(0%)
March	460	-4	(-1%)	465	-2	(0%)
April	392	3	(1%)	429	2	(1%)
May	475	2	(0%)	514	0	(0%)
June	523	3	(1%)	551	-7	(-1%)
July	508	5	(1%)	563	0	(0%)
August	426	7	(2%)	462	-1	(0%)
September	341	1	(0%)	373	5	(1%)
Total	4,798	14	(0%)	5,097	7	(0%)

Source: Common Assumptions Common Modeling Package Version 9, SWP Power CA
Note:
Simulation period: 1922 – 2003
Key:
CP = Comprehensive Plan
GWh = gigawatt-hour
SWP = State Water Project

Impact Hydro-3 (CP3): Increase in CVP and SWP Pumping Plant Energy Consumption Table 23-29 shows the change in monthly energy consumption at CVP pumping plants for CP3 compared to the existing condition, resulting from additional pumping to accommodate the primary planning objectives of the study, increasing water supply reliability and anadromous fish survival. An increase in long-term monthly average energy consumption of 3 percent, observed for July, would be a less than significant impact. Similar operations criteria governing CP3, compared to the future condition, resulted in an increase of 3 percent for long-term average February and July energy consumption, which would also be a less than significant impact. However, when considering the maximum monthly impact for CP3 on energy consumption, increases greater than 5 percent were observed 116 times in the existing condition level of development and 148 times in the future condition level of development out of 984 occurrences. Consequently, there would be a potentially significant impact on CVP energy consumption.

Table 23-29. Simulated Monthly Average CVP Energy Consumption for CP3 and CP5

Month	Existing Condition (2005)			Future Condition (2030)		
	Existing Condition (GWh)	CP3/CP5 Change (GWh (%))		No-Action Alternative (GWh)	CP3/CP5 Change (GWh (%))	
October	100	0	(0%)	101	2	(2%)
November	116	1	(1%)	123	2	(1%)
December	135	0	(0%)	144	2	(2%)
January	145	0	(0%)	151	-2	(-1%)
February	118	1	(1%)	109	4	(3%)
March	104	0	(0%)	85	1	(1%)
April	53	0	(0%)	53	0	(1%)
May	57	1	(1%)	59	1	(2%)
June	89	2	(2%)	90	2	(2%)
July	116	4	(3%)	125	4	(3%)
August	119	3	(2%)	126	3	(2%)
September	90	0	(1%)	98	2	(2%)
Total	1,243	12	(1%)	1,264	21	(2%)

Source: Common Assumptions Common Modeling Package Version 9 LongTermGen
Note:
Simulation period: 1922 – 2003
Key:
CP = Comprehensive Plan
CVP = Central Valley Project
GWh = gigawatt-hour

Table 23-30 shows the change in monthly energy consumption at SWP pumping plants resulting from additional pumping for CP3 compared to the existing condition. The greatest increase in long-term monthly average energy consumption, 2 percent, observed for February, would be a less than significant impact. Similar operations criteria governing CP3 compared to the future condition resulted in a maximum increase of 3 percent for long-term average energy consumption in January, which would also be a less than significant impact. However, when considering the maximum monthly impact for CP3 on energy consumption, increases greater than 5 percent were observed 129 times in the existing condition level of development and 108 times in the future condition level of development out of 984 occurrences. Consequently, there would be a potentially significant impact on SWP energy consumption.

For these reasons, this impact would be potentially significant. Mitigation for this impact is not proposed because increases in energy consumption would be offset by increased generation from other sources.

Table 23-30. Simulated Monthly Average SWP Energy Consumption for CP3 and CP5

Month	Existing Condition (2005)			Future Condition (2030)		
	Existing Condition (GWh)	CP3 Change (GWh (%))		No-Action Alternative (GWh)	CP3 Change (GWh (%))	
October	685	7	(1%)	779	5	(1%)
November	625	9	(1%)	737	4	(1%)
December	673	8	(1%)	766	7	(1%)
January	753	11	(1%)	758	25	(3%)
February	750	14	(2%)	791	7	(1%)
March	815	1	(0%)	884	0	(0%)
April	700	8	(1%)	823	10	(1%)
May	763	5	(1%)	880	0	(0%)
June	801	6	(1%)	880	-9	(-1%)
July	783	8	(1%)	897	3	(0%)
August	803	8	(1%)	905	-1	(0%)
September	774	6	(1%)	881	-1	(0%)
Total	8,925	90	(1%)	9,981	51	(1%)

Source: Common Assumptions Common Modeling Package Version 9, SWP Power CA
Note:
Simulation period: 1922 – 2003
Key:
CP = Comprehensive Plan
GWh = gigawatt-hour
SWP = State Water Project

Impact Hydro-4 (CP3): Decrease in CVP and SWP Net Energy Generation
Table 23-31 shows the change in net energy generation, which is the difference between the long-term monthly average energy generation and monthly average energy consumption, at all CVP plants for CP3 compared to the existing condition. Overall, CP3 shows a beneficial impact in the form of increased long-term monthly net energy generation. No decrease in long-term monthly average net generation was observed. Similarly, an overall beneficial impact from increases on net energy generations was observed for CP3 compared to the future condition. A maximum decrease in net energy generation of 1 percent, observed for September, would also be a less than significant impact. However, when considering the maximum monthly impact for CP3 on net energy generation, decreases greater than 5 percent were observed 143 times in the existing condition level of development and 163 times in the future condition level of development out of 984 occurrences. Consequently, there would be a potentially significant impact on CVP net energy generation.

Table 23-31. Simulated Monthly Average CVP Net Energy Generation for CP3 and CP5

Month	Existing Condition (2005)			Future Condition (2030)		
	Existing Condition (GWh)	CP3 Change (GWh (%))		No-Action Alternative (GWh)	CP3 Change (GWh (%))	
October	204	67	(33%)	191	2	(1%)
November	129	56	(44%)	111	1	(1%)
December	159	60	(38%)	141	0	(0%)
January	191	71	(37%)	181	-1	(0%)
February	235	105	(45%)	237	6	(3%)
March	254	181	(71%)	272	5	(2%)
April	311	248	(80%)	310	2	(1%)
May	454	264	(58%)	449	6	(1%)
June	497	217	(44%)	488	15	(3%)
July	562	195	(35%)	545	25	(5%)
August	414	157	(38%)	420	8	(2%)
September	280	83	(30%)	283	-2	(-1%)
Total	3,691	1,706	(46%)	3,629	67	(2%)

Source: Common Assumptions Common Modeling Package Version 9 LongTermGen
Note:
Simulation period: 1922 – 2003

Key:
CP = Comprehensive Plan
CVP = Central Valley Project
GWh = megawatt-hour

Table 23-32 shows the change in net energy generation, which is the difference between long-term monthly average energy generation and monthly average energy consumption, at all SWP plants for CP3 compared to the existing condition. CP3 shows an overall decrease in long-term monthly net energy generation; the greatest decrease, 4 percent, observed for February, would be a less than significant impact. Similarly, an overall decrease in net energy generation was observed for CP3 compared to the future condition; the greatest decrease in net generation, 5 percent, observed for January, would also be considered a less than significant impact. However, when considering the maximum monthly impact for CP3 on net energy generation, decreases greater than 5 percent were observed 48 times in the existing condition level of development and 99 times in the future condition level of development out of 984 occurrences. Consequently, there would be a potentially significant impact on SWP net energy generation.

For these reasons, this impact would be potentially significant. Mitigation for this impact is not proposed because reductions in power generation would be offset by increased generation from other sources.

Table 23-32. Simulated Monthly Average SWP Net Energy Generation for CP3 and CP5

Month	Existing Condition (2005)			Future Condition (2030)		
	Existing Condition (GWh)	CP3 Change (GWh (%))		No-Action Alternative (GWh)	CP3 Change (GWh (%))	
October	-360	-4	(1%)	-435	-2	(0%)
November	-356	-11	(3%)	-441	-5	(1%)
December	-351	-6	(2%)	-433	-4	(1%)
January	-405	-13	(3%)	-411	-21	(5%)
February	-342	-15	(4%)	-369	-7	(2%)
March	-355	-5	(1%)	-419	-3	(1%)
April	-308	-5	(2%)	-394	-8	(2%)
May	-288	-3	(1%)	-366	-1	(0%)
June	-278	-3	(1%)	-329	2	(-1%)
July	-275	-3	(1%)	-335	-2	(1%)
August	-378	-1	(0%)	-443	0	(0%)
September	-433	-5	(1%)	-508	6	(-1%)
Total	-4,128	-75	(2%)	-4,884	-44	(1%)

Source: Common Assumptions Common Modeling Package Version 9, SWP Power CA
Note:
Simulation period: 1922 – 2003
Key:
CP = Comprehensive Plan
GWh = gigawatt-hour
SWP = State Water Project

Details are included in Attachment 1 of the *Power and Energy Technical Report*, for energy generation, consumption, and change for CP3 compared to the existing condition and No-Action Alternative for all CVP and SWP powerplants and pumping plants.

Impact Hydro-5 (CP3): Decrease in Pit 7 Powerplant Net Energy Generation
Table 23-33 shows an estimate of decreased energy production for the Pit 7 Powerplant under CP3. Energy production for the Pit 7 Powerplant would generally decrease only when the raised Shasta pool is higher than the normal Pit 7 tailwater elevation of 1,067 feet above msl (NGVD29). Assuming that the historic annual pattern of Shasta pool levels is maintained with the higher maximum pool, in an average year, Pit 7 Powerplant energy production would decrease from February through July. These 6 months typically provide roughly 56 percent of the total average annual energy production. Therefore, total average annual energy production for the Pit 7 Powerplant for CP3 could decrease by roughly 14 GWh (3 percent) for the existing condition and 13.9 GWh (3 percent) for the future condition. Considering the maximum monthly impacts for CP3, decreases in net energy generation greater than 5 percent were observed in several instances, particularly in March through July, which could potentially be a significant impact on Pit 7 Powerplant net energy generation.

Table 23-33. Simulated Monthly Average Pit 7 Powerplant Energy Generation for CP3 and CP5

Month	Existing Condition (2005)			Future Condition (2030)		
	Existing Condition (GWh)	CP3 Change (GWh (%))		No-Action Alternative (GWh)	CP3 Change (GWh (%))	
January	52.6	0.0	(0%)	52.6	0.0	(0%)
February	52.6	-0.4	(-1%)	52.6	-0.4	(-1%)
March	64.6	-2.5	(-4%)	64.6	-2.5	(-4%)
April	57.8	-4.2	(-7%)	57.8	-4.2	(-7%)
May	52.1	-4.0	(-8%)	52.1	-4.0	(-8%)
June	38.5	-2.2	(-6%)	38.5	-2.2	(-6%)
July	33.2	-0.8	(-2%)	33.2	-0.7	(-2%)
August	31.2	0.0	(0%)	31.2	0.0	(0%)
September	30.9	0.0	(0%)	30.9	0.0	(0%)
October	33.6	0.0	(0%)	33.6	0.0	(0%)
November	36.7	0.0	(0%)	36.7	0.0	(0%)
December	45.1	0.0	(0%)	45.1	0.0	(0%)
Total	528.9	-14.0	(-3%)	528.9	-13.9	(-3%)

Source: Spreadsheet model, Pit 7 Dam MONTHLY AVG.xls,2007
Note:
Simulation period: 1922 – 2003
Key:
CP = Comprehensive Plan
GWh = gigawatt-hour

Under the existing condition, the turbines operate with a net head range of approximately 173 to 204 feet. Under the 18.5-foot Shasta Dam raise option, the operating range of net head would decrease to about 156 to 181 feet, an approximate 10 percent reduction in net head. Assuming peak turbine efficiency is approximately 204 feet net head, the potential future minimum net head of 156 feet would be about 75 percent of the peak efficiency net head, which should an acceptable range for continuous operation. A decrease in maximum net head from 204 feet to 181 feet would reduce each unit's generating capacity by approximately 17 percent, from the current 56 MW to approximately 47 MW.

For these reasons, this impact would be potentially significant. Mitigation for this impact is not proposed because reductions in power generation would be offset by increased generation from other sources.

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

The primary function of CP4 is to address anadromous fish survival, while still improving water supply reliability. It focuses on increasing the volume of cold water available to the temperature control device through reservoir reoperations, and on raising Shasta Dam by 18.5 feet. As with CP3, and in addition to the common features above, this raise would increase the full pool by 20.5 feet and enlarge total reservoir storage space by 634,000 acre-feet. This additional storage space would expand Shasta Reservoirs' cold-water supply available to the temperature control device by 378,000 acre-feet, a feature that would help improve cooler water temperatures in the upper Sacramento River.

CP4 differs from CP3 by focusing on increased storage to maintaining cold-water volume, resulting in a higher seasonal carryover storage. The operations of CP4 are identical to those of CP1. With that constraint, simulation of CP4 did not involve any changes to the modeling logic for deliveries or flow requirements; all of the benchmark rules were updated to include the new storage, but were not otherwise changed.

Shasta Lake and Vicinity

Impact Hydro-1 (CP4): Decrease in Shasta Powerplant Energy Generation A decrease in Shasta Dam energy generation is one indicator of project impacts because increasing the hydropower capabilities of Shasta Powerplant is a secondary planning objective of the study. This impact would be potentially significant.

Table 23-34 shows an overall beneficial impact from increases on monthly generation at Shasta Powerplant of 5 to 8 percent for CP4 compared to the existing condition. No decrease in long-term monthly generation was observed. Similarly, CP4 shows an overall beneficial impact from increases on hydropower generation of 5 to 11 percent compared to the future condition. No decrease in long-term average monthly generation was observed. Although CP4 indicates an overall beneficial impact, maximum monthly decreases in hydropower generation greater than 5 percent were observed 43 times in the existing condition and 58 times in the future condition out of 984 occurrences.

For this reason, this impact would be potentially significant. Mitigation for this impact is not proposed because reductions in power generation would be offset by increased generation from other sources.

Upper Sacramento River Negligible effects on Power and Energy are expected to occur in the Upper Sacramento River geographic region; therefore, potential effects in that geographic region are not discussed further in this PDEIS.

Table 23-34. Simulated Monthly Average Shasta Powerplant Energy Generation for CP4

Month	Existing Condition (2005)			Future Condition (2030)		
	Existing Condition (GWh)	CP4 Change (GWh (%))		No-Action Alternative (GWh)	CP4 Change (GWh (%))	
October	132	7	(6%)	123	7	(6%)
November	120	6	(5%)	114	6	(6%)
December	156	8	(5%)	152	7	(5%)
January	160	11	(7%)	162	9	(5%)
February	187	14	(8%)	183	20	(11%)
March	180	12	(7%)	179	10	(5%)
April	160	11	(7%)	160	11	(7%)
May	200	12	(6%)	202	11	(5%)
June	259	16	(6%)	257	15	(6%)
July	275	19	(7%)	280	19	(7%)
August	201	16	(8%)	209	16	(8%)
September	116	9	(8%)	124	9	(7%)
Total	2,146	142	(7%)	2,145	141	(7%)

Source: Common Assumptions Common Modeling Package Version 9 LongTermGen
Note:
Simulation period: 1922 – 2003
Key:
CP = Comprehensive Plan
GWh = gigawatt-hour

Lower Sacramento River and Delta Negligible effects on Power and Energy are expected to occur in the Lower Sacramento River and Delta geographic region; therefore, potential effects in that geographic region are not discussed further in this PDEIS.

CVP/SWP Service Areas

Impact Hydro-2 (CP4): Decrease in CVP and SWP Powerplant Energy Generation Table 23-35 shows an overall beneficial impact from increases on monthly generation at CVP powerplants of 1 percent in April and September to 5 percent in November for CP4 compared to the existing condition. No decrease in long-term monthly generation was observed. Similarly, CP4 shows an overall beneficial impact from increases on hydropower generation of 2 to 6 percent compared to the future condition. No decrease in long-term average monthly generation was observed. However, when considering the maximum monthly impact for CP4 on hydropower generation, decreases greater than 5 percent were observed 62 times in the existing condition level of development and 27 times in the future condition level of development out of 984 occurrences. Consequently, there would be a potentially significant impact on CVP energy generation.

Table 23-35. Simulated Monthly Average CVP Energy Generation for CP4

Month	Existing Condition (2005)			Future Condition (2030)		
	Existing Condition (GWh)	CP4 Change (GWh (%))		No-Action Alternative (GWh)	CP4 Change (GWh (%))	
October	304	8	(3%)	292	7	(2%)
November	245	11	(5%)	234	6	(3%)
December	294	10	(3%)	284	7	(3%)
January	336	6	(2%)	332	9	(3%)
February	353	12	(3%)	346	20	(6%)
March	358	16	(4%)	357	8	(2%)
April	364	5	(1%)	362	10	(3%)
May	511	12	(2%)	509	11	(2%)
June	587	19	(3%)	579	17	(3%)
July	678	23	(3%)	671	26	(4%)
August	533	14	(3%)	546	14	(3%)
September	370	2	(1%)	381	7	(2%)
Total	4,934	139	(3%)	4,893	142	(3%)

Source: Common Assumptions Common Modeling Package Version 9 LongTermGen

Note:

Simulation period: 1922 – 2003

Key:
CP = Comprehensive Plan
CVP=Central Valley Project
GWh = gigawatt-hour

Table 23-36 shows an overall increase of 1 percent in monthly generation at SWP powerplants for CP4 compared to the existing condition. A decrease in long-term monthly generation of 1 percent, observed for January, March, and November, would be a less than significant impact. CP4 shows no change in hydropower generation compared to the future condition. A decrease in long-term monthly average generation of 1 percent, observed for February, would be a less than significant impact. However, when considering the maximum monthly impact for CP4 on hydropower generation, decreases greater than 5 percent were observed 60 times in the existing condition level of development and 33 times in the future condition level of development out of 984 occurrences. Consequently, there would be a potentially significant impact on SWP energy generation.

For these reasons, this impact would be potentially significant. Mitigation for this impact is not proposed because reductions in power generation would be offset by increased generation from other sources.

Table 23-36. Simulated Monthly Average SWP Energy Generation for CP4

Month	Existing Condition (2005)			Future Condition (2030)		
	Existing Condition (GWh)	CP4 Change (GWh (%))		No-Action Alternative (GWh)	CP4 Change (GWh (%))	
October	325	2	(1%)	344	0	(0%)
November	269	-2	(-1%)	295	-1	(0%)
December	322	0	(0%)	333	0	(0%)
January	348	-3	(-1%)	347	0	(0%)
February	408	-2	(0%)	422	-3	(-1%)
March	460	-4	(-1%)	465	-1	(0%)
April	392	2	(1%)	429	0	(0%)
May	475	3	(1%)	514	0	(0%)
June	523	3	(1%)	551	-1	(0%)
July	508	6	(1%)	563	0	(0%)
August	426	6	(1%)	462	2	(0%)
September	341	2	(0%)	373	0	(0%)
Total	4,798	12	(0%)	5,097	-4	(0%)

Source: Common Assumptions Common Modeling Package Version 9, SWP Power CA
Note:
Simulation period: 1922 – 2003
Key:
CP = Comprehensive Plan
GWh = gigawatt-hour
SWP = State Water Project

Impact Hydro-3 (CP4): Increase in CVP and SWP Pumping Plant Energy Consumption Table 23-37 shows the change in monthly energy consumption at CVP pumping plants for CP4 compared to the existing condition resulting from additional pumping to accommodate the primary planning objectives of the study, increasing water supply reliability and anadromous fish survival. The greatest increase in long-term monthly average energy consumption, 3 percent, observed for March and July, would be a less than significant impact. Similar operations criteria governing CP4 compared to the future condition resulted in a maximum increase of 1 percent in long-term average energy consumption for February, October, and November, which would also be a less than significant impact. However, when considering the maximum monthly impact for CP4 on energy consumption, increases greater than 5 percent were observed 97 times in the existing condition level of development and 43 times in the future condition level of development out of 984 occurrences. Consequently, there would be a potentially significant impact on CVP energy consumption.

Table 23-37. Simulated Monthly Average CVP Energy Consumption for CP4

Month	Existing Condition (2005)			Future Condition (2030)		
	Existing Condition (GWh)	CP4 Change (GWh (%))		No-Action Alternative (GWh)	CP4 Change (GWh (%))	
October	100	0	(0%)	101	1	(1%)
November	116	0	(0%)	123	1	(1%)
December	135	0	(0%)	144	0	(0%)
January	145	1	(0%)	151	-1	(0%)
February	118	2	(2%)	109	1	(1%)
March	104	3	(3%)	85	0	(0%)
April	53	0	(0%)	53	0	(0%)
May	57	1	(1%)	59	0	(0%)
June	89	1	(1%)	90	0	(0%)
July	116	3	(3%)	125	0	(0%)
August	119	1	(1%)	126	0	(0%)
September	90	0	(0%)	98	0	(0%)
Total	1,243	11	(1%)	1,264	2	(0%)

Source: Common Assumptions Common Modeling Package Version 9 LongTermGen
Note:
Simulation period: 1922 – 2003
Key:
CP = Comprehensive Plan
CVP = Central Valley Project
GWh = gigawatt-hour

Table 23-38 shows the change in monthly energy consumption at SWP pumping plants resulting from additional pumping for CP4 compared to the existing condition. The greatest increase in long-term monthly average energy consumption, 2 percent, observed for February, would be a less than significant impact. Similar operations criteria governing CP4 compared to the future condition resulted in no change in long-term average monthly energy consumption. However, when considering the maximum monthly impact for CP1 on energy consumption, increases greater than 5 percent were observed 125 times in the existing condition level of development and 23 times in the future condition level of development out of 984 occurrences. Consequently, there would be a potentially significant impact on SWP energy consumption.

For these reasons, this impact would be potentially significant. Mitigation for this impact is not proposed because increases in energy consumption would be offset by increased generation from other sources.

Table 23-38. Simulated Monthly Average SWP Energy Consumption for CP4

Month	Existing Condition (2005)			Future Condition (2030)		
	Existing Condition (GWh)	CP4 Change (GWh (%))		No-Action Alternative (GWh)	CP4 Change (GWh (%))	
October	685	6	(1%)	779	0	(0%)
November	625	8	(1%)	737	0	(0%)
December	673	5	(1%)	766	0	(0%)
January	753	9	(1%)	758	4	(0%)
February	750	12	(2%)	791	3	(0%)
March	815	0	(0%)	884	-3	(0%)
April	700	8	(1%)	823	-1	(0%)
May	763	6	(1%)	880	0	(0%)
June	801	8	(1%)	880	1	(0%)
July	783	9	(1%)	897	0	(0%)
August	803	9	(1%)	905	-1	(0%)
September	774	6	(1%)	881	-1	(0%)
Total	8,925	86	(1%)	9,981	2	(0%)

Source: Common Assumptions Common Modeling Package Version 9, SWP Power CA
Note:
Simulation period: 1922 – 2003
Key:
CP = Comprehensive Plan
GWh = gigawatt-hour
SWP = State Water Project

Impact Hydro-4 (CP4): Decrease in CVP and SWP Net Energy Generation
Table 23-39 shows the change in net energy generation, which is the difference between long-term monthly average energy generation and monthly average energy consumption, at all CVP plants for CP4 compared to the existing condition. Overall, CP4 shows a beneficial impact in the form of increased long-term monthly net energy generation, ranging from 1 percent in September to 9 percent in November. No decrease in long-term monthly net energy generation was observed. Similarly, an overall beneficial impact from increases on net energy generation of 2 percent in May and September to 8 percent in February was observed for CP4 compared to the future condition. No decrease in long-term monthly net energy generation was observed. However, when considering the maximum monthly impact for CP4 on net energy generation, decreases greater than 5 percent were observed 112 times in the existing condition level of development and 68 times in the future condition level of development out of 984 occurrences. Consequently, there would be a potentially significant impact on CVP net energy generation.

Table 23-39. Simulated Monthly Average CVP Net Energy Generation for CP4

Month	Existing Condition (2005)			Future Condition (2030)		
	Existing Condition (GWh)	CP4 Change (GWh (%))		No-Action Alternative (GWh)	CP4 Change (GWh (%))	
October	204	8	(4%)	191	6	(3%)
November	129	11	(9%)	111	6	(5%)
December	159	10	(6%)	141	7	(5%)
January	191	5	(3%)	181	10	(5%)
February	235	10	(4%)	237	19	(8%)
March	254	13	(5%)	272	8	(3%)
April	311	5	(2%)	310	10	(3%)
May	454	11	(2%)	449	11	(2%)
June	497	18	(4%)	488	17	(3%)
July	562	20	(4%)	545	26	(5%)
August	414	13	(3%)	420	14	(3%)
September	280	3	(1%)	283	7	(2%)
Total	3,691	127	(3%)	3,629	140	(4%)

Source: Common Assumptions Common Modeling Package Version 9 LongTermGen
Note:
Simulation period: 1922 – 2003
Key:
CP = Comprehensive Plan
CVP = Central Valley Project
GWh = gigawatt-hour

Table 23-40 shows the change in net energy generation, which is the difference between long-term monthly average energy generation and monthly average energy consumption, at all SWP plants for CP4 compared to the existing condition. CP4 shows an overall decrease in long-term monthly net energy generation. The greatest decrease in net generation, 4 percent, observed for February, would be a less than significant impact. No significant change in net energy generations was observed for CP4 compared to the future condition. The greatest decrease in net generation, 1 percent, observed for January, February, and June, would also be a less than significant impact. However, when considering the maximum monthly impact for CP4 on net energy generation, decreases greater than 5 percent were observed 54 times in the existing condition level of development and 32 times in the future condition level of development out of 984 occurrences. Consequently, there would be a potentially significant impact on SWP net energy generation.

For these reasons, this impact would be potentially significant. Mitigation for this impact is not proposed because reductions in power generation would be offset by increased generation from other sources.

Table 23-40. Simulated Monthly Average SWP Net Energy Generation for CP4

Month	Existing Condition (2005)			Future Condition (2030)		
	Existing Condition (GWh)	CP4 Change (GWh (%))		No-Action Alternative (GWh)	CP4 Change (GWh (%))	
October	-360	-4	(1%)	-435	0	(0%)
November	-356	-10	(3%)	-441	-2	(0%)
December	-351	-5	(1%)	-433	0	(0%)
January	-405	-12	(3%)	-411	-4	(1%)
February	-342	-13	(4%)	-369	-5	(1%)
March	-355	-5	(1%)	-419	2	(-1%)
April	-308	-6	(2%)	-394	1	(0%)
May	-288	-3	(1%)	-366	0	(0%)
June	-278	-4	(2%)	-329	-2	(1%)
July	-275	-3	(1%)	-335	0	(0%)
August	-378	-3	(1%)	-443	3	(-1%)
September	-433	-5	(1%)	-508	1	(0%)
Total	-4,128	-74	(2%)	-4,884	-5	(0%)

Source: Common Assumptions Common Modeling Package Version 9, SWP Power CA
Note:
Simulation period: 1922 – 2003
Key:
CP = Comprehensive Plan
GWh = gigawatt-hour
SWP = State Water Project

Details are included in Attachment 1 of the *Power and Energy Technical Report*, for energy generation, consumption, and change for CP4 compared to the existing condition and No-Action Alternative for all CVP and SWP powerplants and pumping plants.

Impact Hydro-5 (CP4): Decrease in Pit 7 Powerplant Net Energy Generation
Table 23-41 shows an estimate of decreased energy production for the Pit 7 Powerplant under CP4. Energy production for the Pit 7 Powerplant would generally decrease only when the raised Shasta pool is higher than the normal Pit 7 tailwater elevation of 1,067 feet above msl (NGVD29). Assuming that the historic annual pattern of Shasta full pool levels is maintained with the higher maximum pool, in an average year, Pit 7 Powerplant energy production would decrease from February through July. These 6 months typically provide roughly 56 percent of the total average annual energy production. Therefore, total average annual energy production for the Pit 7 Powerplant could decrease by roughly 12.2 GWh (2 percent). Considering maximum monthly impact for CP4, decreases in net energy generation greater than 5 percent were observed in several instances, particularly in March through June, which could potentially be a significant impact on Pit 7 Powerplant net energy generation.

Table 23-41. Simulated Monthly Average Pit 7 Powerplant Energy Generation for CP4

Month	Existing Condition (2005)			Future Condition (2030)		
	Existing Condition (GWh)	CP4 Change (GWh (%))		No-Action Alternative (GWh)	CP4 Change (GWh (%))	
January	52.6	0.0	(0%)	52.6	0.0	(0%)
February	52.6	-0.1	(0%)	52.6	-0.2	(0%)
March	64.6	-2.0	(-3%)	64.6	-2.0	(-3%)
April	57.8	-4.1	(-7%)	57.8	-4.0	(-7%)
May	52.1	-3.6	(-7%)	52.1	-3.6	(-7%)
June	38.5	-1.7	(-5%)	38.5	-1.7	(-4%)
July	33.2	-0.4	(-1%)	33.2	-0.3	(-1%)
August	31.2	0.0	(0%)	31.2	0.0	(0%)
September	30.9	0.0	(0%)	30.9	0.0	(0%)
October	33.6	0.0	(0%)	33.6	0.0	(0%)
November	36.7	0.0	(0%)	36.7	0.0	(0%)
December	45.1	0.0	(0%)	45.1	0.0	(0%)
Total	528.9	-11.9	(-2%)	528.9	-11.9	(-2%)

Source: Spreadsheet model, Pit 7 Dam MONTHLY AVG.xls,2007
Note:
Simulation period: 1922 – 2003
Key:
CP = Comprehensive Plan
GWh = gigawatt-hour

Under the existing condition, the turbines operate with a net head range of approximately 173 to 204 feet. Under the 18.5-foot Shasta Dam raise option, the operating range of net head would decrease to about 156 to 181 feet, an approximate 10 percent reduction in net head. Assuming peak turbine efficiency is approximately 204 feet net head, the potential future minimum net head of 156 feet would be about 75 percent of the peak efficiency net head, which should an acceptable range for continuous operation. A decrease in maximum net head from 204 feet to 181 feet would reduce each unit's generating capacity by approximately 17 percent, from the current 56 MW to approximately 47 MW.

For these reasons, this impact would be potentially significant. Mitigation for this impact is not proposed because reductions in power generation would be offset by increased generation from other sources.

CP5 – 18.5-Foot Dam Raise, Combination Plan

CP5 would address both the primary and secondary planning objectives. CP5 includes enlarging Shasta Dam by 18.5 feet, which is consistent with the objectives of the 2000 CALFED ROD, and also includes the common features above. In addition, CP5 includes (1) implementing environmental restoration features along the lower reaches of major tributaries to Shasta Lake, (2) constructing shoreline fish habitat around Shasta Lake, and (3) constructing either additional or improved recreation features at various locations around Shasta Lake to increase the value of the recreational experience. Formulation of specific environmental restoration features and increased recreation components is not yet complete but will be included in the Draft Feasibility Report.

Operations under CP5 would be identical to CP3. The differences between the two alternatives would be limited to nonperational features.

Shasta Lake and Vicinity

Impact Hydro-1 (CP5): Decrease in Shasta Powerplant Energy Generation
This impact would be the same as Impact Hydro-1 (CP3) and would be potentially significant.

Upper Sacramento River Negligible effects on Power and Energy are expected to occur in the Upper Sacramento River geographic region; therefore, potential effects in that geographic region are not discussed further in this PDEIS.

Lower Sacramento River and Delta Negligible effects on Power and Energy are expected to occur in the Lower Sacramento River and Delta geographic region; therefore, potential effects in that geographic region are not discussed further in this PDEIS.

CVP/SWP Service Areas

Impact Hydro-2 (CP5): Decrease in CVP and SWP Powerplants Energy Generation This impact would be the same as Impact Hydro-2 (CP3) and would be potentially significant.

Impact Hydro-3 (CP5): Increase in CVP and SWP Pumping Plant Energy Consumption This impact would be the same as Impact Hydro-3 (CP3) and would be potentially significant.

Impact Hydro-4 (CP5): Decrease in CVP and SWP Net Energy Generation This impact would be the same as Impact Hydro-4 (CP3) and would be potentially significant.

Impact Hydro-5 (CP5): Decrease in Pit 7 Powerplant Net Energy Generation This impact would be the same as Impact Hydro-5 (CP3) and would be potentially significant.

23.3.4 Mitigation Measures

Table 23-42 presents a summary of mitigation measures for power and energy.

No-Action Alternative and CP1 – CP5

No specific mitigation measures are proposed for the decrease in hydropower generation, and the increase in consumption of electrical energy.

There are several potential significant unavoidable impact to energy generation and energy consumption associated with the implementation of No-Action Alternative and CP1 – CP5, as shown in Table 23-42.

Each of these potential significant unavoidable impacts is the result of decrease in energy production (decrease in hydropower generation) or increase in energy usage (increase in power consumption for pumping). These unavoidable impacts are potentially significant because they would likely require the generation of electrical energy from another source (to replace lost hydroelectric generation or to provide additional power for pumping). Replacement of additional generation would likely come from a thermal generation source, such as combined cycle natural gas fired turbine, or a coal fired powerplant. Generation from a source that meets the California Public Utilities Commission's Emissions Performance Standards would contribute up to 1,200 pounds/MWh of greenhouse, plus other pollutants such as particulates and oxides of nitrogen. Thus, additional pumping electoral load of 5,000 MWh per year would likely contribute 3,000 tons of more greenhouse gasses to the atmosphere.

Table 23-42. Summary of Mitigation Measures for Power and Energy

Impact		No-Action Alternative	CP1	CP2	CP3	CP4	CP5
Impact Hydro-1: Decrease in Shasta Powerplant Energy Generation	LOS before Mitigation	PS	PS	PS	PS	PS	PS
	Mitigation Measure	None required.	No mitigation needed; thus, none proposed.				
	LOS after Mitigation	PS	PS	PS	PS	PS	PS
Impact Hydro-2: Decrease in CVP and SWP Powerplant Energy Generation	LOS before Mitigation	PS	PS	PS	PS	PS	PS
	Mitigation Measure	None required.	No mitigation needed; thus, none proposed.				
	LOS after Mitigation	PS	PS	PS	PS	PS	PS
Impact Hydro-3: Increase in CVP and SWP Pumping Plant Energy	LOS before Mitigation	PS	PS	PS	PS	PS	PS
	Mitigation Measure	None required.	No mitigation needed; thus, none proposed.				
	LOS after Mitigation	PS	PS	PS	PS	PS	PS
Impact Hydro-4: Decrease in CVP and SWP Net Energy Generation	LOS before Mitigation	PS	PS	PS	PS	PS	PS
	Mitigation Measure	None required.	No mitigation needed; thus, none proposed.				
	LOS after Mitigation	PS	PS	PS	PS	PS	PS
Impact Hydro-5: Decrease in Pit 7 Powerplant Net Energy Generation	LOS before Mitigation	NI	LTS	PS	PS	PS	PS
	Mitigation Measure	None required.	No mitigation needed; thus, none proposed.				
	LOS after Mitigation	NI	LTS	PS	PS	PS	PS

Key:
LOS = level of significance
LTS = less than significant
NI = No Impact
PS = potentially significant

23.3.5 Cumulative Effects

Chapter 3, "Considerations for Describing the Affected Environment and Environmental Consequences" discusses the overall cumulative impacts of the project alternatives, including the relationship to CALFED Programmatic Cumulative Impacts Analysis, qualitative and quantitative assessment, past and future actions in the study area, and significance criteria.

This section provides an analysis of overall cumulative impacts of the project alternatives with other past, present, and reasonably foreseeable future projects producing related impacts.

The projects listed in the quantitative analysis section of Chapter 3, "Considerations for Describing the Affected Environment and Environmental Consequences" are included in the 2030 level-of-development alternatives. Accordingly, quantitative effects of the projects combined with the SLWRI alternatives are described in the Section 23.2. Project alternatives would cause potentially significant impacts on CVP and SWP facility hydropower generation and consumption. The discussion below focuses on the qualitative effect of the SLWRI alternatives and other past, present, and reasonably foreseeable future projects.

The effects of climate change on operations at Shasta Lake could potentially result in changes to power and energy. As described in the Climate Change Projection Appendix, climate change could result in higher reservoir releases in the winter and early spring due to an increase in runoff during these times. Similarly, climate change could result in lower reservoir inflows and Sacramento tributary flows during the late spring and summer due to a decreased snow pack. This reduction in inflow and tributary flow could result in Shasta Lake storage being reduced due to both a reduced ability to capture flows, and an increased need to make releases to meet downstream requirements.

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

When combined with other past, present, and reasonably foreseeable future projects, it is likely there would be a change in river flows and reservoir elevations. Since Shasta Reservoir is operated to meet flow and water quality requirements in the Sacramento River and Delta, any new project or program along the Sacramento River and in the Delta could potentially impact the CVP and SWP facility hydropower generation and consumption of CP1. With the implementation of many of the projects, Shasta Reservoir could be reoperated, which would result in changes to the Sacramento River flow regime and reservoir elevations, and could cause a potentially significant impact on CVP/SWP facility hydropower generation and consumption.

As stated previously, effects of climate change on operations of Shasta Lake could include increased inflows and releases at certain times of the year, and decreased inflows and storage at other times. The additional storage associated with CP1 would potentially diminish these effects and allow Shasta Lake to capture some of the increased runoff in the winter and early spring for release in late spring and summer. Additionally, the increased storage volume would allow Shasta Lake to maintain greater storage and potentially greater hydropower generation. Therefore, the addition of anticipated effects of climate change, would not result in CP1 having a significant cumulative effect.

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

When combined with other past, present, and reasonably foreseeable future projects, it is likely there would be a change in river flows and reservoir elevations. Since Shasta Reservoir is operated to meet flow and water quality requirements in the Sacramento River and Delta, any new project or program along the Sacramento River and in the Delta could potentially impact the CVP and SWP facility hydropower generation and consumption of CP2. With the implementation of many of the projects, Shasta Reservoir could be reoperated, which would result in changes to the Sacramento River flow regime and reservoir elevations, and could cause a potentially significant impact on CVP/SWP facility hydropower generation and consumption.

As stated previously, effects of climate change on operations of Shasta Lake could include increased inflows and releases at certain times of the year, and decreased inflows and storage at other times. The additional storage associated with CP2 would potentially diminish these effects and allow Shasta Lake to capture some of the increased runoff in the winter and early spring for release in late spring and summer. Additionally, the increased storage volume would allow Shasta Lake to maintain greater storage and potentially greater hydropower generation. Therefore, the addition of anticipated effects of climate change, would not result in CP2 having a significant cumulative effect.

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

When combined with other past, present, and reasonably foreseeable future projects, it is likely there would be a change in river flows and reservoir elevations. Since Shasta Reservoir is operated to meet flow and water quality requirements in the Sacramento River and Delta, any new project or program along the Sacramento River and in the Delta could potentially impact the CVP and SWP facility hydropower generation and consumption of CP3. With the implementation of many of the projects, Shasta Reservoir could be reoperated, which would result in changes to the Sacramento River flow regime and reservoir elevations, and could cause a potentially significant impact on CVP/SWP facility hydropower generation and consumption.

As stated previously, effects of climate change on operations of Shasta Lake could include increased inflows and releases at certain times of the year, and decreased inflows and storage at other times. The additional storage associated with CP3 would potentially diminish these effects and allow Shasta Lake to capture some of the increased runoff in the winter and early spring for release in late spring and summer. Additionally, the increased storage volume would allow Shasta Lake to maintain greater storage and potentially greater hydropower generation. Therefore, the addition of anticipated effects of climate change, would not result in CP3 having a significant cumulative effect.

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

When combined with other past, present, and reasonably foreseeable future projects, it is likely there would be a change in river flows and reservoir elevations. Since Shasta Reservoir is operated to meet flow and water quality requirements in the Sacramento River and Delta, any new project or program along the Sacramento River and in the Delta could potentially impact the CVP and SWP facility hydropower generation and consumption of CP4. With the implementation of many of the projects, Shasta Reservoir could be reoperated, which would result in changes to the Sacramento River flow regime and reservoir elevations, and could cause a potentially significant impact on CVP/SWP facility hydropower generation and consumption.

As stated previously, effects of climate change on operations of Shasta Lake could include increased inflows and releases at certain times of the year, and decreased inflows and storage at other times. The additional storage associated with CP4 would potentially diminish these effects and allow Shasta Lake to capture some of the increased runoff in the winter and early spring for release in late spring and summer. Additionally, the increased storage volume would allow Shasta Lake to maintain greater storage and potentially greater hydropower generation. Therefore, the addition of anticipated effects of climate change, would not result in CP4 having a significant cumulative effect.

CP5 – 18.5-Foot Dam Raise, Combination Plan

When combined with other past, present, and reasonably foreseeable future projects, it is likely there would be a change in river flows and reservoir elevations. Since Shasta Reservoir is operated to meet flow and water quality requirements in the Sacramento River and Delta, any new project or program along the Sacramento River and in the Delta could potentially impact the CVP and SWP facility hydropower generation and consumption of CP5. With the implementation of many of the projects, Shasta Reservoir could be reoperated, which would result in changes to the Sacramento River flow regime and reservoir elevations, and could cause a potentially significant impact on CVP/SWP facility hydropower generation and consumption.

As stated previously, effects of climate change on operations of Shasta Lake could include increased inflows and releases at certain times of the year, and decreased inflows and storage at other times. The additional storage associated with CP5 would potentially diminish these effects and allow Shasta Lake to capture some of the increased runoff in the winter and early spring for release in late spring and summer. Additionally, the increased storage volume would allow Shasta Lake to maintain greater storage and potentially greater hydropower generation. Therefore, the addition of anticipated effects of climate change, would not result in CP5 having a significant cumulative effect.