CHAPTER 6.0

OTHER STATUTORY REQUIREMENTS

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6.0 OTHER STATUTORY REQUIREMENTS

6.1 GROWTH INDUCEMENT

The analysis of growth-inducing effects addresses the effects that economic and population growth fostered by the Proposed Project could have on local resource conditions, including housing, provision of public services, and other resources (i.e., air quality, water quality, and biological resources). The analysis of growth-inducing effects of the project alternatives is based on the expected change in population attributed to the Oroville Facilities, which is addressed in Section 5.9.1, Population and Housing. These effects are summarized below for each alternative.

Under the No-Project Alternative, the Oroville Facilities would continue to be operated and maintained as they are now under the terms and conditions in the existing FERC license, and no new protection, mitigation, and enhancement (PM&E) measures would be implemented, other than those arising from existing legal obligations and agreements. The population of the local area is expected to increase in the future in response to regional and statewide population growth trends. As described in Section 5.9.1, Population and Housing, the population in Butte County supported by the jobs directly and indirectly supported by visitor and operations and maintenance (O&M) spending is estimated to increase from 2,360 in 2002 to 2,770 in 2020 under the No-Project Alternative, representing an increase of 410 persons, or an average annual increase of about 23 persons when spread over the 18-year period. (Growth in recreation use, and resulting growth in visitor-supported population, is presumed to increase at a similar rate throughout the remainder of the anticipated 50-year FERC project license period.) Because changes in projected populations are expected to be small and gradual, population-related effects on the demand for housing and public services (discussed in more detail in Section 5.9.1, Population and Housing, and Section 5.9.2, Public Services, respectively) and ancillary effects on natural resource conditions would be minor. The growth-inducing effects of the No-Project Alternative would be **less-than-significant**.

Under the Proposed Project, recreation facilities in the FERC Project area would be upgraded and new recreation facilities constructed over the term of the new license to address current needs and future needs based on monitoring. As discussed in Section 5.9.1, Population and Housing, implementation of the Proposed Project could generate permanent population growth in Butte County by attracting workers and their families. The population supported by jobs generated by visitor and O&M spending under the Proposed Project could increase from 2,360 in 2002 to 3,160 in 2020, with about half of this project-related growth expected to occur with or without implementation of the Proposed Project in response to regional and statewide population growth trends. (No population estimates are available for the Proposed Project beyond 2020; however, growth in recreation use, and resulting growth in visitor-supported population, is presumed to increase at a similar rate throughout the remainder of the anticipated 50-year FERC project license period.) The 800-person increase between 2002 and 2020 would represent average annual growth of 44 persons, including the annual 23-person

increase that would occur under the No-Project Alternative, when spread over the 18-year period. The effects of this increment of growth generated by the Proposed Project are anticipated to be small because the increase in employment and resulting population growth is expected to be minor and gradual, many new jobs could be filled by persons already residing in Butte County, and project-related population growth would be spread across a number of jurisdictions. Therefore, the growth-inducing effects of the Proposed Project on the demand for housing and public services (discussed in more detail in Section 5.9.1, Population and Housing, and Section 5.9.2, Public Services, respectively), and ancillary effects on natural resource conditions, would be minor and considered **less-than-significant**.

Under the FERC Staff Alternative, the population growth induced would be similar to that induced by the Proposed Project because the alternative proposes only minor changes to the actions comprising the Proposed Project, indicating that changes in visitation levels and resulting population levels would be similar. Therefore, the growth-inducing effects of the FERC Staff Alternative are also considered **less-than-significant**.

6.2 CUMULATIVE IMPACTS

CEQA requires that an EIR contain an assessment of the cumulative impacts that could be associated with a proposed project. This assessment involves examining project-related effects on the environment in the context of similar effects that have been caused by past or existing projects and that would be caused by reasonably foreseeable future projects. Even when project-related impacts are individually minor, the cumulative effects of these impacts, in combination with the impacts of other projects, could be significant under CEQA and must be discussed (State CEQA Guidelines, Sections 15130 and 15355[b]).

As described in Section 15065(c) of the State CEQA Guidelines, an EIR must discuss the cumulative impacts of a project when its incremental effect would be cumulatively considerable. This means that the incremental effects of an individual project would be cumulatively considerable when viewed in connection with the effects of past projects, the effects of other current projects, and the effects of probable future projects.

Section 15355 of the State CEQA Guidelines defines cumulative impacts as "two or more individual effects which, when considered together, are considerable or which compound or increase other environmental impacts." This section states further that "[I]individual effects may be changes resulting from a single project or a number of separate projects. The cumulative impact from several projects is [defined as] the change in the environment which results from the incremental impact of the project when added to other closely related past, present, and reasonably foreseeable future projects. Cumulative impacts can result from individually minor but collectively significant projects taking place over a period of time." Cumulative effects occur when the incremental impacts of a project or action under consideration overlap with the effects of related actions in space (geographic) or in time (temporal).

The fact that a cumulative impact is significant on the whole does not necessarily mean that the project-related contribution to that impact is significant as well. Instead, under CEQA, a project-related contribution to a significant cumulative impact is only significant if the contribution is cumulatively considerable. The significance conclusion of the project's contribution to a cumulative impact considers whether the project implements or funds its fair share of a mitigation measure or measures designed to alleviate the cumulative impact. Where a lead agency is examining a project with an incremental effect that is not cumulatively considerable, it need not consider the effect significant, but must briefly describe the basis for its conclusion. However, Section 15130(a) of the State CEQA Guidelines requires that EIRs discuss the cumulative impacts of a project when the project's incremental effect is cumulatively considerable.

Section 15130(b) of the State CEQA Guidelines also indicates that the level of detail of the cumulative analysis need not be as great as for the project impact analyses; however, it should reflect the severity of the impacts and its likelihood of occurrence, and it should be focused, practical, and reasonable.

To be adequate, a discussion of cumulative effects must include the following elements:

- Either (a) a list of past, present, and probable future projects, including, if necessary, those outside the agency's control, or (b) a summary of projections contained in an adopted general plan or related planning document, or in a prior adopted or certified environmental document, that described or evaluated regional or area-wide conditions contributing to the cumulative impact, provided that such documents are referenced and made available for public inspection at a specified location;

- A summary of the individual projects' expected environmental effects; and

- A reasonable analysis of all the relevant projects' cumulative impacts, with an examination of reasonable, feasible options for mitigating or avoiding the project's contribution to such effects (Section 15130(b)).

The above CEQA guidance was used to develop the approach and format for each of the resource-specific cumulative impacts analyses in this DEIR. Each subsection below describes the cumulative effects of past and present related actions that have interacted with the baseline conditions of the Oroville Facilities and led to the related conditions described in Chapter 4.0, Environmental Setting. The discussion of historical impacts is limited by the amount of available information. Potential cumulative impacts in the future are then defined for each of the resources. These potential impacts may occur as reasonably foreseeable related actions interact with the incremental effects of the alternatives defined in Chapter 3.0.

6.2.1 Cumulatively Affected Resources and Related Actions

The resources listed below have the potential to be cumulatively affected by continued operation of the Oroville Facilities and other past, existing, and reasonably foreseeable related actions. The resource topics that are the focus of the analysis are indicated in parentheses. Other resource topics were considered but are not the focus of the cumulative analysis for the reasons noted in the related cumulative effects subsections of this chapter:

- Geology and soils (gravel recruitment, sediment transport, and large woody debris [LWD]);

- Surface water quantity (Feather River releases below Oroville Dam, Thermalito Diversion Dam, and Thermalito Afterbay, and Lake Oroville water surface elevations) and quality (water temperature);

- Aquatic resources (spring-run Chinook salmon and Central Valley steelhead, green sturgeon, river lamprey, and Sacramento splittail);

- Terrestrial resources (riparian vegetation in the Feather River below Oroville Dam and around Thermalito Afterbay and associated botanical and wildlife species, including special-status species);

- Recreational resources (project recreational resources affected by related actions, Feather River flows downstream of Oroville Dam, or Lake Oroville water surface elevations);

- Cultural resources (resources within the FERC Project boundary affected by related actions, Feather River flows below Oroville Dam, or Lake Oroville water surface elevations);

- Public services (local public services, including law enforcement, criminal justice, fire protection, emergency, and road maintenance services); and

- Agricultural resources (agricultural production within the Feather River Service Area [FRSA]).

Past, present, and reasonably foreseeable related actions addressed in the cumulative effects analysis are listed below. Past and present actions were considered related if they have contributed to cumulative effects on the resources listed above. Future actions were listed below if they were considered "reasonably foreseeable" (i.e., likely to occur given the status of such factors as project approvals, NEPA and/or CEQA compliance, permitting, and funding):

- Urban development and land uses and related population growth;

- Mining and dredging activities;

- Agricultural development and land uses;

- Water resource development needed to support urban or agricultural development (e.g., upstream and downstream diversions, storage and conveyance for supply purposes, upstream hydroelectric facilities, and downstream levee and dike construction for flood management purposes), including original construction of the Oroville Facilities;

- Local, State, or federal agency resource management and land use plans;

- Management of special-status species (including implementation of recovery plans, biological opinions, etc.);

- Ocean and stream harvesting of fish;

- Regional fish hatchery activities;

- Other recreational activities outside of the FERC Project boundary;

- Timber harvesting;

- Watershed management activities;

- The CALFED Bay-Delta Program (CALFED) and its implementation (for more information see http//calwater.ca.gov);

- The Central Valley Project Improvement Act (CVPIA) and its implementation including the Anadromous Fish Restoration Program (AFRP) (for more information see http://www.usbr.gov/mp/cvpia/);

- Pacific Gas and Electric Company's (PG&E's) Upper North Fork Feather River Project relicensing (P-2105), Bucks Creek relicensing (P-619), Poe Project relicensing (P-2107), and Rock Creek-Cresta license implementation (P-1962) (for more information see http://www.FERC.gov);

- South Feather Water and Power Agency's South Fork Feather River Project (P-2088) relicensing (for more information see http://www.FERC.gov);

- Delta Pumping Plant Fish Protection (Four Pumps) Agreement (for more information see http://www.des.water.ca.gov/mitigation_restoration_branch/fourpumps/);

- South Delta Improvements Program and its implementation (for more information see http://sdip.water.ca.gov/);

- Lower Yuba River Accord and its implementation (for more information see http://www.ycwa.com/); and

- The Yuba-Feather Supplemental Flood Control Project (for more information see http://www.ycwa.com/).

Section 5.4.1 contains additional information regarding many of the projects and regulatory proceedings listed above. The SWP, of which the Oroville Facilities are a vital part, and the recent Monterey Agreement, developed to address water allocation and issues pertaining to the management and financing of the SWP, are described below.

6.2.1.1 The State Water Project

The State Water Resources Development System, commonly known as the SWP, is the project authorized and financed by the California Water Resources Development Bond Act, also known as the Burns-Porter Act (Water Code Section 12930 et seq.). The Act was passed by the California Legislature in 1959 and approved by voters in 1960.

The Burns-Porter Act expressly authorized the State of California to enter into contracts for the sale, delivery, or use of water made available by the SWP in return for payment of a major portion of the capital and operation costs of the SWP. The first of these contracts was signed with the Metropolitan Water District of Southern California on November 4, 1960, and served as a prototype for all subsequent SWP long-term water supply contracts. The Burns-Porter Act and the long-term contracts provide the institutional structure supporting the operation and financing of the SWP (Water Code

Section 11450 et seq.; Water Code 12930 et seq.). DWR currently has contracts with 29 water agencies. Collectively known as the SWP contractors, these 29 water agencies deliver water directly to agricultural and urban water users or to water wholesalers or retailers.

Each contract for long term-term water supply contains a Table A that sets forth the maximum amount of dependable SWP water that the State agrees to deliver, if available for delivery, to a contractor on an annual basis. The State and SWP contractors also use Table A amounts to serve as a basis for allocation of some SWP costs among the contractors. Delivery of the Table A amount is not assured, but rather provides the basis for proportional allocation of available SWP supplies among the contractors. The precise amount of water received in any given year will depend on hydrological conditions and SWP operations. If deliveries have not reached the total of Table A amounts held by all 29 contractors, the actual amount received in any given year by a particular contractor will be a proportion of the available water supplies based on its Table A amount.

The water supply contracts call for progressive increases in the amount of Table A water delivered to each contractor, and are structured to reflect increasing water demands. Most contractors reached their maximum Table A in 1990. Originally, the maximum Table A amounts were anticipated to be a collective total of 4,230,000 acre-feet per year (afy) by 2020. This number is also referred to as the minimum project yield. As a result of contract amendments in the 1980s and the Monterey Amendment in 1995, the current combined maximum annual Table A amount is 4,172,686 acre-feet (afy).

As the contractors' Table A amounts increased, the expectation was that additional facilities would be built to meet the expected demand. Project development unfolded substantially as planned through the 1960s and early 1970s. Major components of the SWP were built and put into service, and the contractors took increasing quantities of water from the SWP.

Circumstances began to change in the 1970s. Various concerns, including environmental, political, financial, and hydrologic factors, prevented the development of some components of the SWP. Demands for SWP water are expected to rise as the population of California continues to increase.

6.2.1.2 The Monterey Agreement

The SWP contracts were originally executed in the 1960s. Contract provisions reflected DWR's expectations at that time with respect to future water demand and the construction schedule of SWP components. DWR and the contractors made many amendments to the contracts to resolve disagreements and address matters that arose over a 30-year period, but the most important contract provisions remained substantially unchanged until the early 1990s.

The water contracts in place through the mid-1990s contained provisions that specified how water would be allocated to contractors when the requested Table A amounts exceeded the available water supply. Specifically, Article 18 included 2 provisions intended to address short-term and permanent shortages, and 1 that addressed changes in the minimum project yield. Article 18(a) directed the State to reduce deliveries to agricultural contractors by a percentage not to exceed 50 percent in any year in which a shortage occurred due to drought or other temporary outages that reduced Table A amounts up to an aggregate limit of 100 percent in any series of 7 years before reducing water deliveries for other purposes. If additional reductions were needed, the contract specified that further reductions would be borne by all contractors. Article 18(b) dealt with permanent shortages and specified that DWR would reduce Table A amounts to all contractors such that the Table A amount equaled the minimum project yield. Article 18(d) allowed DWR to revise Table A amounts upward after implementing Article 18(b) if future conditions justified a revision.

During the drought in 1986–1992, water supply to agricultural contractors was drastically reduced. They were exposed to 50 percent reductions before the municipal and industrial (M&I) contractors experienced reductions in deliveries. Then in 1991, the supplies to agricultural contractors were cut 100 percent. During this time agricultural contractors were contractually required to make payments for Table A amounts even though they received no water. M&I contractors also recognized that the SWP supplies were not as dependable from year to year as they had anticipated, and began developing local water supplies and projects that could more effectively use surplus SWP water available only in wet periods to place in local groundwater or underground storage. However, opportunities for such projects were limited within each contractor's service area and M&I users were seeking contract amendments to store SWP water outside their service area.

Certain agricultural contractors began to complain about the lack of supply from the SWP during dry years, and disagreements arose among DWR, the agricultural contractors, and the urban contractors over water allocations during shortages. In 1994, in order to resolve these disagreements, DWR, some of the water contractors, and the Central Coast Water Authority (a joint powers authority representing two contractors, San Luis Obispo County Flood Control and Water Conservation District (CFC & WCD) and Santa Barbara CFC & WCD began mediated negotiations. Soon after negotiations began, the parties determined that the water allocation problem could not be addressed as a single issue. The parties adopted a broader approach to address water allocation and a number of other interrelated issues pertaining to the management and financing of the SWP.

These discussions, which took place in Monterey, led to the development of a set of 14 principles to modify the long-term water supply contracts. With regard to water allocation, they deleted the provisions that required agricultural contractors to take first shortages and also allowed them first priority on surplus water. Instead, all water was to be allocated on a pro-rata share based on each contractor's Table A amount. The broader issues that the negotiators addressed included development of measures to

facilitate the more effective management of the more limited SWP water supplies anticipated to be available to them in the future.

Later in 1994, DWR and 27 of the 29 SWP contractors agreed to the Monterey Agreement. An EIR was prepared on the Monterey Agreement with the Central Coast Water Authority acting as the lead agency. Following certification of the EIR in 1995, DWR and the contractors incorporated most of the principles into a contract amendment named the Monterey Amendment. All SWP contractors except Plumas CFC & WCD and the Empire West Side Irrigation District signed the Monterey Amendment. These two contractors continue to receive SWP water from DWR in accordance with the SWP contracts in effect before the Monterey Amendment.

6.2.1.3 The Monterey Settlement Agreement

After completion and certification of the Monterey Agreement EIR, the Planning and Conservation League (PCL) (and several other plaintiffs) filed a lawsuit challenging the adequacy of the EIR for the Monterey Amendment. It also argued that DWR should be lead agency for the preparation and certification of the EIR. A Sacramento County Superior Court judge later dismissed the lawsuit. PCL appealed the decision and on September 15, 2000, the Third District Court of Appeal reversed the Superior Court ruling. On December 13, 2000, the California Supreme Court denied review. The parties commenced mediation and proceedings in Superior Court were stayed pending completion of mediation.

The parties executed a Settlement Agreement in May 2003. The Monterey Settlement Agreement allows the SWP to continue to operate pursuant to the Monterey Agreement while the new EIR is being prepared. SWP operational issues concerning the Monterey Amendment will be addressed in that new EIR.

The Monterey Settlement Agreement provides a way for the contractors and the plaintiffs to advise DWR in the preparation of the new EIR and commits DWR to a number of actions, including deleting reference to the term “entitlement “in the long-term water supply contract, developing a water supply reliability report to be published every 2 years, and providing more opportunity for public involvement in SWP activities. The Monterey Settlement Agreement also provides that DWR and the contractors will not approve any new project or activity in reliance on the Monterey Agreement EIR that was not approved, initiated, or implemented prior to March 26, 2001, which could require separate environmental documentation. Provisions in the Monterey Settlement Agreement also provide that up to $8 million will be paid to Plumas CFC & WCD beginning in 2003, primarily for watershed improvement for the mutual benefit of Plumas CFC & WCD and the SWP in the Feather River watershed, and for the district’s related purposes, to be disbursed with input from a forum composed of representatives of Plumas CFC & WCD, DWR, and SWP contractors. To date, $4 million has been paid to Plumas CFC & WCD. The new EIR is currently being prepared and the draft will be released in 2007.

6.2.2 Geographic Scope

This section describes the geographic areas where cumulative effects on the resources listed above have occurred or are expected to occur. Per CEQA guidance, the geographic (or spatial) scope for selected resources typically varies and is based on the geographic reach or boundaries of the effects of existing Oroville Facilities operations, the effects of the Proposed Project defined in Chapter 3.0, and the effects of the related actions described in Chapter 5.0.

The geographic scope of the geomorphic resource topics (gravel recruitment, sediment transport, and LWD) ranges from the upper Feather River watershed, downstream in the Feather River to its confluence with the Sacramento River. Oroville Facilities operations in combination with flow contributions from downstream tributaries (Yuba and Bear Rivers) affect flows and water quality in the lower Feather River down to the confluence with the Sacramento River and, in conjunction with other Central Valley tributaries and hydroelectric/flood management operations, affect water quality and flows downstream to the Sacramento–San Joaquin Delta (Delta). Therefore, the geographic scope of the analysis for water quality and quantity extends downstream from the FERC Project boundary to the Delta.

The geographic scope of the analysis of cumulative effects on aquatic resources, including spring-run Chinook salmon and Central Valley steelhead, is broad, given their large geographic distribution and the many different types of related actions that affect these anadromous fish species. It ranges from the upper portions of the Feather River basin where the species spawned prior to construction of other mining, hydroelectric, and water development projects by mining entities, electric utilities, and water agencies, down to the Feather and Sacramento Rivers, to the San Francisco Bay/Sacramento–San Joaquin Delta (Bay-Delta) and even the Pacific Ocean.

The geographic scope of the terrestrial resources in the cumulative analysis varies with individual species affected but generally includes the California range for species identified in Chapter 5.5 as being affected by the Proposed Project. The scope includes lands within and near the FERC Project boundary and adjacent to the Feather River downstream to the Sacramento River.

The geographic scope of the recreational resources analysis is confined to lands within and near the FERC Project boundary and adjacent to the Feather River and water-based recreational opportunities in Northern California within a few hours drive of the Oroville Facilities. For the analysis of cumulative effects on cultural resources, the geographic scope incorporates the Feather River watershed. The geographic scope of the public services impacts is contained within the boundary of Butte County, and the scope of the agricultural resources impacts is confined to the FRSA and to Central Valley rice production areas.

6.2.3 Temporal Scope

The temporal scope of the cumulative analysis varies by selected resource, but in general it is from the time a selected resource is initially affected by past, related actions through the period of time covered by the new license for the Oroville Facilities (assuming 50 years).

This section briefly summarizes the temporal scope of the cumulative analysis, including some of the key events over time that affected the resources found in the FERC Project area. Additional information regarding the nature and timing of key events and related actions that provides historic context and other background information related to the selected resources is found in Chapter 4.0.

Cumulative effects on geology and soils and surface water quantity and quality began during the 1849 California Gold Rush with extensive hydraulic, placer, and hard-rock mining activities. While hydraulic mining activities were stopped by court order before 1900, the activity led to major amounts of sediment and heavy metals moving into streams and other receiving waters. The downstream transport of sediment and metals from this and other historic and current mining activities continues today. Starting in the 1910s, the Feather River and its tributaries were diverted by water agencies and irrigation districts to supply urban communities and large-scale agricultural development along both sides of the lower Feather River and in the Sacramento Valley. Major engineering activities in the lower Feather River, including channel dredging, levee construction, and ongoing maintenance, have been undertaken by the U.S. Army Corps of Engineers (USACE), U.S. Bureau of Reclamation (USBR), and State and local agencies to provide nearby urban and agricultural areas with much-needed flood protection. Congress initially authorized the Sacramento River Flood Control Project in 1917, and most of the related lower Feather River channelization and levee construction was completed by 1940, prior to the construction of Oroville Dam.

Despite all of these efforts, flooding in the lower Feather River can still occur, with substantial amounts of regular levee maintenance required. New levee setback projects are being investigated and implemented along the lower Feather River by USACE, the Three Rivers Levee Improvement Authority, and others as a way to improve flood protection, reduce maintenance requirements, and enhance natural riparian and floodplain habitat values. DWR also is investigating the feasibility of taking additional steps to coordinate Lake Oroville flood management operations with operations at Yuba County Water Agency's New Bullards Bar Reservoir.

Starting in the early 1900s with Miocene and Big Bend Dams (1907 and 1908, respectively), a number of upstream hydroelectric power and water storage projects were constructed and have affected Feather River hydrology and runoff patterns. Most of Pacific Gas and Electric Company's (PG&E's) upstream hydroelectric project–related facilities (including Lake Almanor Dam, Butt Valley Dam, Poe Dam, etc.) were constructed beginning in the 1910s through the 1980s. Oroville Dam planning was started in the late 1950s. Section 204 of the Flood Control Act of 1958 (Public Law (PL) 85-500, 72 Stat. 297) appropriated federal funds to contribute to the construction of

Oroville Dam, contingent upon an agreement that was subsequently entered into between the State of California and USACE pursuant to the provisions of Section 7 of the Flood Control Act of 1944 (PL 78-534, 58 Stat. 890). Construction of Oroville Dam and Lake Oroville was completed in 1968. Additional information concerning upstream water development projects is found in Section 4.2.1, Surface Water Quantity.

Cumulative effects on aquatic resources, including spring-run Chinook salmon and steelhead, began in the mid-1800s with mining activities, including dewatering of the Big Bend area, and continued during the first few decades of the 1900s as approximately 750,000 acres of undeveloped Delta wetlands and tidal marsh were converted to what is now a 700-mile maze of channelized streams with dikes and levees, and about 57 man-made islands. By 1930, almost all of the Delta's marshland had been converted to agricultural and urban uses. During the 1940s through 1970s, California's salmon and steelhead continued to be affected by many related actions, including unscreened agricultural and urban stream diversions; and the construction of local, federal, and State pumps in the southern Delta and along the Sacramento, Feather, Yuba, and other rivers. In addition, construction of dams and other water projects in the Sierra Nevada foothills and the range's upper elevations; ocean harvesting; the construction and operations of hatcheries; and the introduction of such predators as striped bass also affect aquatic resources. Some relatively recent legislation and programs, including the CVPIA, CALFED, and State bond initiatives, have started to improve conditions for many species; however, steelhead and spring-run Chinook salmon remain the focus of recovery efforts and their population numbers are a concern in many portions of their range. Section 4.4, Aquatic Resources, summarizes the status of these species throughout their range and in the Feather River basin.

The temporal scope for cumulative effects on terrestrial resources, recreation, and cultural resources would be the same as that described above for geology and soils, and water quantity and quality. The temporal scope for cumulative impacts on public services ranges from construction of the Oroville Facilities through the term of the future FERC license. Agricultural impacts range from initial agricultural diversions from the Feather River through the term of the future FERC License.

6.2.3.1 Climate Change

Climate change refers to the significant change in climate measurements such as temperature, precipitation, wind, and solar input measured over several decades. Theories regarding climate change have existed since the 1800s, and by the late 1900s, the science had progressed sufficiently to convince many that the Earth's climate was not static but had changed over time. Today, most scientists agree that some warming has occurred over the past century (DWR 2006). The United Nations Intergovernmental Panel on Climate Change predicts that changes in the Earth's climate will continue through the 21st century and that the rate of change may increase significantly in the future because of human activity (IPCC 2001). These activities include human-induced alterations to the land and activities that involve the burning of fossil fuels that have contributed to the alteration of the historical composition of the atmosphere.

On June 1, 2005, Governor Arnold Schwarzenegger issued Executive Order S-3-05 (Order) establishing greenhouse gas (GHG) emission targets for California and requiring biennial reports on potential climate change effects on several areas, including water resources. A Climate Action Team (CAT) was established by the governor to lead the reporting efforts. The Order established the following goals for reducing GHG emissions in the state:

- By 2010, reduce emissions to the 2000 level.
- By 2020, reduce emissions to the 1990 level.
- By 2050, reduce emissions to 80 percent below 1990 emissions.

Executive Order S-3-05 identifies the agencies involved and coordination expected:

> The Secretary of the California Environmental Protection Agency shall coordinate oversight of the efforts to meet the targets with: the Secretary of the Business, Transportation and Housing Agency, Secretary of the Department of Food and Agriculture, Secretary of the Resources Agency, Chairperson of the Air Resources Board, Chairperson of the Energy Commission, and the President of the Public Utilities Commission.

In 2006, the California Legislature passed Assembly Bill 32 (also known as the Global Warming Solutions Act of 2006) that establishes a State goal of reducing GHG emissions to 1990 levels by 2020. The bill requires the California Air Resources Board (ARB) to adopt regulations and develop an enforcement mechanism to ensure compliance. ARB is currently developing policy for GHG reductions in the state.

In accordance with resulting State Goals and standards, hydroelectric generation can play a role in meeting these statewide GHG reduction targets when compared with higher GHG-emitting thermal power sources. With extensive resource monitoring plans and adaptive management measures, the Oroville Facilities also provide managers with an ability to respond to the impacts of climate change upon resources associated with the Oroville Facilities.

6.2.3.2 Climate Change and DWR Water Management

Climate change is identified in the 2005 update of the *California Water Plan* (Bulletin 160-05) (Water Plan) as a key consideration in planning for the state's future water management (DWR 2005). The 2005 Water Plan update qualitatively describes the effects that climate change may have on the state's water supply. It also describes efforts that should be taken to quantitatively evaluate climate change effects for the next Water Plan update.

On July 9, 2006, DWR released a report on climate change and its potential impact on California's water resources. Entitled *Progress on Incorporating Climate Change into Management of California's Water Resources,* the report was prepared in response to Executive Order S-3-05 and summarizes recent research into changes in precipitation,

air temperatures, snow levels, rainfall, and snowmelt runoff, and the related potential future impact on California's water resources. The climate change report explicitly cautions that all results presented are "preliminary, incorporate several assumptions, reflect a limited number of climate change scenarios, and do not address the likelihood of each scenario. Therefore, the results are not sufficient by themselves to make policy decisions." DWR and USBR have formed a joint Climate Change Work Team to provide and regularly update information for decision makers on potential impacts and risks of climate change, flexibility of existing facilities to cope with climate change, and available mitigation measures.

6.2.3.3 Consequences From Climate Change

As summarized by the DWR climate report, there is a significant amount of uncertainty over the magnitude of climate change that will occur over this century and, according to Dettinger (2005), it is unlikely that the level of uncertainty will diminish significantly in the foreseeable future. There is also uncertainty about changes in hydrologic conditions, aquatic ecosystems, and water demand that could occur as the result of various amounts of climate change.

It is questionable whether climate change is a reasonably foreseeable "action" in the CEQA context, partly because of the uncertainty and speculative nature of predicted outcomes. However, the potential consequences of climate change on resources associated with the Oroville Facilities can be preliminarily discussed in the context of regional climate changes. These regional climate changes could include changes in both quantity and timing of precipitation and runoff that could affect water quantity, water quality, aquatic resources, recreation, cultural resources, and agricultural practices. Further discussion of the regional effects of future climate change on specific resources associated with the Oroville Facilities is included in the appropriate sections below.

6.2.4 Geology, Soils, and Paleontological Resources

Potential cumulative effects discussed in this subsection address geologic, soils, and paleontological resources, along with the various alternatives associated with the Oroville Facilities. Because no significant impacts were identified for paleontological resources, there will be no further discussion regarding this topic. The analysis of potential impacts and associated mitigation measures on geology and soils is provided in Section 5.1.4.

Cumulative effects include past, present, and probable future projects that incrementally affect resources in combination with a proposed project. For this analysis, the source of these effects is not restricted to activities directly associated with the Oroville Facilities. For example, sediments being trapped by upstream projects above Lake Oroville that disrupt the natural geomorphic processes of sediment transportation are considered in this discussion.

The principal effects on the natural geomorphic process and function of the Feather River from the many current and historic human-induced changes and land uses include:

- A reduction in gravel recruitment, sediment transport, and LWD transport through the watershed;
- A loss of channel meandering, a reduction in sinuosity, incision, and an overall loss in channel complexity;
- Disconnection of the river channel from its natural floodplain through the development of levees; and
- Large-scale erosion and sediment deposition from historical and current mining, timber harvesting, and wildfires.

6.2.4.1 Past and Present Related Actions

Historically, rivers in the Sacramento Valley were bordered by extensive floodplains that supported natural geomorphic and fluvial processes, including natural hydrologic flow regimes, erosional and depositional processes, and sediment transport. The Feather River has a long history of land uses that have affected natural river processes within its floodplain, including hydraulic mining, gravel mining, gold dredging, timber harvesting, construction of levees and dams, water diversion, agricultural encroachment, and urbanization. In the 1800s riparian forests within the watershed were logged for lumber and fuel. The primary result of these activities included the loss of the soil-retaining riparian cover, leading to increased erosion and sedimentation into the river channel. By the late 1800s, hydraulic mining had introduced massive amounts of sediment into the system, and in the early 1900s, Feather River water diversions began for agricultural and urban uses. Channelization and levee construction was mostly completed by the 1940s. In addition, starting in the early 1900s, a number of hydroelectric and reservoir projects were constructed upstream of the City of Oroville, which regulated streamflow and blocked sediment transport above Oroville in the watershed. Furthermore, as the risk of floodflows decreased downstream, more lands within the floodplain were converted to agricultural and urban use, which further reduced the historical connection of the river with its floodplain. The construction of Oroville Dam in the 1960s further altered streamflow patterns, reduced floodflows, reduced erosion and channel migration rates, and reduced sediment loads and sediment transport downstream.

The channel morphology of the Feather River upstream of the Oroville Facilities is influenced partially by the presence of upstream hydroelectric and reservoir projects on the North Fork, West Branch of the North Fork, and South Fork; however, the dominating factor affecting the shape of the river has been the steep bedrock-lined canyons in much of the upper watershed that confine the river's channel morphology, and thereby maintain a moderate-to-steep channel gradient.

Although the Feather River reaches upstream of Lake Oroville have continued to flow between steep canyon walls, upstream hydroelectric and reservoir projects, including the Oroville Facilities, have affected the Feather River's natural geomorphic function. These facilities have been responsible for the reduction in sediment transport, gravel recruitment, and LWD transport though the Feather River watershed. For example, while the Middle Fork Feather River remains relatively hydrologically unaltered before it enters Lake Oroville, much of the bedload material transported by the North Fork Feather River is captured in upstream reservoirs before the North Fork enters Lake Oroville.

Geomorphic Processes

For over 100 years, the Feather River has been affected by a number of human-induced events, resulting in a change in the natural geomorphic processes. Several of the effects from historic land uses and human-induced changes to the watershed are discussed below. Many of these human-induced activities have affected the geomorphic function of the upper watershed, resulting in a number of physical and ecological effects.

Timber Harvesting and Wildfires

The impact on riparian forests within the watershed from timber harvesting and wildfire has resulted in the loss of soil retaining riparian cover. Both timber harvesting and wildfire expose the barren soils to increased rates of erosion and potential loss of the most productive soil layers in a forest system, causing an increase of sedimentation into the Feather River.

Hydraulic Mining

Hydraulic mining activities in the Feather River watershed associated with gold mining caused massive amounts of soil erosion, and the runoff from hydraulic mining operations introduced enormous quantities of sediment into the system. The consequence of this was to increase sediment loads in the Feather River beyond the river's capacity to move the sediments, resulting in an accumulation and subsequent buildup of the channel bed throughout the lower river system. This increased channel bed elevation relative to surrounding floodplain elevation resulted in a need for additional levee placement.

Levee Construction

The winter flood event of 1861-62 convinced citizens of Marysville and the surrounding Feather River watershed of the need to install levees around cities to protect the populations from inundation, and preserve their property from destruction. The first levees were constructed in Marysville in 1862, and the city was surrounded by levees by 1868. The winter floods of 1875 caused the overtopping of the levees and by 1876, the legislature authorized the city to borrow funds to increase the levee height to 3 feet (ft) above the 1875 high-water mark. The levee construction eventually extended from near the southern FERC Project boundary to the Sacramento River. While levee

placement has resulted in a reduction in flooding, the Feather River has become almost completely disconnected from its historic floodplain.

Agriculture and Urbanization

Agriculture and urbanization are some of the main land use changes affecting the lower Feather River. Inspection of 1997 aerial photographs suggests that almost all of the riparian vegetation on the floodplain south of the FERC Project boundary has been converted to agriculture, and only a minimal percentage of the original riparian vegetation remains. Removal of streambank vegetation also reduces the amount of LWD contribution in the river.

Urbanization and economic development have modified the land use within the watershed, initially through logging, road building, and grazing. Furthermore, as the risk of floodflows decreased with the installation of protective levees, more lands within the historic floodplain were converted to agricultural and urban uses. This, along with more recent urban development in the upper watershed, has altered hydrologic conditions, causing increased sedimentation and runoff, and larger peak flows have affected the entire Feather River system. This effect, however, has largely been ameliorated by the flood management provided by the Oroville Facilities and the downstream levee system.

Dams, Flow Regulation, and Flood Management

Starting in the early 1900s, a number of hydroelectric and reservoir projects were constructed in the upper watershed, above Lake Oroville. These projects regulated streamflow and blocked sediment transport through the watershed. The construction of Oroville Dam in the 1960s further altered Feather River flow regimes, reduced floodflows, and reduced sediment discharge downstream. In addition to those projects upstream of the present-day Oroville Dam, there were also two downstream agricultural diversion dams. These dams were referred to as the Western Canal Dam and the Hazelbush Dam and both dams were constructed prior to approximately 1920. Construction of Thermalito Afterbay replaced both dams. Because both dams required reinstallation or reconstruction after high-flow events, it is doubtful that these dams significantly affected geomorphic processes.

Sediment Transport, Large Woody Debris, and Gravel Recruitment

Beginning in 1967, the Oroville Facilities started to regulate the lower Feather River, adding to the change in streamflow and amount of LWD recruitment and sediment discharge in the system. More than 97 percent of the sediment from the upstream watershed is trapped in the upstream reservoirs (including Lake Oroville), resulting in sediment starvation downstream. The loss of gravel recruited from reaches upstream of Oroville Dam has reduced the suitability of salmonid spawning gravel in downstream reaches. In addition, the loss of LWD recruitment has reduced the ability of the river to trap sediments as they move through the system during high-flow events. The reduction of gravel and LWD recruitment reduces the channel complexity of the lower Feather River.

Channel Meandering

Before 1855, the lower Feather River below the City of Oroville was a meandering river, probably similar to the present Sacramento River between Red Bluff and Colusa (WET 1990). Between 1855 and the early 20th century, a large increase in sediment resulting from hydraulic mining caused buildup of the channel bed in the lower Feather River and subsequent seasonal overbank flooding, necessitating levee construction and/or improvements. This levee construction associated with agricultural and urban development within the floodplain and flow attenuation caused by hydroelectric development interrupted the river's ability to meander across its historic floodplain.

Channel Depth and Width

The Feather River channel and width is still adjusting to changes caused by historic hydraulic mining and dam construction. Currently, the river is eroding vertically through the hydraulic mining debris, incising the river channel. The U.S. Geological Survey (USGS) (Blodgett 1972) documented channel changes between 1909 and 1970. USACE surveyed the lower Feather River between the city of Oroville and Verona and published a series of topographic river surveys between 1909 and 1911; DWR resurveyed the USACE cross sections in 1965 and 1969, and then again in 2002–2003. Detailed descriptions and analysis of these sections are provided in the report for Study Plan G-2 (SP-G2) Task 3/Task 4, Channel Cross-Sections and Photography. These cross sections are also shown in the reports for SP-G2 Task 7, Hydraulic and Sediment Transport Modeling with Fluvial 12, and SP-G2 Task 5, Dam Effects on Channel Hydraulics and Geomorphology. In general, the cross sections show continuing scour with a large increase in cross-sectional area and an increase in both depth and width. This has also increased channel capacity and the ability to convey high flows without flooding. The increase in depth and width is characteristic of the entire lower Feather River. Channel widening is also related to the fact that dams in the upper watershed continue to trap sediment. As a result, sediment eroded from the banks and bed in the lower river is not replenished from upstream sources. However, the reduced floodflows attributed to Oroville Dam's flood management functions would tend to reduce this effect, and therefore reduce the rates of bank erosion and property loss along the river.

6.2.4.2 Cumulative Effects of the Alternatives and Future Related Actions on Geology, Soils, and Paleontological Resources

No-Project Alternative

The interruption of natural geomorphic processes that has been occurring in the Feather River watershed beginning with timber harvesting and hydraulic mining activities in 1800s, followed by hydroelectric facility construction within the watershed since the early 1900s, would continue under the No-Project Alternative. The Oroville Facilities and other upstream hydroelectric dams would continue to reduce the contribution of sediment, gravel recruitment, and LWD in the lower Feather River. The continued deprivation of sediment load in the lower Feather River from related actions would also result in a reduction in the formation of sediment benches and point bars, which in turn

affects the ability of the channel to capture and retain quantities of LWD. These geomorphic effects result in incremental reductions to channel complexity downstream of the Oroville Facilities. The most significant reductions in downstream channel complexity are the continued coarsening of the Feather River salmonid spawning beds and reduced woody debris, both of which reduce the quantity and quality of salmonid spawning and rearing habitat over time. The Oroville Facilities would continue to attenuate peak flows, providing flood protection benefits downstream.

Proposed Project

The Proposed Project includes actions that mitigate the Oroville Facilities' contribution to loss of connectivity between the upper Feather River watershed and the lower Feather River. For example, although the Oroville Facilities would continue to block the recruitment of LWD and gravel to the lower Feather River from upstream tributaries below the next hydroelectric facility, the LWD and gravel supplementation actions would simulate connectivity between upstream and downstream reaches of the watershed. The Channel Improvement Program (SA Article A103), Structural Habitat Supplementation and Improvement Program Plan (SA Article A104), and Riparian and Floodplain Improvement Program (SA Article A106) included in the Proposed Project combined with the Gravel Supplementation and Improvement Program (SA Article 102) would increase channel complexity below Oroville Dam and address the Oroville Facilities' contribution related to sediment and LWD blockage and the downstream results from controlled flows and loss of connectivity with upstream reaches.

FERC Staff Alternative

There are no substantive differences in cumulative effects on geology, soils, and paleontological resources that would occur with the implementation of the FERC Staff Alternative as compared to the Proposed Project.

6.2.5 Surface Water

Surface water analyses include discussions of cumulative effects on both surface water quantity as well as surface water quality.

6.2.5.1 Water Quantity

This section addresses potential cumulative effects on water quantity. Water quantity cumulative effects addressed in this section are the result of local and upstream actions, as well as actions located outside the FERC Project boundary that have affected or could affect operations of the Oroville Facilities. The analysis of potential impacts and associated mitigation measures on surface water quantity is provided in Section 5.2.1.4.

The CALSIM II modeling conducted for this analysis was designed to simulate existing and future cumulative water quantity effects of past, present, and reasonably foreseeable future actions. The modeling incorporated the effects of the following actions on project operations and local hydrology:

- Diversion, storage, and conveyance of water by water projects upstream of the Oroville Facilities;

- Local water diversions used to supply local agricultural and urban water demands;

- Flood management operations at the Oroville Facilities per related USACE flood control criteria and agreements with DWR;

- SWP and CVP coordinated operations whereby DWR and USBR work together to meet a variety of water quality and other environmental flow standards in the Delta and its major tributaries. Lake Oroville is the major SWP storage facility that DWR relies upon to meet such environmental commitments;

- Existing SWP water demands (as represented by 2001 level-of-development assumptions in the CALSIM II modeling) and an increase in such demands over time in the many different areas served by the SWP (future SWP water demands are represented by 2020 level-of-development modeling assumptions);

- Future SWP and CVP infrastructure improvements expected to affect future operations at the Oroville Facilities, including an increase in the capacity of the Banks Pumping Plant and other South Delta improvements; and

- Implementation of other actions affecting project operations, including higher Trinity River releases by the CVP (see Appendix C of the PDEA for more information regarding the assumptions used in the CALSIM II modeling; see also Section 5.2, Surface Water).

CALSIM currently relies on historic monthly hydrological data to assess project impacts. CALSIM is constrained to utilize hydrological data related to the 73 years of historical data for which the model has been calibrated. DWR recognizes the potential for significant impacts associated with climate change. Because only limited data and tools exist to provide answers to important questions for decision makers, water managers, and resource planners, DWR is working in conjunction with others to develop a new analytical approach for the preparation of the *California Water Plan 2010*. Climate changes could produce hydrologic conditions and extremes of a different nature than current systems were designed to manage. Through development of a functional water management tool capable of incorporating climate change data, ordered reductions in GHG emissions, and proper resource planning, agencies in California will continue preparing for climate change impacts.

Past and Present Related Actions

Historically, the entire Feather River watershed has been developed and altered. In 1907 and 1908, the Miocene and Big Bend Dams were constructed. Additional water development occurred during the 1920s and 1950s with construction of Lake Almanor, Bucks Lake, and Butt Valley, Poe, Rock Creek, and Cresta Reservoirs. In the 1960s, DWR constructed three reservoirs: Frenchman Lake, Antelope Lake, and Lake Davis.

These upstream reservoirs have a cumulative effect on the hydrology of the Feather River, upstream and downstream of the Oroville Facilities. In general, these reservoirs alter the unimpaired runoff magnitude, volume, and timing of flow in the Feather River upstream of Lake Oroville. The average annual inflow into Lake Oroville is a little less than 4.0 million acre-feet (maf). Mean monthly Feather River flow below the Thermalito Afterbay Outlet is generally below unimpaired conditions from November through June and is generally increased from July through October.

Operations of the Oroville Facilities in combination with other facilities in the CVP/SWP system affect baseline flows and reservoir storage throughout the system. The CVP and SWP use the Sacramento River and the Delta as common conveyance facilities. CVP/SWP reservoir releases and Delta exports must be coordinated to ensure that each project receives its share of benefit from shared water supplies and bears its share of joint obligations to protect beneficial uses. Project agencies operate the CVP and SWP to meet these requirements through the Coordinated Operations Agreement (COA). The Operations Criteria and Plan (OCAP) Biological Assessment (BA) describes the ongoing operations of the system under the COA and its effects on environmental resources.

Cumulative Effects of the Alternatives and Future Related Actions

There are no expected cumulative impacts on surface water quantity that would result from continued operation of the Oroville Facilities under any of the alternatives. Although the SA includes increases of minimum flows and potential increases in flows for water temperature management in the Low Flow Channel (LFC) to benefit anadromous salmonids, it would not increase net facility releases. Changes to net facility releases are in response to timing or future changes to allocations that would apply equally to the No-Project, Proposed Project, and FERC Staff Alternatives. The Lower Yuba River Accord could alter quantity and timing of flows in the lower Feather River downstream of the confluence with the Yuba River. The Yuba-Feather Supplemental Flood Control Project could alter the timing and magnitude of flood management releases from the Oroville Facilities.

Climate Change and Water Supply

According to the DWR climate change report, temperatures in California are projected to increase several degrees Celsius (^{o}C) by the end of this century as a result of climate change. One expected consequence of this is a reduction in the State's annual snowpack, with more precipitation falling as rain, and earlier melting of snow. In addition to altering watershed characteristics from snowpack-fed to rainfall-fed, climate change could also affect the intensity, duration, and timing of precipitation events and the spatial distribution and temporal variability of precipitation in California. Significant changes in one or more of these factors will present major challenges for water supply management in the state. Warming and reduction to the State's snowpack would affect the operation of most major multi-purpose reservoirs at low and mid-elevations in the Sierra Nevada, including the Oroville Facilities (DWR 2006).

Climate change would likely also have an effect on future water demand patterns and quantities needed for agricultural and urban uses and environmental water demand for both salinity and water temperature control. However, many other factors such as population, land development, and economic conditions that are not directly related to climate change would also affect future demand.

6.2.5.2 Water Quality

This section addresses potential cumulative effects on water quality. Water quality cumulative effects addressed in this section are the result of local and upstream related actions, as well as actions located outside the FERC Project boundary that have affected or could affect water quality–related operations of the Oroville Facilities. The analysis of potential impacts and associated mitigation measures on surface water quality is provided in Section 5.2.2.4.

Past and Present Related Actions

Reduced riparian shade, increased water surface area in reservoirs, and increased residence time of water in the system all tend to increase water temperatures in portions of the Feather River basin rivers and reservoirs. Water released from the hypolimnion of the reservoirs provides water for portions of the river that can be colder than water that would have occurred in these tributaries prior to construction of these reservoirs. Specifically, the areas of the lower Feather River immediately below Oroville Dam are, at some times of the year, 10 degrees Fahrenheit (^{o}F) cooler than those that occurred in these locations prior to the construction of the Oroville Facilities (DWR 2001). At certain times of the year, Diversion Pool water temperatures can also be influenced by inflows from the South Feather Water and Power Agency's Kelly Ridge Power Plant. Water releases from the Oroville Facilities and some of the upstream reservoirs are managed to benefit coldwater fish species.

Cumulative Effects of the Alternatives and Future Related Actions

No-Project Alternative

Under the No-Project Alternative, the Oroville Facilities would continue to be operated under the terms and conditions of the existing FERC license. Water temperatures downstream of the Oroville Facilities are not anticipated to change relative to existing conditions.

Proposed Project

The Proposed Project would result in a reduction in water temperatures in the lower Feather River to benefit the coldwater fisheries. The reduced water temperatures singularly and in combination with the lower Feather River habitat enhancement actions included in the Proposed Project would result in a reduction in anadromous salmonid pre-spawn mortality rates, reduced in-vivo and in-redd egg mortality rates, increased juvenile rearing survival, and increased juvenile and smolt emigration survival rates. See Section 6.2.6, Aquatic Resources.

Additional reductions in water temperatures as compared to historical or Existing Conditions would incrementally adversely affect contact and non-contact recreation. See Section 6.2.8, Recreational Resources.

Additional reductions in water temperatures compared to historical or Existing Conditions with implementation of the Proposed Project would result in a small incremental reduction in water temperatures at the agricultural diversions in Thermalito Afterbay. These reductions in water temperatures at the agricultural diversions would likely result in an incremental additional yield loss in rice production in some areas of the FRSA. See Section 6.2.10, Agricultural Resources.

FERC Staff Alternative

There are no substantive differences in cumulative impacts on surface water quality resources that would occur with the implementation of the FERC Staff Alternative as compared to the Proposed Project.

Climate Change and Water Quality

Climate change could have a significant effect on water quality in the Feather and Sacramento Rivers and the Delta. Water quality salinity control requirements (environmental releases for salinity control in the Delta) could be affected by sea level changes while the ability to meet the needs of the Delta with freshwater releases from foothill reservoirs such as Lake Oroville could be affected by the decreased availability of water in storage during the warmer summer months as precipitation falls earlier in the year and as rainfall instead of snow. Increased water temperatures could cause decreased dissolved oxygen and other water quality problems, including a likely increase in algae growth and aquatic weed production.

6.2.6 Aquatic Resources

Federally listed species (spring-run Chinook salmon, Central Valley steelhead, and green sturgeon) have the potential to be cumulatively affected by continued operation of the Oroville Facilities and other past, existing, and reasonably foreseeable related actions. Similarly, species of management concern (fall-run Chinook salmon, river lamprey, and Sacramento splittail) also have the potential to be cumulatively affected by continued operation of the Oroville Facilities and other past, existing, and reasonably foreseeable related actions. Other species of management concern occurring in the project area, including American shad, black bass, hardhead, and striped bass, are not expected to be affected by Oroville Facilities operations.

Actions affecting spring-run Chinook salmon would have similar effects on fall-run Chinook salmon; therefore, they are not discussed separately. Most Oroville Facilities–related actions affecting aquatic resources are designed to reduce water temperatures and enhance habitat in the lower Feather River to benefit anadromous salmonids. These actions may have a slightly adverse effect on black bass, as they prefer warmer water temperatures. However, most lower Feather River black bass spawning and

juvenile rearing occurs downstream of the FERC Project boundary and potential adverse effects are likely to be minimal. Therefore, this section focuses on potential cumulative effects on spring-run Chinook salmon, Central Valley steelhead, green sturgeon, river lamprey, and Sacramento splittail. Additional information regarding the current status of these species is provided in Section 4.4.2.3, Listed Fish Species.

Study plan report summaries addressing project effects on spring-run Chinook salmon and steelhead are presented in Appendix G-AQUA1.3 of the PDEA, Fish and Their Habitat within Lake Oroville, its Upstream Tributaries, the Thermalito Complex, and the Oroville Wildlife Area; Appendix G-AQUA1.5 of the PDEA, Fisheries Management; Appendix G-AQUA1.8 of the PDEA, Salmonids and Their Habitat in the Feather River Below the Fish Barrier Dam; and Appendix G-AQUA1.11 of the PDEA, Predation. A description of each spring-run Chinook salmon and steelhead life stage and the associated time periods is presented in Section 4.4.2. Descriptions of green sturgeon, river lamprey, and Sacramento splittail are also available in Section 4.4.2.

6.2.6.1 Past and Present Related Actions

Historically, naturally reproducing populations of Chinook salmon and steelhead were abundant in the Central Valley of California. At least 25 Central Valley streams supported an annual Chinook salmon run, with at least 18 of those streams supporting 2 or more runs (Yoshiyama et al. 1996). Early estimates of Chinook salmon runs did not differentiate run timing, but those estimates indicate populations of 800,000–1 million returning adults prior to 1915 (DFG 1993). In 1965, DFG estimates for annual escapement of Chinook salmon to the Central Valley were about 421,000, of which 28,000 were classified as spring-run (DFG 1993). Current estimates of the Central Valley evolutionarily significant unit (ESU) for spring-run Chinook salmon are approximately 6,700, of which 4,300 return to the Feather River each year (DFG 1993).

Prior to the construction of Oroville Dam, spring-run Chinook salmon population estimates in the Feather River ranged from 500 to 4,000 (Painter et al. 1977). The Feather River spring-run population of Chinook salmon was affected by hydropower facilities in the upper watershed upstream of Oroville Dam well before the construction of Oroville Dam. Prior to Oroville Facilities construction, DFG found significant overlap in the spawning distribution of spring- and fall-run Chinook salmon upstream of the present-day location of Oroville Dam (DWR and USBR 2001). Following construction of Oroville Dam in 1967, the spring-run population of Chinook salmon dropped to 146, but averaged 312 per year between 1968 and 1974 (Painter et al. 1977). The highest post-Oroville spring-run Chinook salmon population estimate for the Feather River occurred in 1998 when 8,430 adults returned (based on the number of fish returning to the Feather River Fish Hatchery) (DWR and USBR 2001) with reportedly over 10,000 hatchery adult returns in 2006. The Feather River run numbered at least 3,400 in 2004 (DWR 2004). The Central Valley spring-run Chinook salmon ESU is more thoroughly discussed in Section 4.4.2.3.

Like Chinook salmon, steelhead abundance in California has been greatly reduced from historic levels (DFG 1996). McEwan (2001) reviewed the literature on steelhead and

Chinook salmon distributions in California and suggests that historic steelhead distribution can be inferred from Chinook salmon distribution, as studies examining Chinook salmon distribution almost always reported steelhead. Furthermore, because steelhead are often found at higher elevations in streams than Chinook salmon, Yoshiyama et al. (1996) concluded that steelhead were more broadly distributed than Chinook salmon. The *California Fish and Wildlife Plan* of 1965 estimated a combined annual steelhead run size for the Central Valley and tributaries to San Francisco Bay to be about 40,000 during the 1950s (DFG 1965 in DFG 1996). The steelhead spawning population for the Central Valley was estimated to be 27,000 in the 1960s (DFG 1996). McEwan and Jackson (DFG 1996) estimated the annual run size of steelhead to the Central Valley to be less than 10,000 by the early 1990s.

Historically, the Feather River supported a large naturally spawning steelhead population. The Feather River Fish Hatchery steelhead program was established to compensate for habitat loss as a result of the construction of Oroville Facilities and steelhead losses due to SWP Delta pumping facilities. Today, the Feather River steelhead population is substantially supported by the Feather River Fish Hatchery, which produces about 400,000 yearling steelhead each year (DWR 2001). The Central Valley steelhead ESU is more thoroughly discussed in Section 4.4.2.3.

Several factors influence overall populations of steelhead and Chinook salmon. The construction of dams and other water storage projects has created impassable barriers to upstream migration, significantly reducing the quantity of available habitat for spawning and juvenile rearing as well as a reduction in the quality and complexity of available habitat. Effects of this alteration of geomorphic processes on aquatic habitat are most acute immediately following dam construction. Longer term, dams block the recruitment of spawning gravel and LWD to downstream reaches, causing streambed armoring and a reduction in habitat quality for adult spawning and juvenile rearing as a result of the construction of the Oroville Facilities. The lack of gravel and woody debris recruitment combined with controlled flow regimes also reduces channel complexity. Other factors influencing salmon and steelhead populations include ocean and in-river harvest, ocean conditions and climatic cycles (e.g., El Niño events), timber harvest, water supply diversions, and agricultural practices.

A number of existing environmental programs and measures provide protection for at-risk fish species and/or their habitats, many of which are described in Section 5.4.1, Aquatic Resources Regulatory Setting. These include: (1) CALFED, which includes a long-term plan to restore the Bay-Delta and consists of the ecosystem restoration program, water quality program, levee system integrity program, water use efficiency program, water transfer program, watershed program, storage, and conveyance; and (2) the CVPIA (PL 102-575, Title 34), which amends the authorization of the CVP to include fish and wildlife protection, restoration, and mitigation as project purposes having equal priority with irrigation and domestic water uses and power generation.

The Environmental Water Account (EWA) is a key component of CALFED's water management strategy. Created to address the problems of declining fish populations and water supply reliability, the EWA is an adaptive management tool that aims to

protect both fish and water users as it modifies water project operations in the Bay-Delta. The EWA provides water for the protection and recovery of fish beyond that which would be available through the existing baseline of regulatory protection related to CVP/SWP operations.

USBR and DWR work closely with USFWS, NMFS, and DFG to coordinate CVP/SWP operations with fishery needs. This coordination is facilitated through several forums. The CALFED Operations Group consists of USBR, DWR, USFWS, NMFS, and DFG (collectively referred to as the Management Agencies), SWRCB staff, and the U.S. Environmental Protection Agency (USEPA). The CALFED Operations Group meets to discuss the operation of the CVP and SWP, as well as implementation of the CVPIA and coordination with endangered species protection. Several teams were established through the Operations Group process, including the Operations and Fishery Forum, the Data Assessment Team, the B2 Interagency Team, and the EWA Team. In addition, several fisheries-specific teams have been established to provide guidance on resource management issues: the Sacramento River Temperature Task Group, the Delta Smelt Working Group, the American River Operations Work Group, the San Joaquin River Technical Committee, and the Delta Cross Channel Project Work Team.

Agreements between DFG and facility operators have been established for minimum flow regimes and water temperature goals to benefit anadromous salmonids. For example, a 1983 agreement between DFG and DWR established minimum flow regimes in the lower Feather River and water temperature requirements downstream of the Fish Barrier Dam (DWR 2001). Federal ocean fisheries management and restoration programs that have been implemented to reduce ocean harvest impacts on Sacramento River winter-run Chinook salmon populations are also likely providing some benefit to spring-run populations. Existing ocean harvest regulations likely reduce spring-run harvest through minimum size limits, gear restrictions, reduced bag limits, and shortened recreational salmon fishing seasons (DFG 2002). Additionally, inland sport fishing regulations likely reduce harvest of spring-run Chinook salmon and steelhead through gear restrictions, fishing hour regulations, and special regulations (e.g., closures of certain areas, zero bag limits) in key tributaries (DFG 2002).

In 1986, DWR and DFG signed an agreement to provide for offsetting direct losses of fish caused by the diversion of water at the Banks Pumping Plant. The agreement is commonly referred to as the Four Pumps Agreement because it was adopted as part of the mitigation package for four new pumps at the Banks Pumping Plant. Among its provisions, the agreement provides for the estimation of annual fish losses and mitigation credits, and for the funding and implementation of mitigation projects. The agreement gives priority to mitigation measures for habitat restoration and other non-hatchery measures to help protect the genetic diversity of fish stocks and reduce reliance on hatcheries.

Anadromous fish hatcheries in California provide a substantial fraction of the commercial and recreational fisheries harvest for Chinook salmon and steelhead (DFG and NMFS 2001). DFG operates four hatcheries in the Central Valley to compensate

for the loss of Chinook salmon spawning habitat caused by dams. DFG-operated hatcheries in the Central Valley include the Feather River Fish Hatchery on the Feather River, the Nimbus Hatchery on the American River, the Mokelumne Hatchery on the Mokelumne River, and the Merced Hatchery on the Merced River. In addition, Coleman National Fish Hatchery, located on Battle Creek and operated by USFWS, produces Chinook salmon to compensate for habitat lost by the construction of Shasta Dam. USFWS also operates the Livingston Stone National Fish Hatchery on the upper Sacramento River to aid in the recovery of winter-run Chinook salmon (DFG and NMFS 2001). Hatcheries in California have also implemented programs to enhance steelhead populations. The four hatcheries located in the Central Valley have programs to mitigate for lost habitat and supplement steelhead populations.

The Feather River Fish Hatchery was opened in 1967 to compensate for the loss of upstream habitat caused by the construction of Oroville Dam. The hatchery is part of the licensed project under FERC Project No. 2100, and is operated for DWR by DFG. The hatchery raises spring- and fall-run Chinook salmon and steelhead. It normally spawns about 10,000 adult salmon per year. Chinook salmon are released at various locations in the Feather River, Sacramento River, and San Pablo Bay. Most steelhead releases occur in the Feather River (see Appendix G-AQUA1.7 of the PDEA for more detailed information on Feather River Fish Hatchery operations). The Feather River Fish Hatchery program is the only program in the Central Valley attempting to compensate for the loss of spring-run Chinook salmon (CPUC 2000).

Quantity of Spawning Habitat

Prior to construction of major dams in the Central Valley, anadromous salmonids had access to approximately 6,000 river miles of freshwater habitat (USFWS 1988 in CPUC 2000). From 1900 to 1930, hydroelectric projects and other diversions had created impassable fish barriers blocking access to approximately 80 percent of this habitat (Fisher 1994). Because these projects blocked access to higher elevation habitats, both spring-run Chinook salmon and steelhead were primarily affected. Spring-run Chinook salmon were extirpated from the San Joaquin River drainage with the completion of Friant Dam in 1942 (Fisher 1994). At the same time, construction of Shasta Dam affected approximately 200 miles of spring-run Chinook salmon and steelhead habitat in the upper Sacramento River (Fisher 1994). To date, it is estimated that 95 percent of habitat once utilized by anadromous salmonids in the Central Valley has been lost (USFWS 1988 in CPUC 2000).

Prior to any dam construction in the Feather River, it is estimated that 211 river miles of freshwater habitat was available to anadromous salmonids in the Feather River basin (Yoshiyama et al. 2001). This estimate of 211 river miles should be considered a minimum because only mainstems and major tributaries were considered. Numerous smaller tributaries were likely used by salmonids to some extent (Yoshiyama et al. 2001). Furthermore, the extent of habitat lost to steelhead was likely greater as steelhead were more extensively distributed due to their superior jumping ability, timing of upstream migration, and less restrictive preferences for spawning substrate

(Yoshiyama et al. 2001). Figure 6.2-1 shows the location of the dams in the Feather River basin and the date of construction associated with each dam.

Development of permanent hydroelectric and water diversion facilities in the Feather River basin began in 1907 with the construction of the Miocene Dam on the West Branch North Fork Feather River and ended with the construction of the Oroville Facilities in 1967. Table 6.2-1 lists the dams in the Feather River and the anadromous salmonid habitat lost as a result of blocking upstream migration. Note that in some cases, dam construction resulted in no habitat loss because barriers to upstream migration were already in place. For example, no habitat was lost as a result of Rock Creek Dam construction in 1950 because the Cresta Dam is located downstream and was constructed in 1927.

In addition to the upstream dams listed above, two dams downstream of the present-day Oroville Dam were constructed for agricultural diversions. Both dams were constructed prior to 1920 and were replaced by the construction of Thermalito Afterbay. Additionally, both dams required reinstallation or reconstruction after high-flow events. Western Canal Dam was seasonal; flashboards would not have been installed until the flows were reduced in the later spring. Once the lower flows occurred, not much gravel or LWD movement would have occurred to be disrupted by the flashboard dam. Hazelbush Dam, being a year-round installation, would have had some temporary affect on gravel and LWD, but this temporary affect would have been effectively erased every time the dam was washed out by a flood event. These dams may have contributed to some warming of water temperatures in the lower Feather River at some times of the year, although this is speculative as no supporting data could be located.

It is also possible that the Western Canal and Hazelbush Dams partially blocked upstream adult anadromous salmonid migration; however, this blockage was likely only partial, flow dependent, or just a migration impediment, as DFG did much of its fish counting in the Feather River at a counting weir that was located near the current Oroville Dam location for a number of years pre-project. Yoshiyama (1998a, 1998b) describes Hazelbush Dam in his treatment of historic anadromous salmonid presence in the Central Valley as “The Sutter-Butte Dam, 6 miles below Oroville, was a 5-ft-high irrigation diversion dam with a reportedly ineffective fishway, and lacking fish screens on the intake ditches, although the salmon nonetheless surmounted it (Clark 1929). Yoshiyama’s reference to the Sutter-Butte Dam is believed to refer to Hazelbush Dam, which was the diversion dam for the Sutter-Butte Canal located just downstream of the Thermalito Afterbay Outlet.

The effects of reduced habitat availability in the Feather River caused by development of the Feather River basin include high pre-spawning mortality, lower egg-to-smolt survival, and genetic introgression between the spring and fall runs of Chinook salmon. Reduction in the quantity of spawning habitat, as well as hatchery return contributions, has resulted in increased spawning densities of anadromous salmonids leading to high rates of redd superimposition. Redd superimposition occurs when spawning Chinook salmon dig redds on top of redds previously dug by other Chinook salmon. Redd disruption can result in increased egg and alevin mortality, leading to reduced

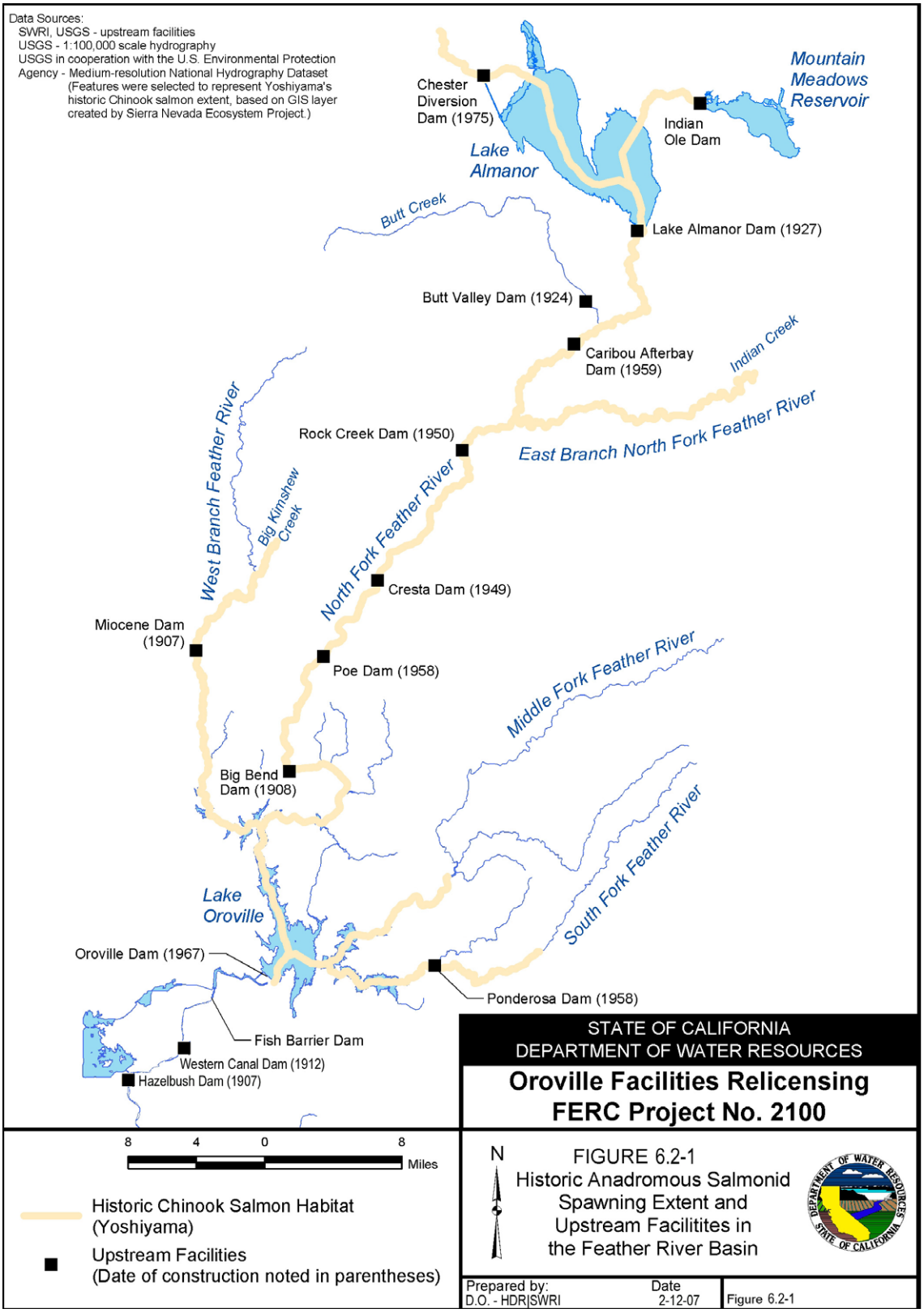
Data Sources:
SWRI, USGS - upstream facilities
USGS - 1:100,000 scale hydrography
USGS in cooperation with the U.S. Environmental Protection Agency - Medium-resolution National Hydrography Dataset (Features were selected to represent Yoshiyama's historic Chinook salmon extent, based on GIS layer created by Sierra Nevada Ecosystem Project.)
Chester Diversion Dam (1975)
Lake Almanor
Indian Ole Dam
Mountain Meadows Reservoir
Butt Creek
Lake Almanor Dam (1927)
Butt Valley Dam (1924)
Caribou Afterbay Dam (1959)
Indian Creek
West Branch Feather River
Big Kimshew Creek
Rock Creek Dam (1950)
East Branch North Fork Feather River
North Fork Feather River
Cresta Dam (1949)
Miocene Dam (1907)
Poe Dam (1958)
Middle Fork Feather River
Big Bend Dam (1908)
Lake Oroville
South Fork Feather River
Oroville Dam (1967)
Ponderosa Dam (1958)
Fish Barrier Dam
Western Canal Dam (1912)
Hazelbush Dam (1907)
8 4 0 8
Miles
Historic Chinook Salmon Habitat (Yoshiyama)
Upstream Facilities (Date of construction noted in parentheses)
STATE OF CALIFORNIA
DEPARTMENT OF WATER RESOURCES
Oroville Facilities Relicensing
FERC Project No. 2100
N
FIGURE 6.2-1
Historic Anadromous Salmonid Spawning Extent and Upstreamm Facilitites in the Feather River Basin
Prepared by: D.O. - HDR|SWRI
Date 2-12-07
Figure 6.2-1

Table 6.2-1. Dam construction and anadromous salmonid habitat losses in the Feather River Basin.

Tributary	Dam	Date Constructed	River Miles Lost	Cumulative Loss
West Branch	Miocene	1907	11.1	11.1
Feather River	Hazelbush (Sutter-Butte) [1]	1907	0.0	11.1
North Fork	Big Bend [2]	1908	0.0	11.1
Feather River	Western Canal	1912	0.0	11.1
North Fork	Butt Valley [3]	1924	0.0	11.1
North Fork	Canyon [4]	1927	30.9	42.0
North Fork	Cresta	1949	56.7	98.7
North Fork	Rock Creek	1950	0.0	98.7
North Fork	Poe	1958	6.6	105.3
South Fork	Ponderosa	1958	8.4	113.7
North Fork	Caribou Afterbay	1959	0.0	113.7
Feather River	Oroville	1967	66.9	180.6
North Fork	Chester Diversion	1975	0.0	180.6

Notes:

[1] Sutter-Butte was reportedly "an ineffective fishway, and lacking fish screens on the intake ditches, although the salmon nonetheless surmounted it."

[2] Big Bend Dam was constructed with a fish ladder—assuming that it was functional at the time of construction, 0 miles lost.

[3] Butt Valley Dam constructed on Butt Creek. Salmonid usage of Butt Creek is unknown.

[4] Canyon Dam forms Lake Almanor.

Sources: Yoshiyama et al. 1996; Yoshiyama et al. 2001

production. Redd superimposition may disproportionately affect early spawners and therefore have a greater negative impact on spring-run Chinook salmon. Field observations indicate high rates of redd superimposition in the lower Feather River (Sommer et al. 2001). High spawning densities also result in high densities of rearing juveniles; this in turn can lead to competition for resources, potentially precipitate early out-migration of juveniles, and reduce fry to smolt survival, as these smaller fish would be more susceptible to predation.

Another effect of blocking upstream migration has been the elimination of spatial separation between fall and spring-run Chinook salmon spawning. Restricted access to historic spawning grounds causes spring-run Chinook salmon to spawn in the same lowland reaches utilized by fall-run Chinook salmon. The overlap in spawning site location, combined with a slight overlap in spawning timing (Moyle 2002) with temporally adjacent runs, may be responsible for in-breeding between spring-run and fall-run Chinook salmon populations in the lower Feather River (Hedgecock et al. 2001).

Straying

Hatcheries raising anadromous salmonids in the Central Valley are listed in Table 6.2-2. California's anadromous fish hatcheries were constructed to compensate for the loss of spawning and juvenile rearing habitat as a result of dam construction. Hatcheries provide a substantial fraction of the harvest of California Chinook salmon. The policy of

the California Fish and Game Commission regarding hatcheries is that "California anadromous salmonid hatcheries are to be operated in such a way that the population and genetic integrity of salmon and steelhead stocks are maintained, with management emphasis on natural stocks" (DFG and NMFS 2001).

Table 6.2-2. Anadromous salmonid hatcheries in the Central Valley.

Hatchery	Location	Operator	Anadromous Stocks
Coleman	Battle Creek	USFWS	Fall-run, late fall-run, winter-run Chinook salmon, steelhead
Livingston Stone	Upper Sacramento River	USFWS	Winter-run Chinook salmon
Feather River	Feather River	DFG	Fall-fun, spring-run Chinook salmon, steelhead
Nimbus	American River	DFG	Fall-run Chinook salmon, steelhead
Merced	Merced River	DFG	Fall-run Chinook salmon
Mokelumne	Mokelumne River	DFG	Fall-run Chinook salmon, steelhead

Source: DFG and NMFS 2001

Between September 1999 and December 2000, DFG and NMFS conducted a joint review of California's anadromous fish hatcheries. One of the conclusions of this review was that the artificial propagation of salmon poses management, ecological, and genetic hazards to natural populations and that straying of hatchery populations increases the risk of these hazards (DFG and NMFS 2001). Furthermore, off-site releases result in increased rates of straying of hatchery-reared salmon relative to fish released on-site (at or near the hatchery) (DFG and NMFS 2001). The straying of hatchery fish could result in hybridization of hatchery and natural populations, leading to a reduction in genetic variation among populations and reducing fitness. Straying by hatchery fish could also cause ecological risks such as competition for food and habitat, reduced productivity of natural populations, and disease transmission.

Several authors have investigated the straying of Chinook salmon raised at the Feather River Fish Hatchery. Cramer and Chapman (2002) analyzed straying rates for Chinook salmon reared at the hatchery and released at different locations in the Feather River and San Pablo Bay. Mean straying rates of fish released in the Feather River were estimated to be less than 8 percent, while the straying rates of fish released in San Pablo Bay were estimated to be approximately 54 percent. These straying rates are consistent with a DFG study of the Coleman National Fish Hatchery operations that reported straying rates of 8 and 54 percent for in-river releases and San Pablo Bay releases, respectively (DFG and NMFS 2001). This same report cited straying rates of 8 percent from on-site releases and 32 percent for San Pablo Bay releases for the Nimbus Hatchery Chinook salmon on the American River. In contrast, a DFG study as reported in the report for SP-F9, Evaluation of the Feather River Hatchery Effects on Naturally Spawning Salmonids, which is summarized in Appendix G-AQUA1.7 of the PDEA, reported straying rates of 5 percent for Feather River–released fish and 10 percent straying rates for fish released in San Pablo Bay.

Overall Habitat Quality and Quantity

The CVP has 11 power plants and some 20 reservoirs impounding more than 11 maf of water. These facilities are generally operated as an integrated project whose purposes include flood control; navigation; provision of water for irrigation and domestic uses; fish and wildlife protection, restoration, and enhancement; and power generation (Allan 1995), and also operate in an integrated manner with the SWP, of which the Oroville Facilities are a major component. Major dams blocking access to historic anadromous salmonid spawning and rearing habitat in the Central Valley include Nimbus Dam on the American River; Keswick Dam and Red Bluff Diversion Dam on the Sacramento River; Friant Dam on the San Joaquin River; Crocker Diversion Dam on the Merced River; Goodwin Dam on the Stanislaus River; New Hogan Dam on the Calaveras River; New Bullards Bar Dam and Daguerre Point Dam on the Yuba River; and Camanche Dam on the Mokelumne River. Although not the first dam constructed on the Feather River, Oroville Dam presently constitutes the first barrier to upstream migration on the Feather River. Camp Far West Dam on the Bear River and Englebright Dam on the Yuba River present migration barriers in the lower Feather River system.

Dams have several negative effects on river ecosystems. Dams cause fundamental changes in the ecosystem as the continuous free-flowing river is transformed into river segments interrupted by impoundments (Allan 1995). The most obvious biological effect in the Central Valley is the blocking of upstream passage to anadromous fish species. Unless a mechanism is provided for fish passage, habitat upstream of the dam is effectively lost to the anadromous fish species. Dams that do not provide for anadromous fish passage also deprive upland areas of marine-derived nutrients from the decay of salmon carcasses. Several studies have demonstrated the importance of salmon carcasses to stream productivity (Bilby et al. 1996; Bilby et al. 1998; Wipfli et al. 1998). Reduced nutrient loading in upstream areas may reduce ecosystem productivity and macroinvertebrate quantity and diversity, and therefore reduce downstream juvenile salmonid rearing foodbase quantity and quality.

Natural river systems form a continuum from headwaters to river mouth, in which processes taking place upstream influence downstream dynamics. Dams interrupt this continuum. For example, dams reduce or eliminate upstream tributary contributions of sediment and LWD to downstream reaches. Sediment, in the form of gravel, is important to salmonid spawning, and LWD provides cover for juvenile rearing. Periodic high-flow events carry gravel and woody debris downstream, and because dams block recruitment of these materials, armoring of the salmonid spawning gravel and a reduction in habitat complexity can occur. The result is a reduction in the quantity and quality of spawning habitat, and LWD that served as cover for juveniles is depleted over time. In addition, lack of gravel and LWD combined with regulated flow regimes reduce channel complexity and habitat diversity.

Controlled flow regimes in the lower Feather River may cumulatively affect green sturgeon. Although the historic extent of green sturgeon usage of the lower Feather River is not known, lower flows may currently impede upstream migration of green

sturgeon. One potential migration barrier that has been identified is at Shanghai Bench in the lower Feather River (DWR 2003). Additionally, there is some evidence that sturgeon are attracted to the Feather River at flows of 5,000 cubic feet per second (cfs) or higher (DWR 2003). Controlled flow regimes may reduce the amount of time that suitable attraction flow exists in the lower Feather River to attract upstream migrating sturgeon in the Sacramento River.

From a cumulative perspective, river lamprey have been affected by lack of gravel recruitment, which has reduced the quantity and quality of spawning habitat. Actions that have negatively affected anadromous salmonids in the project area have had a similar effect on river lamprey.

Sacramento splittail make use of flooded benches and the inundated floodplain in the lower Feather River, below the southern FERC Project boundary, for spawning and juvenile rearing. Levee construction and controlled flows have reduced the quantity and quality of inundated floodplain habitat available to splittail.

Other actions that have contributed to the degradation of aquatic habitat in the Central Valley include urban development, agriculture, forestry, mining, levee and dike construction and maintenance for flood management, and road building. Normally, in areas of urban and agricultural development, channel morphologies are made straighter and deeper to promote drainage of low-lying areas. Channelization results in a reduction of flooding and thus, an increase in tillable land. However, it also results in a loss of floodplain aquatic habitat and a reduction in the quantity, quality, and complexity of in-river aquatic habitat. Water diversions for agricultural irrigation result in reduced flow in rivers and streams utilized by anadromous salmonids and may result in entrainment of young salmonids in diversion facilities. Agricultural drainage is also a major source of pollutants to aquatic habitats. Forestry practices that do not incorporate adequate riparian area buffer zones can also lead to reduced or degraded aquatic habitat. Logging activity can expose the streambed to reduced riparian shade, increasing water temperatures. Logging activities and wildfires are also associated with increased sediment production as a result of erosion. Accelerated erosion is a soil loss greater than natural geologic conditions, which can reduce reservoir capacity, degrade water quality, and harm fish and wildlife (DFG and NMFS 2001). Road building in riparian zones may also lead to increased fine sediment loading and erosion, reducing the quality of aquatic habitat.

6.2.6.2 Cumulative Effects of the Alternatives and Future Related Actions

The following sections address future operations of the Oroville Facilities under the No-Project Alternative, the Proposed Project, and the FERC Staff Alternative.

No-Project Alternative

From a cumulative affect on aquatic resources perspective, as it relates to threatened and endangered species, there are very few differences between Existing Conditions and the No-Project Alternative (see Chapter 3.0, Description of the Proposed Project

and Alternatives, for a detailed description of existing conditions and each alternative). Ongoing impacts associated with upstream migration barriers and loss of connectivity with upstream tributaries that affect quantity and quality of aquatic habitat would continue under the No-Project Alternative.

Proposed Project

Actions included in the Proposed Project address ongoing resource impacts associated with upstream migration barriers that cumulatively affect spring-run Chinook salmon and steelhead. The Proposed Project implements actions targeted at increasing the quantity and quality of anadromous salmonid and river lamprey spawning and juvenile rearing habitat downstream of the Fish Barrier Dam. Actions under the Proposed Project include increased minimum flows in the LFC (SA Article A108), supplementation of spawning gravel (SA Article A102), LWD supplementation (SA Article A104), Riparian and Floodplain Improvement Program (SA Article A106), and the enhancement of side-channel habitat (SA Article A103). Increased minimum flows in the LFC would increase the quantity of suitable spawning habitat for spring-run Chinook salmon and potentially reduce water temperatures in the LFC, benefiting all life stages of Chinook salmon and steelhead. These lower Feather River habitat enhancements mitigate the Oroville Facilities' contribution to the ongoing incremental affects of loss of access to upstream habitat.

Fish barrier weirs (SA Article A105) would be installed in the LFC under the Proposed Project to provide selective access to spawning habitat for Chinook salmon. For example, appropriately placed weirs could potentially simulate historic spatial segregation of runs by selectively allowing or blocking fish passage on a temporal basis. Additionally, by controlling access to spawning habitat on a temporal basis, the elevated levels of redd superimposition resulting from spring- and fall-run Chinook salmon spawning habitat spatial overlap would be reduced or eliminated, depending on the location and operation of the fish segregation weirs. Additional information on the implementation and potential benefits of a fish barrier weir system is included in Appendix C3, Impacts of the Proposed Project Relative to Existing Conditions.

The Proposed Project also includes a Habitat Expansion Agreement (HEA) (SA Appendix F) that would fully mitigate the loss of habitat associated with the Oroville Facilities blocking of upstream fish migration (see Section 3.3 for a description of the HEA). The HEA complements and expands upon other fish habitat programs to benefit spring-run Chinook salmon and steelhead.

The Proposed Project would implement an adaptive management approach to program operations at the Feather River Fish Hatchery (SA Article A107). The goal of this program is to provide for continuous evaluations and improvements to hatchery practices and operations. Different release strategies are among the hatchery practices to be reviewed (see Appendix G-AQUA1.7 of the PDEA for more information on Feather River Fish Hatchery operations). Release location can be highly correlated with straying rates. A common practice of anadromous salmonid hatcheries in the Central Valley is to release a portion of their fish in San Pablo Bay rather than on-site. For

example, in 1999 the Feather River Fish Hatchery released 78 percent of its fall-run Chinook salmon downstream of the Delta; Nimbus Hatchery released 100 percent of its fall Chinook salmon there; and the Mokelumne River released 57 percent of its fall Chinook salmon there. In addition, the Feather River Fish Hatchery released 100 percent of its spring-run Chinook salmon in San Pablo Bay (DFG and NMFS 2001). Because of the potential risks to the genetic integrity of stocks and potentially negative ecological impacts, the DFG and NMFS joint review of California's anadromous fish hatcheries recommends that spring-run Chinook salmon from the Feather River Fish Hatchery be released in-stream, and fall-run Chinook salmon from both the Feather River and Nimbus Hatcheries be released in-stream (DFG and NMFS 2001). Under the Proposed Project, adaptive management of in-river release of Feather River Fish Hatchery stocks would result in a cumulative reduction in the contribution of hatchery straying to the degradation of anadromous salmonid stock genetic integrity.

The Gravel Supplementation, Riparian and Floodplain Improvement, and LWD Supplementation Programs (SA Articles A102, A104, and A106) are included in the Proposed Project. Under current regulated flow regimes, LWD and gravel placements would provide localized fish habitat benefits until a high-flow event. When that occurs, the magnitude of the flow event would redistribute both naturally recruited and supplemented LWD and gravel. This redistribution is a normal ecosystem function; however, the LWD and gravel in the upstream reaches of the LFC would need to be replenished following these events. Because high-flow events cannot be predicted, both the LWD and Gravel Supplementation Programs would be implemented for the duration of the project. In the event that LWD and gravel are mobilized during high-flow events, they would provide fish habitat benefits farther downstream in the Feather River, Sacramento River, and perhaps as far as the Delta.

Channel complexity downstream of the Fish Barrier Dam would be increased by the proposed improvements to Moe's Ditch and Hatchery Ditch and the establishment of additional side-channel habitat with implementation of the Proposed Project (see Appendices C3 and C4 regarding impacts under the Proposed Project). The supplementation of gravel and LWD may indirectly enhance channel complexity by diverting flows and creating more interaction with the floodplain. Increased channel complexity could cumulatively contribute to increased quantity and quality of aquatic habitat downstream of the Fish Barrier Dam.

No actions included in the Proposed Project would contribute to cumulative impacts on green sturgeon. Continued moderated flows from the Oroville Facilities (that would occur under all alternatives) and other Feather River tributaries would be expected to reduce the frequency and magnitude of attraction flow to the Feather River.

In summary, implementation of the actions described above and included in the Proposed Project would increase habitat availability for both spring-run Chinook salmon and steelhead spawning and juvenile rearing. Increased habitat availability in terms of both quantity and quality may lead to increased egg-to-smolt survival for anadromous salmonids. Furthermore, installation of fish barrier weirs and an adaptive hatchery management program would aid managers in better understanding current population

dynamics of both Chinook salmon and steelhead. These actions would contribute to the mitigation of cumulative effects on spring-run Chinook salmon and Central Valley steelhead associated with the continued operation of the Oroville Facilities and other past, existing, and reasonably foreseeable related actions. Additionally, actions included in the Proposed Project would partially mitigate for the cumulative effects on river lamprey, and Sacramento splittail.

FERC Staff Alternative

There are no substantive differences in cumulative effects on aquatic resources with the implementation of the FERC Staff Alternative as compared to the Proposed Project other than implementation of the HEA. Under the FERC Staff Alternative, the HEA would not be implemented and there would be no mitigation for the ongoing loss of habitat access for spring-run Chinook salmon and steelhead as a result of the continued existence of the Oroville Facilities.

Climate Change and Aquatic Resources

According to the DWR climate change report, Sierra Nevada watersheds with snowpack (such as the Feather River) are predicted to get less snow and more rain, more winter and less spring and summer runoff, and warmer runoff. Increased water temperatures pose a threat to aquatic species that are sensitive to temperature, including anadromous fish. Increased water temperatures would also cause decreased dissolved oxygen concentrations in water and would likely increase production of algae and some aquatic weeds (DWR 2006).

In many low- and middle-elevation streams in California today, summer temperatures often come close to the upper tolerance limits for salmon and trout. Thus, anticipated climate change that raises air temperatures a few degrees Celsius may be enough to raise water temperatures above the tolerance of salmon and trout in many streams, favoring instead non-native fishes such as carp and sunfish. Spring-run Chinook salmon and steelhead trout that migrate up the Feather River early in the year, spending the summer in deep, cold pools, and spawning the following fall (salmon) or winter (steelhead), depend on the availability of cold water for survival over the summer months. Climate change could reduce the volume of cold water in storage at Oroville Reservoir since it would receive less snowmelt and have reduced carryover storage. Thus, the availability of cold water volumes needed to maintain releases of cold water to support fish spawning and rearing below the Oroville Facilities may decline. Due to the combination of anticipated warmer and shallower streams and rivers, climate change may diminish most summer habitat for steelhead and potentially all such habitat now used by spring-run salmon. (DWR 2006.)

6.2.7 Terrestrial Resources

6.2.7.1 Wildlife

Potential cumulative effects discussed in this section address wildlife and wildlife habitat, State-listed species, special-status species, and federally listed species

protected under the Endangered Species Act (ESA). For purposes of this discussion on cumulative impacts on wildlife species from the implementation of the No-Project Alternative, Proposed Project, and FERC Staff Alternative, these species include the federally listed bald eagle, giant garter snake, California red-legged frog, valley elderberry longhorn beetle (VELB), and vernal pool invertebrates, and the State-listed Swainson's hawk and bank swallow. The analysis of potential impacts and associated mitigation measures on wildlife resources is presented in Section 5.5.1.

Cumulative effects could include the loss or degradation of wildlife species and habitats as a result of flow fluctuations, project operations, maintenance activities, or changes in project recreational facilities or uses, as well as non-project related activities (see Section 5.5.1.4 for more detailed information on effects). Detailed information regarding wildlife and wildlife habitats, State-listed species, and special-status species is contained in the reports for SP-T1, SP-T2, and SP-T9.

Detailed information regarding State-listed and federally listed species trends, historical information, and current threats to the species is contained in Appendix E of the PDEA, Draft Terrestrial BA, and the reports for SP-T2, SP-T3/5, and SP-T9.

Past and Present Related Actions

Reservoir development has resulted in the conversion of upland, riparian, and wetland habitats in the Feather River floodplain to less productive habitats. Reservoir water level fluctuations result in barren shorelines used by relatively few wildlife species. The lack of cover in barren areas potentially increases predation rates for upland species traversing from upland habitats to lacustrine habitats. Further, reservoirs can act as dispersal barriers to some sedentary wildlife species, affecting territorial behaviors and reducing gene flow among local populations.

Flood management in the Feather River floodplain and controlled flow regimes in the Feather River have resulted in disruption of geomorphic processes essential for the maintenance and development of riparian and wetland habitats. An indirect effect of flood management activities is that it allows for urban and agricultural development in the Feather River historic floodplain and the consequent loss of wildlife habitat. Flood management–related bank stabilization actions have also resulted in loss of riparian habitats.

Fire suppression, increased recreational development and use, and urban development have all cumulatively contributed to wildlife habitat loss and degradation. Additionally, maintenance activities associated with increased recreation and urban development including pesticide use, road and trail building activities, and gravel harvest and drainage control activities have all contributed incrementally to decreased quantity, quality, and diversity of wildlife habitat.

Cumulative Effects of the Project and Past and Present Related Actions on Federally Listed Wildlife Species

Bald Eagle

The bald eagle was reclassified from Endangered to Threatened in 1995 throughout its range, and the species has been petitioned for delisting. While the Recovery Plan goals were met or exceeded for 6 of the 7 states in the Pacific Recovery Zone, including California, the Recovery Plan target goal for distribution by management zone has not been met for Zone 27, which includes the Lake Oroville area. The target goal for Zone 27 is 15 nesting territories, including 4 in the Lake Oroville area. In 1985, there were 4 known territories in Zone 27. Historically, at least 5 bald eagle nest territories have been documented within and adjacent to the project area; of these, 4 territories were occupied and produced young in 2005 and 2006 (see Appendix E of the PDEA and Draft Terrestrial BA for additional discussion). A January 2007 survey documented a new winter roost site in the North Fork Feather River and increased use compared to previous monitoring.

Historic actions that have served to reduce bald eagle populations in the project area include habitat alterations and loss, human disturbance, shooting, and environmental contaminants. Reservoir developments (including project reservoirs) have generally benefited bald eagle populations by increasing habitat and providing a more stable year-round food source. Nesting bald eagles are currently present at all of the larger reservoirs within the Feather River watershed (Jurek 1997).

Cumulative actions that may currently affect the bald eagle in the project area include project recreational development and use, project water level fluctuations, non-project recreational use and development, non-project logging and other forest harvest activities, non-project establishment of new roads and trails, and non-project residential development around Lake Oroville.

Giant Garter Snake

The giant garter snake is endemic to the Sacramento and San Joaquin River valleys and historically (pre-European settlement) occurred coincidental with the historical distribution of large floodplain basins, freshwater wetlands, and tributary streams. Agriculture and flood management activities have extirpated the giant garter snake from the southern third of its range. There are currently 13 existing populations that largely coincide with historical riverine flood basins and tributary streams in the Central Valley. These populations are distributed discontinuously in small isolated patches and are vulnerable to extirpation by naturally occurring environmental events, population dynamics, and genetic processes (Miller and Hornaday 1999).

Historic actions that have adversely affected giant garter snake and their habitat within the project area include flood management, agricultural conversion, environmental contaminants, livestock grazing, introductions of non-native species, and road kills. At the same time, development of rice production as well as irrigation supply and drainage

canals in the Sacramento Valley has resulted in the creation of some suitable giant garter snake habitat.

Cumulative actions that may affect giant garter snakes or their habitat in the project area include project recreational use and development, project water level fluctuations, mosquito abatement activities, illegal dumping in aquatic systems, and urban/residential development.

California Red-legged Frog

Historically, the California red-legged frog inhabited suitable habitat from coastal Marin County to northern Baja California and inland to near Redding, California, and was documented in 46 counties. Today, the California red-legged frog is considered extirpated from 24 of the 46 California counties.

Current and historical factors associated with declining populations of California red-legged frogs include degradation and loss of habitat through urbanization, mining, improper management of grazing, recreation, invasion of nonnative plants, water impoundments, water diversions, degraded water quality and introduced predators (66 Federal Register [FR] 14626–14757). Several researchers have attributed the decline and extirpation of California red-legged frogs to the introduction of bullfrogs and introduced predatory fishes (Hayes and Jennings 1986; Moyle 1973). The fragmentation of existing habitat and the continued colonization of existing habitat by non-native species, likely represent the most significant current threats to California red-legged frogs (66 FR 14626–14757).

Valley Elderberry Longhorn Beetle

VELB is found in isolated populations throughout the Central Valley, although it is locally common in the project area. Historically the species occurred in association with its host plant, the elderberry (*Sambucus* sp.), which was common in riparian forests and adjacent grasslands in the Central Valley (Barr 1991), which historically was estimated to cover 900,000 acres. In 1991, approximately 324,000 acres supported VELB habitat in parks, wildlife areas, and public lands in the Central Valley and adjacent foothills, of which valley elderberry longhorn beetle was present in about 187,000 acres (Barr 1991). Current and historical factors contributing to this species' current population status include habitat loss, degradation or fragmentation associated with agricultural and urban conversion, maintenance associated with waterways, insecticide use, livestock grazing, and bank stabilization/protection activities.

Current threats to this species include continued conversion of land to urban, industrial, and agricultural land uses, transportation, and additional future water–related facilities in the foreseeable future (USFWS 1996), which result in habitat destruction, degradation, and isolation of existing populations.

Vernal Pool Invertebrates

Vernal pool wildlife species are endemic to vernal pools in the Central Valley. A wide range of activities has historically affected vernal pool habitats and vernal pool wildlife and plant species (USFWS 1994). Vernal pool habitat in the Central Valley has been reduced 50–85 percent since the 1970s from agricultural and urban development; water and flood management, highway and utility projects, chemical contaminants, and agricultural practices (USFWS 1994). Current threats to vernal pool invertebrates in the project area include agricultural conversion, urban development, and expansion of transportation systems.

Cumulative Effects of the Project and Past and Present Related Actions on State-Listed Species and Species of Special Concern

Principal historic actions affecting habitats of two State-listed species occurring in or near the FERC Project area (Swainson's hawk) and downstream of the FERC Project area (bank swallow) include both project and non-project urban and agricultural conversion of habitat and flood management activities resulting in the loss or degradation of riparian, wetland, and upland habitats. These losses have cumulatively contributed to a decline in the Swainson's hawk population in the project area. Flood management–related bank stabilization actions downstream of the Oroville Facilities have resulted in a reduction in bank swallow nesting habitat, which has cumulatively contributed to a reduction in bank swallow population size and the number of nesting colonies.

Current project and non-project actions affecting Swainson's hawk and bank swallow populations include non-project urban development, resulting in alteration, loss, and degradation of upland, riparian, and wetland habitats. Feather River controlled flow regimes and sediment blockage have resulted in a disruption of natural geomorphic processes, which are essential for the maintenance and development of riparian and wetland habitats. Changes in river flow during bank swallow nesting periods could affect nesting success. Additionally, increased recreational use and development with associated maintenance activities (i.e., pesticide and herbicide use, grading, and road and trail construction), have incrementally contributed to habitat alteration, degradation, and loss.

Cumulative Effects of the Alternatives and Future Related Actions

Wildlife habitat (especially annual grassland, blue oak woodland, and blue oak/foothill pine habitats) would continue to be lost to urban development within the project area. Both direct and indirect wildlife habitat losses and degradation associated with increased recreational use would continue to increase over time as the human population increases and recreational demand increases. Recreational use and development are expected to continue under each of the project alternatives.

No-Project Alternative

The No-Project Alternative, because it does not include recreation facility development or habitat enhancement actions, would result in the least direct and indirect wildlife habitat conversion or loss. Increased recreational use would still be anticipated, but not to the extent that would occur under the alternatives with recreational improvements. Effects on habitat quantity, quality, and diversity caused by regulated flow regimes and the loss of connectivity with upstream reaches of the Feather River caused by Oroville Facilities and operations would continue.

Proposed Project

Increased recreational use and access provided by some of the actions included in the Proposed Project would likely have a cumulatively negative effect on wildlife habitat. However, actions included in the Proposed Project as Draft Terrestrial BA measures would serve to alleviate effects within annual grassland, freshwater emergent wetland, riparian, vernal pool, and mature coniferous forest habitats.

Flow regime and the effect of reduced upstream sediment contribution on riparian habitat would continue under the Proposed Project. The increase in minimum flows in the LFC in the Proposed Project would not result in a significant change in the quantity and quality of riparian habitat within the Feather River floodplain or stimulate natural geomorphic processes. However, any retention of LWD and side-channel enhancement and creation as well as the riparian and floodplain improvements included in the Proposed Project would increase riverine and riparian habitat values.

Several resource actions designed to protect specific species of management concern (i.e., California red-legged frog, giant garter snake, vernal pool invertebrates, and VELB) would also serve to protect and enhance wildlife habitat within the project area. Implementation of the Oroville Wildlife Area Management Plan (SA Article A115) and the Invasive Plant Management action (SA Article A126) would also likely lead to wildlife habitat improvements and mitigates for habitat disrupted by increased recreational use and development.

FERC Staff Alternative

There are no substantive differences in cumulative impacts on wildlife resources with the implementation of the FERC Staff Alternative as compared to the Proposed Project with the exception of the accelerated implementation schedule developed by FERC for the Riparian and Floodplain Improvement Program. While floodplain benefits may be realized earlier under the FERC Staff Alternative, impacts on sensitive species may limit potential project options or increase potential impacts from construction and therefore lessen total benefits to terrestrial resources.

Federally Listed Wildlife Species

Bald Eagle. Water level fluctuations have been documented to adversely affect bald eagle production at Shasta Lake (USBR 1992). However, the limited bald eagle

production data available for Lake Oroville are insufficient to draw similar conclusions at Lake Oroville. Implementation of any of the alternatives would not change Lake Oroville water levels.

No-Project Alternative. Residential development adjacent to the project area is likely to continue to occur in the future and could result in the reduction of the suitability of these areas for bald eagle nesting.

Increased recreational development and use in the project area could result in disturbance/displacement of wintering bald eagles. However, recreational use of Lake Oroville, which is the primary wintering habitat in the project area, is currently minimal during the period when wintering bald eagles are present (December through February).

Timber harvest activity can adversely affect bald eagles through habitat modification and disturbance. Future commercial timber harvest, including fire fuel load reduction activity, is planned and would likely continue in the project area.

Proposed Project. The adoption of Bald Eagle Territory Management plans (SA Article A118) (see Appendix E of the PDEA for further discussion) as part of the Proposed Project serves to limit habitat disturbance due to recreational use and development within the FERC Project boundary.

FERC Staff Alternative. There are no substantive differences in cumulative effects on bald eagles or their habitat with the implementation of the FERC Staff Alternative as compared to the Proposed Project.

Giant Garter Snake. A potential cumulative effect on this species is the current and future anticipated use of insecticides by county and municipal agencies. Both the Butte County Mosquito and Vector Control District and the City of Oroville (City) annually administer active mosquito abatement programs, which apply insecticide fog around the Feather River and the Thermalito Complex, including the Oroville Wildlife Area (OWA). This program has the potential to reduce insect populations in the project area and could affect elements of the giant garter snake habitat and food chain. Efforts to control West Nile virus are likely to increase the level of mosquito abatement actions in the future.

Illegal dumping of trash and hazardous materials in aquatic systems within the project area would continue to occur on a sporadic basis. Residential development and associated grading or drainage improvements adjacent to the project area have the potential to alter or destroy wetland habitat and reduce the connectivity of giant garter snake habitat within the project area.

No-Project Alternative. Under the No-Project Alternative, cumulative effects related to Thermalito Afterbay water level fluctuations would continue. The 4,281 acres of giant garter snake habitat would continue to be managed for multiple uses. Periodic minor habitat degradation and loss of giant garter snake aquatic and upland habitat would likely occur related to recreation use, recreation development, and project maintenance activities.

Proposed Project. The Proposed Project contains Draft Terrestrial BA conservation measures (SA Articles A117, A119, A120, and A121) and brood pond construction (SA Article A122) developed in consultation with USFWS to minimize or avoid potential project effects associated with water level fluctuations, recreational development and use, environmental contaminants, and maintenance activities. These measures would serve to reduce cumulative effects as compared to the No-Project Alternative. The Proposed Project would further reduce cumulative effects through increased patrol and enforcement as well as the installation of vehicular barriers within the OWA. Both of these actions would serve to reduce habitat degradation and the potential for illegal dumping of environmental contaminants.

FERC Staff Alternative. There are no substantive differences in cumulative effects impacts on giant garter snake or their habitat with the implementation of the FERC Staff Alternative as compared to the Proposed Project.

California Red-Legged Frog. Potential habitat exists in the project area for California red-legged frog, although the habitat quality is poor. Actions that may degrade the habitat quality include insecticide use within the project area. The Butte County Mosquito and Vector Control District and the City both administer annual active mosquito abatement programs, which apply insecticide fog around the Feather River and around the Thermalito Complex. These applications have the potential to decrease insect populations in the project area and, as such, could affect the California red-legged frog's food supply and degrade potential habitat.

No-Project Alternative. None of the measures within the No-Project Alternative would affect California red-legged frogs or their habitat. Degradation of potential California red-legged frog habitat would continue through increased urbanization and recreational use.

Proposed Project. The Proposed Project includes conservation actions specifically targeted at protection of California red-legged frog habitat (SA Article A121); see Chapter 3.0. Additionally, the Proposed Project includes measures to improve OWA visitor management through patrol/enforcement and the erection of additional vehicular barriers (SA Article A117). Both of these actions would serve to reduce potential effects associated with dispersed recreation use, including off-highway vehicle (OHV) use, on potential California red-legged frog habitat.

FERC Staff Alternative. There are no substantive differences in cumulative effects impacts on California red-legged frogs or their habitat with the implementation of the FERC Staff Alternative as compared to the Proposed Project.

Valley Elderberry Longhorn Beetle. Future activities that would have a cumulative effect on VELB populations in the FERC Project area include herbicide and insecticide use, recreational use and development, road and levee maintenance, and gravel extraction activities with the FERC Project area.

Mosquito abatement programs apply insecticide fog around the Feather River and around the Thermalito Complex. These applications have the potential to increase

effect on insects, including VELB, in the FERC Project area. Efforts to control West Nile virus are likely to increase the level of mosquito abatement actions in the future.

Recreational activities affecting VELB include camping, OHV travel, fires, and establishment of new trails in areas populated with valley elderberry shrubs. VELB may be adversely affected through soil disturbance and/or compaction affecting the elderberry shrubs.

Mining companies extract gravel from the dredger spoils piles within the Feather River floodplain. Operations potentially could affect VELB habitat through dust and habitat disturbance or destruction from extraction activities and truck traffic.

No-Project Alternative. Under the No-Project Alternative, cumulative effects related to project road and maintenance activities and recreational use would continue. The 95 acres of VELB habitat within the project boundary would continue to be managed for multiple uses. Periodic minor habitat degradation and loss of beetle habitat would likely continue to occur related to recreation use, recreation development, and project maintenance activities.

Proposed Project. The Proposed Project contains Draft Terrestrial BA conservation measures (SA Articles A117, A119, A120, and A121) developed in consultation with USFWS to minimize or avoid potential project effects associated with recreational development or use, environmental contaminants, and maintenance activities. These measures would serve to mitigate cumulative effects as compared to the No-Project Alternative. Further, the Proposed Project includes measures to improve OWA visitor management through patrol and enforcement and the installation of additional vehicular barriers. These actions would serve to reduce potential effects associated with dispersed recreation use including OHV use to VELB habitats.

FERC Staff Alternative. There are no substantive differences in cumulative effects impacts on VELB and their habitat with the implementation of the FERC Staff Alternative as compared to the Proposed Project with the exception of the accelerated implementation schedule developed by FERC for the Riparian and Floodplain Improvement Program. While floodplain benefits may be realized earlier under the FERC Staff Alternative, impacts on sensitive species may limit potential project options or increase potential impacts from construction and therefore lessen total benefits to terrestrial resources.

Vernal Pool Invertebrates. The Butte County Mosquito and Vector Control District and the City annually administer an active mosquito abatement program, which applies insecticide fog around the Feather River and around the Thermalito Complex, including the OWA. These applications have the potential to directly affect vernal pool invertebrates and indirectly affect them by changing the fragile balance between water, soil, plants, and other vernal pool species. Efforts to control West Nile virus are likely to increase the level of mosquito abatement actions in the future.

No-Project Alternative. Continued urban development in and adjacent to the project area would result in the continuation of degradation and loss of additional vernal pool habitats. Soil compaction may also result in decreasing habitat suitability for some vernal pool plant species or encourage algae growth, thus directly affecting the pools' suitability to sustain a viable invertebrate population. OHV use outside the FERC Project boundary may also result in physically crushing or directly damaging adults and cysts within a vernal pool adjacent to the Project area.

Proposed Project. Under the Proposed Project, OHV use and other recreational use of vernal pool areas within the project area would be reduced through implementation of conservation measures, including signage, patrol, enforcement, and barrier maintenance (SA A117).

Additionally, project road and levee maintenance practices would be modified to reduce potential sediment, compaction, chemical contamination, or altered hydrology of pool habitats. Road improvements, expansion, or maintenance undertaken by an agency other than DWR may affect vernal pool integrity through grading, mechanical and/or chemical weed control, alteration of drainage patterns, and alteration of soil chemical and physical characteristics.

FERC Staff Alternative. There are no substantive differences in cumulative effects impacts on vernal pools with the implementation of the FERC Staff Alternative as compared to the Proposed Project.

State-Listed Wildlife Species and Species of Concern

Cumulative effects on State-listed species and species of concern would continue under the alternatives with actions that result in the loss or degradation of habitat utilized by these species, especially riparian and riverine habitats. Continuing project operations as described above could affect Swainson's hawk and bank swallow habitat and production. No significant differences in cumulative effects were identified between project alternatives for the State-listed Wildlife Species of Concern.

Swainson's Hawk. Flow regime effects on riparian habitat would continue under all of the project alternatives. The proposed flow modifications considered under the Proposed Project would not result in significant change in the quantity and quality of Swainson's hawk nesting habitat. The Proposed Project would likely have beneficial effects on Swainson's hawk nesting habitat through the implementation of the Riparian and Floodplain Improvement Program (SA Article A106).

Bank Swallow. Flow regime effects on bank swallow habitat along the Feather River downstream of the OWA and outside the FERC Project boundary would continue under all of the project alternatives.

6.2.7.2 Botanical

Potential cumulative effects discussed in this section address botanical resources including vegetation communities, special-status plants, and invasive non-native plant

species. The analysis of potential impacts and associated mitigation measures on botanical resources is provided in Section 5.5.2.

Federally listed Threatened or Endangered plant species were not located within the FERC Project area during the relicensing studies. Therefore, there would be no cumulative effects on federally listed plant species under any of the project alternatives. Future actions conducted in potentially suitable habitat for vernal pool species and serpentine species would require the completion of floristic surveys to determine presence or absence of these listed plant species. For any future actions that may affect listed plant species, DWR would be required to coordinate with USFWS.

Cumulative effects could include the loss or degradation of native plant communities; the introduction and spread of non-native and noxious terrestrial and aquatic weeds; and the loss or reduction of special-status plant species populations (see Section 5.5.2 for more detailed information on effects). Detailed information regarding historic information, trends, and current threats to these botanical resources also can be found in the reports for SP-T2, SP-T3/5, SP-T4, SP-T7, and SP-T10.

The cumulative effects evaluations are limited to the additive nature of project-related and non-project-related effects on botanical resources, including native plant communities, special-status plant species, and non-native invasive plants.

Plant Communities

Riparian Resources

Historically, rivers in the Sacramento Valley were flanked by extensive floodplains that supported riparian forests and associated wetlands (Katibah 1984). Complex fluvial geomorphic processes, including hydrology, erosion, sediment transport, and depositional patterns, maintained these forests. In the 1800s riparian forests were logged for lumber and fuel. By the late 1800s, hydraulic mining had introduced massive amounts of sediment into the system and, in the early 1900s, Feather River water diversions began for agricultural and urban uses. Regulated streamflow from hydroelectric and reservoir projects as well as levee construction resulted in a reduced risk of downstream flooding, allowing more floodplain plant communities to be converted to agricultural and urban use.

The construction of Oroville Facilities in the 1960s further altered streamflow patterns, reduced floodflows, and reduced sediment discharge downstream. As a result of these hydrologic and floodplain alterations, the riparian forests along the Feather River downstream of Oroville Dam are narrow and fragmented, with little or no recruitment of riparian successional species, and are therefore relatively low in structural and species diversity. The Proposed Project includes a Riparian and Floodplain Improvement Program (SA Article A106) to address the ongoing contribution of the Oroville Facilities to the overall effects on riparian plant communities in the Feather River. Additional information on riparian resources in the project vicinity can be found in the SP-T3/5 report.

Upland Plant Communities and Associated Wetlands

Upland plant communities in the project vicinity consist of oak/pine woodlands, chaparral, and conifer forest types in the foothills of the Sierra Nevada and annual grasslands containing vernal pools and swales in the Sacramento Valley. Urban development, recreational use, wildfire suppression, and the introduction of invasive plant species have resulted in loss and degradation of upland communities. Additional information on historic and project effects on plant communities can be found in the SP-T10 report.

Over the last century, California grasslands have been heavily affected by the invasion of non-native species. Soil disturbance and seed dispersal by vehicles increase the rate of invasive species colonization. Construction of the 4,930-acre Thermalito Forebay and Thermalito Afterbay included the conversion of grasslands, some with vernal pools and swales, to project waters and emergent wetland vegetation. Subsequently, DFG converted over 200 acres of grasslands containing vernal pools and swales around Thermalito Afterbay to non-native crops to enhance waterfowl foraging and nesting cover. Outside the FERC Project boundary, upland plant communities and associated wetlands have been and continue to be lost largely due to non-project-related agricultural and urban development. The quality of upland plant communities has been and would continue to be degraded by soil disturbance related to construction and maintenance activities and by invasive species seed dispersal by recreational activities. The Proposed Project includes Protection of Vernal Pools (SA Article A117) and Invasive Plant Management (SA Article A126) to address the ongoing contribution of the Oroville Facilities to the overall effects on upland plant communities.

Special-Status Plant Species

Historic effects on special-status species habitats date back to Euro-American settlement of the 1800s. The majority of special-status species that occur in the vicinity of Lake Oroville inhabit openings in woodlands, forests, and chaparral communities. As wildland fire suppression began around the turn of the century, stand densities increased and the quantity and quality of special-status species habitats has decreased. The loss of special-status species populations and habitats has also occurred from urban development and non-native species invasions. Special-status species habitats in valley grasslands and associated vernal pools and swales have been affected by non-native species invasions. Non-project conversion of lands for agricultural and urban uses has also affected these species' habitats. The construction of Thermalito Forebay and Thermalito Afterbay converted over 3,000 acres of grasslands, some containing vernal pools and potential special-status plant species habitat to open water habitat with emergent vegetation habitat along the shorelines. The Proposed Project includes Draft Terrestrial BA actions (SA Articles A117, A119, and A121) to address the ongoing contribution of the Oroville Facilities to the overall effects on special-status species.

Non-Native Invasive Plant Species

Non-native species have been recorded in California prior to the 1800s, although their proliferation has been greatest during the last century. These species are highly adapted to disturbance and colonize areas affected by human and natural factors, including stream flows, change in wildfire frequencies, urbanization, and other human activities. Historically, these species have increased in numbers due to land use practices that favor invasive species. Construction of the Oroville Facilities led to further disturbance of natural areas and potential sites for invasive plant species colonization. The Proposed Project includes Invasive Plant Management (SA Article A126) to address the ongoing contribution of the Oroville Facilities to the overall effects on non-native invasive plant species.

Cumulative Effects of the Alternatives and Future Related Actions

No-Project Alternative

Plant Communities. Under the No-Project Alternative, effects on botanical resources as identified in Section 5.5.2. would continue. Flow management, reduced sediment load and LWD transport, and water use downstream of Oroville Dam would continue to adversely affect riparian plant communities within the Feather River floodplain. Non-native plant species would continue to colonize riparian and wetland plant communities both inside the FERC Project boundary as well as within surrounding areas. Upland plant communities around Lake Oroville would continue to be affected by fire suppression as plant community densities increase and catastrophic fires occur. Effects from non-native plant species invasions would continue. Direct effects on natural communities would occur from urban development adjacent to the project area. Direct and indirect losses associated with recreation use and development would continue. Valley grassland and associated vernal pools and swales would continue to be affected as natural areas are lost to urban development. Within the FERC Project boundary, grasslands and swales not designated as listed species habitat, and thus not protected under State or federal regulations, would continue to have moderate adverse effects from project-related activities, recreational use, and invasions by non-native plant species. Introduction of non-native plant species and continued fertilizer use, which favors non-native species over native species, would continue to affect grasslands, vernal pools, and swales.

Special-Status Plant Species. Effects on special-status plant species and their habitats would continue. These effects in the vicinity of Lake Oroville would be primarily from fire suppression activities and encroachment into natural areas from urban development. Special-status species associated with annual grasslands, vernal pools, and wetlands in the vicinity of the project area below Lake Oroville would continue to be affected as these areas are lost to non-project urban development. Although conservation measures relating to vernal pool invertebrates would reduce effects on these species' habitats in the FERC Project boundary, there would continue to be some adverse effects from project-related activities, recreational use, and invasions by non-native plant species into special status plant habitats.

Non-native Invasive Species. Invasive plant species affect both natural plant communities and special-status species habitats. Non-native species effects would continue to occur under the No-Project Alternative.

Proposed Project

Under the Proposed Project, effects on botanical resources would be reduced by the implementation of Invasive Plant Management, the Riparian and Floodplain Improvement Program, and the Draft Terrestrial BA–related SA Articles 117–121 (including vernal pool protection, protection measures implemented for the giant garter snake, valley elderberry longhorn beetle, and red-legged frog), which would have beneficial effects on native plant communities in the project area and those associated with waters downstream. The Invasive Plant Management actions would target specific species that are considered to have the greatest impact on plant communities of the project area, especially wetland and riparian vegetation, and those that are affecting special-status species habitats. The continuation of upland forage and cover crop programs (SA Articles A123 and A124) and construction of additional waterfowl brood ponds (SA Article 122) would continue to benefit special-status wetland plant species.

FERC Staff Alternative

There are no substantive differences in cumulative impacts on botanical resources with the implementation of the FERC Staff Alternative as compared to the Proposed Project.

6.2.8 Recreational Resources

The recreational resources that are potentially cumulatively affected by the continued operation of the Oroville Facilities and other past, existing, and reasonably foreseeable related actions are primarily recreation facilities and dispersed recreational use opportunities. The analysis of cumulative effects also addresses Lake Oroville surface water elevations and Feather River flows downstream of Oroville Dam. Section 4.7.1 provides additional information on other similar recreational resources in the region, public recreational access and facilities in the project area, past and current recreation use levels, and current recreation use patterns, capacity, and management. The 17 recreation studies completed as part of the relicensing effort as well as the report for SP-L3, Comprehensive Plans Consistency Evaluation, provide information utilized in this analysis.

6.2.8.1 Cumulative Effects of the Project and Past and Present Related Actions

Past and Present Actions in the Project Area

Past actions that have affected project recreation resources include the development of over 30 recreational facilities beginning in 1968, soon after construction of the Oroville Facilities. Prior to the construction of the Oroville Facilities, recreation in the area included angling, camping, picnicking, swimming, river boating, hunting, and hiking activities with access to some areas limited by rugged terrain and lack of developed roadways. Most of the current recreation facilities have been managed as part of the

Lake Oroville State Recreation Area (LOSRA), which has reported visitor attendance between 500,000 and 950,000 visits most years since the mid-1970s. Additional recreation use, much of it dispersed in nature, has occurred at the OWA (estimated between 100,000 and 250,000 visitors per year).

Present actions include the operation and maintenance of the recreation facilities discussed above, as well as management of lands for dispersed uses such as hunting, hiking, bike riding, equestrian use, and boating. The SP-R9 report estimated that these facilities supported over 1.6 million recreation days (RDs) of use by visitors engaged in a wide range of recreation activities, including power and non-power boating, camping, swimming, picnicking, angling, hiking, bike riding, horseback riding, hunting, wildlife viewing, and nature appreciation within the FERC Project area during the 12-month relicensing study period. Past and present actions in the project area also include normal project operations for water storage and hydroelectric power, which result in annual water surface level fluctuations at Lake Oroville and modified flows in the Feather River.

Related Actions by Regional Recreation Providers

Regional past and present related actions include the construction and recreational development of many moderate to large reservoirs in California. The SP-R14 report described 20 reservoirs, ranging from about 700 acres to nearly 30,000 acres in size, within a few hours' drive of the project area. This includes the 2 largest reservoirs in the State in surface area: Shasta Lake (29,500 acres) and Lake Almanor (27,000 acres). The region also offers two large natural lakes: Lake Tahoe (122,000 acres) and Clear Lake (40,000 acres). These reservoirs and lakes provide a wide range of public and private recreation development, and many offer recreation opportunities similar to those available at the Oroville Facilities.

In addition to the primarily water-based recreation opportunities provided by these regional water bodies, the region also contains large areas of federal lands managed by USFS, BLM, and the National Park Service. Plumas National Forest to the west and Lassen National Forest to the north of the project area each provide over 1 million acres of primarily forested and mountainous public lands for recreation, including hundreds of lakes and thousands of miles of streams. Lassen Volcanic National Park covers over 100,000 acres of forested foothills and includes unique volcanic features. BLM manages scattered parcels of public land in the project vicinity, often interspersed with other federal lands. These areas offer developed camping and boating opportunities similar to those provided in the project area, in addition to much more extensive areas for dispersed activities like hunting and wildlife viewing and for OHV use. These areas clearly play an important role in providing both developed and dispersed recreation opportunities that complement those provided by the Oroville Facilities within the FERC Project boundary.

Cumulative Effects of Past and Present Actions on Recreation

Cumulatively, the effect of past and present actions within the FERC Project boundary has been to substantially increase the amount and range of recreation opportunities in the region, particularly with regard to water-based recreation such as boating, angling, and swimming. Opportunities for other activities that may be enhanced by proximity to a reservoir and water-based recreation opportunities, such as camping and hiking, and dispersed-use activities such as hunting and wildlife viewing have also increased substantially.

6.2.8.2 Cumulative Effects of the Alternatives and Future Related Actions

This section describes the reasonably foreseeable future actions of federal, State, and local agencies that provide recreation opportunities in the region, as well as the cumulative effects of those actions and the project alternatives on recreation in the region.

Future Related Actions of Regional Recreation Providers

As discussed below, several providers of recreation facilities and opportunities in the region surrounding the FERC Project boundary have plans for future related actions that would increase recreation opportunities.

Regional Reservoirs

Several of the reservoirs in the region have recently completed or plan to make additions and improvements to recreation facilities (the SP-R14 report provides additional detail on these actions). The recreation opportunities are generally provided by the federal or State agencies that own and/or operate the reservoirs or their concessionaires and permittees.

Federal Agencies

Plumas National Forest is the primary federally managed area within and adjacent to the project area. The National Forest's Land and Resource Management Plan (LRMP), adopted in 1988, directs the management of the National Forest, and emphasizes continued cooperation with DPR in managing USFS lands within the LOSRA. Additional recreation management described in the LRMP is focused primarily on providing semi-primitive and primitive recreation facilities and programs, extending and improving the trail system, upgrading forest roads as needed, and protecting unique scenic values on forest lands.

BLM owns scattered parcels of land in the project area. All of these lands are within the Redding Resource Area and are addressed by the 1993 *Redding Resource Management Plan* (RRMP). In general, the BLM lands are managed for similar types of primitive, undeveloped, and dispersed recreation as nearby USFS lands. A primary focus of the RRMP as it relates to lands in and near the FERC Project boundary is the potential transfer of public lands within the boundary from BLM to other federal, State,

or local entities. In particular, 6,900 acres of land within and adjacent to the LOSRA are identified as available for transfer to the State of California pending DPR application under the Recreation and Public Purposes Act (68 Statute 173; 43 U.S. Code [USC] 869 et seq.1954).

In general, these USFS- and BLM-managed lands provide for undeveloped, dispersed, and open-space-dependent forms of recreation, such as hunting, hiking, and primitive camping, along with roads and trails for OHV use. As such, the future management of these federal lands provides opportunities that complement the similar opportunities available within the FERC Project area.

State Agencies

At the State level, the SP-R14 report highlights the conclusions drawn by DPR in the 2002 *California Outdoor Recreation Plan* (CORP) regarding latent demand and public support for government funding for particular recreation activities. Although the CORP does not indicate what actions would result from these conclusions, they are intended to guide State actions in the near future for expanding recreation opportunities. Camping in both developed and primitive sites, hiking and walking, nature study, and picnicking in developed sites all were identified to have high unmet demand in California, and strong public support for expanded opportunities.

Local Governments

At the local level, the *Butte County General Plan* (1971, as amended) has elements addressing recreation, open space, and scenic highways. Although the plan is county-wide in scope, the Recreation and Open Space elements are focused on promoting recreation development within the LOSRA and the OWA. The Scenic Highways Element proposes pursuing State Scenic Highway designation for a portion of State Route 70 in the FERC Project vicinity. Related policies aim to establish scenic areas and corridors.

The *City of Oroville General Plan* (1995) states the City's long-term vision, including for open space and natural resources. Recreation is addressed in several elements. The Land Use Element designates land for parks, including parks within the city and lands within Oroville's unincorporated planning area, which are managed by DPR. The policies set out in the plan are generally aimed at fostering cooperation with the State and local entities to encourage continued recreation development, particularly at Thermalito Forebay, Thermalito Afterbay, and along the Feather River.

DWR provided over $5 million toward funding the planning, design, permitting, and construction for the expansion of Riverbend Park along the eastern bank of the LFC adjacent to the city of Oroville. Expansion activities include trails, picnic facilities, boat launch, playgrounds, a frisbee golf course, and paved parking.

These plans suggest that the Feather River Recreation and Park District and the City would continue to function both as park providers and as cooperators with the State in recreation development in the project area.

Regional FERC Relicensing Efforts

Of particular interest for this analysis is the anticipated FERC relicensing of three other hydroelectric power projects. PG&E is currently involved in the relicensing of two hydroelectric power projects: the Poe Project (FERC Project No. 2107) and the Upper North Fork Feather River Project (FERC Project No. 2105). The Poe Project consists of 2 dams on the North Fork Feather River that create 2 small reservoirs (each about 50 acres) and related tunnels, penstocks, powerhouses, and related facilities immediately upstream of the Oroville Project area. The Upper North Fork Feather River Project consists of three dams and reservoirs and related powerhouses, tunnels, and penstocks. Project reservoirs include Lake Almanor (27,000 acres), Butt Valley Reservoir (1,600 acres), and Belden Forebay (42 acres). These reservoirs regulate and store water in the upper Feather River basin before it flows downstream to Lake Oroville. FERC completed a DEIS on the Upper North Fork Feather River Project in 2004 and a Draft and Final Environmental Assessment in August 2006 and March 2007 respectively, for the Poe Project.

The Settlement Agreement for the Upper North Fork Feather River Project was signed in April 2004 and filed with FERC in September 2004. FERC's DEIS for the relicensing indicates that recreation developments and improvements are planned for family and group campgrounds, day use areas, swim beaches, and boat ramps on Project waters. The SWRCB is currently directing a CEQA analysis on the Upper North Fork Feather River Project in accordance with its role of water quality certificate issuance pursuant to Section 401 of the Clean Water Act.

The South Feather Water and Power Agency (formerly Oroville Wyandotte Irrigation District) is currently relicensing its 118-MWh South Feather Power Project (FERC Project No. 2088). The project includes diversions from the South Fork of the Feather River.

Cumulative Effects of Regional and Project Area Actions

No-Project Alternative

The cumulative effects of the No-Project Alternative in the project area and the actions of regional providers of recreation opportunities would result in a moderate degree of growth in recreation opportunities. Most of the growth in opportunities would occur outside the project area. Due to future population growth and increased demand for recreation activities, recreation attendance in the project area and the region would be expected to continue to increase.

Proposed Project

The cumulative effects of the Proposed Project, which includes more than 60 actions that would enhance recreation facilities and management in the FERC Project area, and the actions of regional providers of recreational opportunities, would result in growth in recreation opportunities in the region. Cumulatively, these measures would have

beneficial effects on the full range of recreational opportunities available in the FERC Project area, including boating, camping, angling, swimming and other shoreline use, trails use, and open space–dependent activities such as hunting and wildlife viewing. The region would benefit from growth in recreational opportunities within the FERC Project area, in particular for boating and camping. The boating season would be extended for reservoir boaters during low-water periods. The past, present, and future development of recreational opportunities across the region, along with future population growth and associated increased demand for recreation activities, would lead to steady growth in recreation attendance in the FERC Project area and the region.

FERC Staff Alternative

There are no substantive differences in cumulative effects on recreational resources with the implementation of the FERC Staff Alternative as compared to the Proposed Project.

Climate Change and Recreational Resources

As previously described and according to the DWR climate change report, Sierra Nevada watersheds with snowpack (such as the Feather River) are predicted to get less snow and more rain, more winter and less spring and summer runoff, and warmer runoff. Such changes could reduce the volume of water in storage at Oroville Reservoir during the summer months since it would receive less snowmelt, could have reduced carryover storage, and could have increased environmental water demands during the warmer months. A reduced volume could result in lower reservoir water levels and an expanded fluctuation zone during the summer recreation months. Access to some recreation facilities could be affected by lower water levels.

6.2.9 Cultural Resources

As discussed previously, cumulative effects include past, present, and reasonably foreseeable related actions that incrementally affect individual resources in combination with a proposed action. For the analysis of cumulative impacts on cultural resources, the source of the effects is not restricted to activities directly associated with the Oroville Facilities. Local population growth and related urban development, for example, and actions taken by federal land management agencies such as USFS and BLM are considered in this analysis.

Cumulative effects are relevant to archaeological sites and ethnographic and ethnohistoric resources, as described in Section 4.8. Because of their unique nature, the 14 NRHP-eligible historical structures associated with the Oroville Facilities noted in Section 4.8.2 are not considered subject to cumulative effects.

6.2.9.1 Cumulative Effects of the Project and Past and Present Related Actions

Section 4.8, Cultural Resources, noted that effects on archaeological sites and ethnographic and ethnohistoric resources were occurring before construction of the Oroville Facilities. These effects included the loss of archaeological sites as a result of

erosion, with a substantially increased rate of effects on these resources with the onset of mining and later historical developments such as establishment of the City of Oroville. (Some of these activities resulted in the creation of resources now documented as historic-era archaeological sites.) These activities also affected ethnographic resources and altered the traditional Native American use of the land.

Construction of the Oroville Facilities also affected archaeological sites and ethnographic resources. Archaeological sites were inundated, buried by fill, disturbed by vegetation removal, or affected by archaeological excavations conducted prior to inundation of the reservoir. The extensive historic-era dredge mining tailings along the Feather River provided a source for materials used during construction of Oroville Dam. Traditionally used plant gathering areas, hunting and fishing grounds, swimming holes, and even residences and burial sites were inundated with construction of the project. Since that time, the construction and use of campgrounds, trails, and other support facilities, Lake Oroville water surface fluctuation, and some O&M activities have affected cultural resources.

Continued development in and around the FERC Project area, the construction of hydroelectric projects elsewhere on the Feather River and its tributaries, and actions such as timber harvesting and road building have all led to the loss of archaeological sites. Alterations to the landscape resulting from activities such as reservoir construction and inundation also affected resources such as native plants traditionally used by the local Native American community, and impacted resources of sacred and traditional concern to the local Maidu community.

6.2.9.2 Cumulative Effects of the Project Alternatives and Future Related Actions

This section describes the potential cumulative effects of past, present, and reasonably foreseeable related actions when combined with the environmental effects for the No-Project Alternative, Proposed Project, and FERC Staff Alternative as documented in Section 5.8.4. The Proposed Project and FERC Staff Alternatives include implementation of a draft Historic Properties Management Plan (HPMP) that addresses ongoing effects (e.g., resource monitoring and protection/stabilization) as well as protocols for proposed actions (e.g., site avoidance, data recovery, public interpretation) to avoid or reduce potentially significant impacts on cultural resources. This analysis is qualitative in nature and highlights the relative degree of cumulative effects under each of these scenarios.

No-Project Alternative

Under the No-Project Alternative, the ongoing project effects on cultural resources would continue, including public use and related effects from OHV use, vandalism, and looting. Future non-project-related activities involving new ground disturbance could further affect archaeological sites and ethnographic resources. The loss of archaeological sites and access to traditionally used resources resulting from future non-project-related actions (e.g., continued development in and around the City of Oroville, timber harvesting) would continue.

Proposed Project

With the inclusion of the draft HPMP and other measures to reduce, avoid, or otherwise resolve project-related effects on cultural resources, as described in Section 5.8.4, the potential for long-term cumulative effects on archaeological sites and ethnographic resources would be reduced under the Proposed Project. A number of new development projects that require ground-disturbing activities would be constructed under this scenario; therefore, recreational use and potential related effects on cultural resources would be greater than under the No-Project Alternative. The Proposed Project includes measures that would reduce impacts with implementation of the HPMP and result in beneficial effects on these resources (e.g., the Interpretation and Education Program).

FERC Staff Alternative

There are no substantive differences in cumulative effects on cultural resources with the implementation of the FERC Staff Alternative as compared to the Proposed Project.

6.2.9.3 Climate Change and Cultural Resources

Climate changes that would result in less snowmelt and thus reduce the volume of water in storage at Oroville Reservoir could result in lower reservoir water levels and an expanded fluctuation zone during the summer recreation months. Cultural resources that are currently submerged during the summer recreation months could be exposed more often by lower reservoir water surface levels and subject to vandalism if actions were not taken to protect these resources.

6.2.10 Public Services

This section focuses on the potential cumulative impacts of the project alternatives related to changes in the demand for local public services. It should be noted that CEQA does not treat social and economic effects of projects as significant effects on the environment if they do not create, or are not caused by, physical effects. The demand for public services, and a local government's ability to pay for them, is not itself a physical effect on the environment, but instead is a socioeconomic issue that could potentially lead to physical effects. For example, the need to build or change existing facilities to accommodate the cumulative demand for public services could result in physical effects on the environment. Thus, the cumulative impact assessment in this section focuses on how past, present, and reasonably foreseeable actions have affected the demand for public services in Butte County and whether the incremental contribution of the project alternatives to the need for new or altered public services facilities to meet this demand is considerable.

The analysis therefore addresses the increment contributed by the project alternatives to the demand for local public services, including the direct change in demand generated by recreation visitors and workers commuting to the Oroville Facilities and the change generated by the local population supported by jobs directly and indirectly generated by visitor spending and Oroville Facilities O&M activities. The project's

effects on public services are discussed in Section 5.9.2, Public Services, and Section 5.14, Transportation and Traffic.

For the purposes of the analysis of cumulative impacts related to the provision of public services, the focus is on projects and actions that have generated or will generate public services impacts similar to those that would be generated by the project alternatives. These projects and actions specifically include those affecting the demand for public services most frequently used by visitors to the Oroville Facilities, including law enforcement, criminal justice, fire protection, emergency services, and road maintenance services. Relevant projects and actions considered by the cumulative analysis include:

- Past and future urban development in Butte County and related population growth; and
- Original construction and ongoing operation and maintenance of the Oroville Facilities.

Rather than focus on a lengthy list of past and future development projects that have generated or that could generate population growth and a resulting change in the demand for local public services, the cumulative analysis uses past growth trends and projections of future growth to characterize cumulative changes in the demand for public services. Population projections used for this analysis were prepared by the Butte County Association of Governments (BCAG) (2006). BCAG staff collaborated and reached consensus with city, town, and Butte County (County) planning staff on the development of the projections, which reflect the growth trends that are anticipated to occur by local planners within Butte County and incorporated cities and towns between 2006 and 2030.

6.2.10.1 Cumulative Effects of the Project and Past and Present Related Actions

The current ability of local agencies, including the City and County, to provide adequate public services has been shaped by how the demand for public services and the funding to meet that demand have changed over time.

Over the past several decades, innumerable actions have occurred that have added to the cumulative demand for public services in the vicinity of the Oroville Facilities, including the City and County. These actions include approval of residential, commercial, industrial, and public projects that have drawn and supported populations requiring public services. Between 1970 and 2004, Oroville's population grew by 77 percent, adding 5,800 persons. Over the same time, the countywide population grew by 48 percent, reflecting the addition of 68,900 new persons requiring public services.

Other past actions, including the development of public projects and facilities, have also resulted in changes in the demand for public services. Among these actions were the construction and operation of the Oroville Facilities in the mid-1960s, which drew visitors to recreation sites and workers to the Oroville area to construct and later

operate project facilities and to fill new jobs generated by local area spending by recreationists. The visitor and resident population related to the Oroville Facilities contributes a small but constant increment to the cumulative demand for public services that has grown over several decades. Based on estimates prepared for the SP-R9 report, an estimated 697,970 visitors from outside of Butte County and from cities within Butte County were drawn to the Oroville Facilities during a 12-month period in 2002-03. On an average daily basis, these visitors added an estimated 1,910 persons to the service area population of local service providers, effectively increasing the countywide population by 0.9 percent in 2003. Additionally, O&M activities and visitor spending in 2002-03 indirectly supported an estimated 2,360 persons residing in Butte County, representing 1.1 percent of the county's 2003 population.

The ability of local service providers to meet the cumulative demand for public services such as law enforcement, criminal justice, fire protection, emergency, and road maintenance services depends to a large extent on the availability of funding to construct and operate public services facilities and to support adequate staffing levels, especially for law enforcement and fire protection services. Since the mid-1970s, when Proposition 13 was passed by California voters, several actions have occurred that have made funding public services more difficult for public agencies, especially for counties such as Butte. Proposition 13 greatly slowed the growth of property tax revenues for cities and counties over time, reducing general revenues available to agencies to fund services. Subsequently, several other actions affected the fiscal condition of public agencies, with these changes often adversely limiting the flexibility of local agencies and their ability to react to changes in the demand for services. These changes include, but are not limited to, State/local agency service realignments and property tax shifts in the early 1990s, local and statewide sales tax initiatives, vehicle license fee revenue realignments, new State and federal mandates for providing services, and changes in State and federal subvention payments to local agencies. The changes have made counties heavily reliant on State allocations of revenue, much of which is generated at the local level but allocated by the State. According to a State Legislative Analyst's Office report (*Why County Revenues Vary: State Laws and Local Conditions Affecting County Finance*, 1998), the California Legislature largely controls the allocation of virtually all major county general purpose revenues.

The structural budget challenges faced by the County and other counties, largely caused by their reliance on State funding sources, is exacerbated by State and federal mandates to provide services countywide that generate governmental costs that are not necessarily offset by local public revenue sources. Many revenues transferred to the County by the State and federal governments to offset the costs of providing mandated countywide services do not necessarily increase in response to population growth, potentially resulting in net costs to the County when the countywide population expands.

Past and present actions that have increased the demand for public services in Butte County, including urban development that has led to population growth, and operation and use of the Oroville Facilities, have cumulatively resulted in considerable growth in the demand for public services in Oroville and countywide, requiring the construction of

facilities to accommodate this demand that have resulted in physical effects on the environment.

6.2.10.2 Cumulative Effects of the Project Alternatives and Future Related Actions

This section describes the potential cumulative effects of past, present, and reasonably foreseeable related actions when combined with the environmental effects for the No-Project Alternative, Proposed Project, and FERC Staff Alternatives documented in Sections 5.9.2, Public Services, and Section 5.14, Transportation and Traffic. For the Proposed Project and FERC Staff Alternatives, this analysis highlights the relative degree of cumulative effects under each of these scenarios.

Future Urban Development and Population Growth

Future urban development in Butte County, including residential, commercial, industrial, and public facilities development, will generate population growth that will result in an increased demand for public services in Oroville and Butte County. BCAG has developed projections of population growth that are consistent with development anticipated under the current general plans of the County and the towns and cities within the county. These projections are shown in Table 6.2-3. As shown, the overall population of Butte County is projected to grow by 31.5 percent between 2003 and 2020, adding 66,250 persons. This level of growth would likely lead to the need to develop new public service facilities to meet the related increase in the demand for public services, potentially resulting in physical effects on the environment.

Table 6.2-3. Projected population in Butte County, 2003–2020.

Jurisdiction	2003 [1]	2010 [2]	2015 [2]	2020 [2]	Increase 2003–2020
Biggs	1,810	1,960	2,310	3,060	1,250
Chico	68,480	85,610	94,520	104,360	35,880
Gridley	5,760	7,230	9,140	10,800	5,040
Oroville	13,250	15,700	20,030	23,450	10,200
Paradise	26,650	27,590	29,430	30,780	4,130
Butte County (unincorporated)	94,080	93,990	98,790	103,830	9,750
Butte County (Total)	**210,030**	**232,080**	**254,220**	**276,280**	**66,250**

[1] *Source: California Department of Finance 2006*

[2] *Source: BCAG 2006*

Future Traffic Growth

The 2004 Regional Transportation Plan includes information regarding future traffic volumes and Levels of Service on State highways and key County roads based on peak hour traffic volume. The forecasts for the State highways have been interpolated to

daily traffic volumes and are presented in Table 6.2-4. As noted, background traffic growth on the regional circulation system is projected to result in LOS F conditions at many locations on SR 70, SR 99 and SR 162.

Table 6.2-4. Year 2025 annual average daily traffic.

Route	From (Postmile)	To (Postmile)	2005 Annual Average Daily Traffic	2025 Estimated Daily Traffic	Year 2025 Level of Service
SR 70	Yuba County line (0.00)	Beginning of Freeway south of Oroville (13.51)	12,100 to14,900	22,600	F
	Beginning of freeway South of Oroville	SR 162 (Oroville) (13.90)	14,900	32,000	F
	SR 162	Montgomery Street (Oroville) (14.61)	23,300	45,200	C
	Montgomery Street	Grand Avenue (Oroville) (15.43)	31,500	45,000	C
	Grand Avenue	Nelson Avenue (Oroville) (15.72)	23,600	48,500	C
	Nelson Avenue	End of Freeway (20.14)	21,600	40,600	C
	End Of Freeway	SR 149 (20.48)	21,600	40,600	C
	SR 149	SR 191 (21.87)	8,200	21,000	F
	SR 191	Plumas County line (48.08)	3,100 to 1,450	4,800 to 10,000	D
SR 99	Sutter County line (0.00)	Wilson Street (Gridley) (4.12)	16,400 to 19,200	29,000	F
	Wilson Street (Gridley)	Spruce Street (Gridley) (4.38)	23,100	35,000	F
	Spruce Street (Gridley)	SR 162 (east) (13.16)	15,100 to 10,900	26,000 to 22,000	F
	SR 162 (east)	SR 149 (21.81)	11,100	21,000	F
	SR 149	Begin Freeway (30.40)	25,500	43,000	F
	Begin Freeway	Skyway (Chico) (30.60)	34,000	48,000	F
	Skyway	East 20th St (Chico) (31.50)	52,000	64,000	D
	East 20th St	SR 32 (Chico) (32.45)	72,000	86,000	E
	SR 32	Cohassatt Hwy (Chico) (34.25)	75,000 to 61,000	92,000 to 82,000	E
	Cohassatt Hwy	East Avenue (Chico) (34.93)	42,500	85,000	D
	East Avenue	End of Freeway (37.32)	29,000 to 19,500	69,000 to 29,000	D
	End of Freeway	Tehama County Line (45.98)	19,500 to 11,900	29,000 to 20,000	F

Table 6.2-4. Year 2025 annual average daily traffic.

Route	From (Postmile)	To (Postmile)	2005 Annual Average Daily Traffic	2025 Estimated Daily Traffic	Year 2025 Level of Service
SR 162	Glen County line (0.00)	SR 99 (Biggs) (9.73)	1,500 to 1,050	3,000 to 2,000	C
	SR 99 (9.73)	12th Street (Oroville) (14.96)	2,700 to 8,600	4,000 to 12,000	C
	12th Street	SR 70 (Oroville) (15.83)	13,200	30,800	F
	SR 70	Washington Ave (Oroville) (17.55)	32,000 to 30,500	42,500 to 40,500	D
	Washington Avenue	Lower Wyandotte Road (Oroville) (18.01)	29,000	35,000	F
	Lower Wyandotte Rd	Foothill Blvd (18.46)	20,900	33,000	F
	Foothill Blvd	Canyon Drive (21.26)	12,400 to 11,000	22,500 to 29,000	F
	Canyon Drive	Forbestown Road (24.19)	7,600 to 4,550	10,000 to 6,000	D
	Forbestown Road	Foreman Road (31.07)	1,850 to 1,500	2,500	C

Source: 2004 Regional Transportation Plan

No-Project Alternative

Under the No-Project Alternative, recreation-related visitation to the Oroville Facilities would increase as a result of regional and statewide population growth unrelated to the project improvements. Similarly, employment supported by visitor spending would increase as visitation increases. Thus, the visitor and resident population would increase over time, requiring additional public services from local service providers.

As discussed in Section 5.9, Population, Housing, and Public Services, regional and statewide growth is projected to result in visitation by non-residents of unincorporated Butte County to the Oroville Facilities to potentially increase from about 697,970 visitor-days in 2002-03 to about 861,070 visitor-days in 2020, an increase of 163,100 visitors. Additionally, the population in Butte County supported by the jobs directly and indirectly generated by visitor and O&M spending is estimated to increase from 2,360 in 2002-03 to 2,770 in 2020 under the No-Project Alternative, representing an increase of 410 persons. (Visitor and population projections are not available for the period beyond 2020; however, growth in recreation use, and resulting growth in visitor-supported population, is presumed to increase at a similar rate throughout the remainder of the FERC Project license period.)

On an average daily basis, recreation visitors in 2020 coming from outside of Butte County and from incorporated cities within Butte County would potentially add about 2,360 persons to the service area population of local service providers, effectively

increasing the countywide service area population by 0.8 percent in 2020. Workers who commute from out-of-county locations also could contribute to the countywide service area population; however, as discussed in Section 9.5.2, Public Services, the number of workers commuting from outside of the county is anticipated to be minor. Additionally, the 2,770 persons potentially supported by jobs directly and indirectly generated by O&M activities and visitor spending in 2020 would represent 1.0 percent of Butte County's projected 2020 population. Combined, the project-supported population, including visitors, would potentially represent 1.8 percent of Butte County's 2020 population, potentially accounting for a similar percentage of the cumulative demand for public services in the county. Because the potential project-supported population is expected to be relatively small, the No-Project Alternative's contribution to the total demand for public services would be minor. (Note that residents of incorporated cities in Butte County who recreate at the Oroville Facilities would likely travel into the unincorporated areas of Butte County and impact service providers even if they were not recreating at the Oroville Facilities; therefore, the inclusion of residents of the incorporated areas in the visitor estimates used in this analysis likely overestimates the actual increase in the demand for public services.) Background traffic volume forecasts for the regional street and highway system can reasonably be assumed to include the continuing operation of the Oroville Facilities under the No-Project alternative.

Although the cumulative demand for public services in 2020 could require the development of new facilities to accommodate this demand, potentially resulting in physical effects on the environment, the fact that a cumulative impact is significant on the whole does not necessarily mean that the project-related contribution to that impact is significant as well. Instead, under CEQA, a project-related contribution to a significant cumulative impact is only significant if the contribution is cumulatively considerable. As discussed previously, the contribution of the No-Project Alternative to cumulative effects would be minor; therefore, the No-Project Alternative's cumulative impact would be considered **less-than-significant**.

Proposed Project

Under the Proposed Project, implementation of the SA Recreation Management Plan (RMP) and other programs and actions could result in an increase in recreational visits and workers commuting to the project area and an accompanying increase in demand for public services. Additionally, implementation of the Proposed Project could generate population growth and an increased demand for public services in Butte County by attracting additional workers and their families to relocate to the county to fill permanent jobs required to construct and operate new and improved project facilities and to fill new jobs that would be supported by increased visitor spending.

Under the Proposed Project, visitation by non-residents of unincorporated Butte County to the Oroville Facilities is projected to potentially increase from about 697,970 visitor-days in 2002-03 to about 1,028,400 visitor-days in 2020, an increase of 330,430 visitors, with about half of this increase expected to occur with or without implementation of the project improvements due to regional and statewide growth in the demand for recreation. Workers who commute to the project area from out-of-county

locations also could contribute to the countywide service area population, although this increase in anticipated to include fewer than 5 workers, as discussed in Section 5.9.2, Public Services. Additionally, as discussed in Section 5.9.1, Population and Housing, the population supported by jobs generated by visitor and O&M spending under the Proposed Project could increase from 2,360 in 2002 to 3,160 in 2020, with about half of this project-generated growth expected to occur with or without implementation of the Proposed Project in response to regional and statewide population growth trends. (No visitor or population estimates are available for the Proposed Project beyond 2020; however, growth in recreation use, and resulting growth in visitor-supported population, is presumed to increase at a similar rate throughout the remainder of the FERC Project license period.)

On an average daily basis, recreation visitors in 2020 coming from outside of Butte County and from incorporated cities within Butte County would potentially add about 2,820 persons to the service area population of local service providers, effectively increasing the countywide service area population by 1.0 percent in 2020. Workers who commute to the project area from out-of-county locations also could contribute a minor number of persons (estimated at fewer than five) to the daily countywide service area population. Additionally, the 3,160 persons potentially supported by O&M activities and visitor spending in 2020 would represent 1.1 percent of Butte County's projected 2020 population. Combined, the project-supported population, including visitors, would potentially represent 2.2 percent of Butte County's 2020 population, potentially accounting for a similar percentage of the cumulative demand for public services in the county. This percentage of countywide demand for public services is similar to the percentage of countywide demand attributable to the project in 2002-03 (2.0 percent). (Note that residents of incorporated cities in Butte County who recreate at the Oroville Facilities would likely travel into the unincorporated areas of Butte County and impact service providers even if they were not recreating at the Oroville Facilities; therefore, the inclusion of residents of the incorporated areas in the visitor estimates used in this analysis likely overestimates the actual increase in the demand for public services.)

Because this potential project-supported population is anticipated to be relatively small, the Proposed Project's contribution to the total demand for public services is anticipated to be minor relative to the total demand for public services in Butte County. Additionally, the increased demand for services would be spread among a number of State and local agencies, and funding provided by the Proposed Project, such as the OWA funding, is expected to minimize the increased demand on local service providers. DWR also offered during settlement discussions to provide additional funding that it believes would fully mitigate the public service impacts on Butte County that are generated by visitors to the Oroville Facilities.

As noted in Section 5.14, implementation of the Proposed Project is projected to result in increased traffic as compared to the No-Project Alternative, with an additional 900 daily trips spread among all of the streets and highways serving the site. This increase would be slight in proportion to forecast traffic volumes and would not result in the baseline volume increasing by more than 1.0%. Thus, while cumulative impacts on

traffic on the regional circulation system are significant, the incremental contribution of the Proposed Project is not significant.

Although the Proposed Project would add to the overall cumulative impact on local public service providers, potentially requiring the development of facilities that could result in physical effects on the environment, under CEQA, the Proposed Project's contribution to the significant cumulative public services impact would be considered significant only if the project's contribution is cumulatively considerable. As discussed previously, the Proposed Project's incremental contribution to the cumulative demand for local public services is anticipated to be minor. Additionally, DWR has previously expressed a willingness to provide funding for mitigation of public services impacts; this would fund its fair share of measures designed to alleviate the project's cumulative impact. The Proposed Project's contribution to cumulative impacts related to the provision of public services would be considered **less-than-significant**.

FERC Staff Alternative

Program- and project-level measures that could affect visitation levels and project-related population levels and the demand for public services would be the same as under the Proposed Project because the alternative proposes only minor changes to the actions comprising the Proposed Project's SA RMP. Therefore, the cumulative public service impacts of the FERC Staff Alternative would be less-than-significant.

6.2.11 Agricultural Resources

A qualitative effects assessment was completed to evaluate the potential cumulative effects of the No-Project Alternative, Proposed Project, and FERC Staff Alternative on agricultural resources in the vicinity of the Oroville Project area. The effects assessment focuses on the incremental effects of water temperature changes on rice production induced by project operations under the alternatives. Because water temperature–related effects on rice production reportedly occur between planting and the reproductive phase of rice growth and because the majority of planting in the FRSA occurs during May, the period of primary concern is from May 1 through July. For the purposes of this section, the cumulative effects of the project over time and in combination with other historical, current, or reasonably foreseeable projects on agricultural resources, and specifically rice production, are evaluated.

6.2.11.1 Cumulative Effects of the Project and Past and Present Related Actions

Prior to construction of the Oroville Facilities, water and irrigation districts in Butte County built several projects for diverting water from the Feather River for irrigation purposes. The first of these projects was the Butte County Canal, built in 1905. The purpose of the canal was to divert water from the Feather River for irrigation purposes. Water entered the Butte County Canal through eight cement gates located near the current Thermalito Afterbay Outlet. Water from the canal was delivered to areas north and south of Gridley, up to 30 miles away from the river. To facilitate summer diversions, Hazelbush Dam was built in 1907 near the intake of the Butte County Canal.

The structure was a rock barrier that raised the water level several feet to provide adequate head for summer diversions into the canal. The barrier had to be rebuilt after every flood event, as it was subject to repeated damage from flood events on the Feather River.

The Western Canal was built by the Feather River Canal Company during the years from 1912 through 1915. The purpose of the Western Canal was to deliver water northeast of Biggs and east of Nelson. Additionally, a flashboard dam referred to as the Western Canal Dam was built across the Feather River at River Mile 63 for diverting water into the Western Canal. Western Canal Dam had to be reinstalled every year, as it was also subject to repeated damage from flood events on the Feather River.

Prior to the construction of the Oroville Facilities, a number of hydroelectric dams were constructed in the tributaries upstream of the current FERC Project boundary. These hydroelectric facilities altered the hydrology and water temperatures of the lower Feather River and may have cumulatively reduced the water temperatures at the historical points of diversion during the May-through-July rice water temperature sensitive growth stages by as much as several degrees.

The construction of Thermalito Afterbay replaced the Hazelbush Dam and Western Canal Dam headworks and several miles of the irrigation canals. In 1969, DWR executed two agreements, one with the Joint Water Districts Board and one with PG&E, to resolve issues related to water deliveries to senior water rights holders. In 1986 PG&E assigned its agreement to the Western Canal Water District. The agreements acknowledge the new delivery points at Thermalito Afterbay and specified annual delivery amounts, rates of deliveries and timing for water diversions.

An effect of the construction and operation of the Oroville Facilities has been a reduction in the water temperature of deliveries to the districts during the rice-growing season. After the construction of the Oroville Facilities, water temperatures at the agricultural diversions are generally slightly warmer during the initial phase of the rice growing season but become cooler (mid-May) for the duration of the season. These cooler water temperatures are a result of the Oroville facilities–mandated operating requirements to deliver cooler water to the lower Feather River to support anadromous salmonids. These cooler water temperatures have the potential to negatively affect rice yields in the areas of the rice pads adjacent to the irrigation water outlets. At the same time, construction of the Oroville Facilities has resulted in an increase in acreage of rice production, likely due in part to the increased reliability of the water supply and flood protection benefits. Total rice production has also increased in part because of improved cultural practices; pest, weed, and fertility management; water management; and rice genetics.

6.2.11.2 Cumulative Effects of the Project Alternatives and Future Related Actions

No-Project Alternative

Under the No-Project Alternative, rice yield losses due to water temperature would be expected to continue at generally the same rate as currently occur under the Existing Conditions. Some hydroelectric facilities upstream of the Oroville Facilities are in the process of undergoing FERC relicensing, which may result in decreased water temperatures in the tributaries upstream of Oroville Reservoir that, in turn, would result in potential changes to cold water pool resources in the reservoir; however, the changes in cold water pool resources upstream would not be expected to result in changes to water temperatures at the agricultural diversions in Thermalito Afterbay during the May-through-July period.

Proposed Project

Under the Proposed Project, during the initial new license period, operations of Thermalito Afterbay are not expected to change substantially. As described in Section 5.13.4, lower water temperature targets at Robinson Riffle have the potential to result in a less than 2^{o}F decrease in water temperatures at the agricultural diversions in Thermalito Afterbay. Water temperature reductions at Robinson Riffle do not necessarily directly equate to water temperature changes of the same magnitude at the agricultural diversions within Thermalito Afterbay. During the rice-water-temperature sensitive-growth stages, water temperatures at Robinson Riffle are at times more than 2^{o}F cooler than the current water temperature requirements. These conditions would also occur in the same proportions under the Proposed Project, with no water temperature changes needed to meet the Proposed Project's water temperature objectives at Robinson Riffle relative to Existing Conditions. Therefore, under these conditions no change in the source water temperatures for Thermalito Afterbay would occur. For almost all conditions, water temperatures under Existing Conditions at Robinson Riffle are somewhat cooler than the current water temperature requirements. These conditions would also occur under the Proposed Project with probable water temperature reductions of less than 2^{o}F, resulting in less than a 2^{o}F reduction in the source water temperatures for Thermalito Afterbay during May through July. These decreases in water temperature at the agricultural diversions during the initial new license period would not be expected to substantially increase the amount of rice yield loss or increase the amount of rice production area affected by cold water exposure within the FRSA.

Future changes to water temperatures at the agricultural diversions after implementation of the potential future facilities modifications are uncertain and dependent upon which modifications or what combination of modifications could be selected. After the completion of any potential future facilities modifications designed to reduce water temperatures in the lower Feather River to benefit anadromous salmonids, it is likely that water temperature requirements in the lower Feather River would change relative to water temperature targets during the initial new license period. However, the

degree of water temperature change in Thermalito Afterbay associated with any operational changes is unknown until the potential future facilities modifications have been selected and further evaluated in subsequent environmental documentation.

Implementation of the Proposed Project would likely also reduce water temperatures at the agricultural diversions slightly during the initial new license period and subsequent potential future facilities modifications would further alter the water temperatures at the diversions, relative to the initial new license period. However, these alterations in water temperature are not expected to be of a magnitude sufficient to substantially increase the amount of rice yield loss attributable to cold water exposure.

FERC Staff Alternative

There are no substantive differences in cumulative effects on agricultural resources with the implementation of the FERC Staff Alternative as compared to the Proposed Project.

6.2.11.3 Climate Change and Agricultural Resources

Some changes in crop type, planting cycles, time of planting, and crop productivity would likely occur as the result of increased temperatures from climate change. Regional irrigation water demand may increase or decrease as the result of these changes. Several factors related to climate change, such as possible changes in humidity, cloudiness, wind, and increasing temperatures, could affect evapotranspiration rates and related water demand. Irrigation water temperatures may increase, coincident with source water temperature increase, and this could affect future crop choices, especially with regard to water-temperature-sensitive crops. Crop yields currently impacted by cold water temperatures could increase as water temperatures increase.

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6.3 SIGNIFICANT IRREVERSIBLE ENVIRONMENTAL CHANGES WHICH WOULD BE CAUSED BY THE PROPOSED PROJECT SHOULD IT BE IMPLEMENTED

Section 15126.2(c) of the State CEQA Guidelines requires a discussion of any significant irreversible and irretrievable environmental changes that would be caused by the proposed project. Section 15126.2(c) states:

> Uses of nonrenewable resources during the initial and continued phases of the project may be irreversible, since a large commitment of such resources makes removal or nonuse thereafter unlikely. Primary impacts and, particularly, secondary impacts (such as highway improvement which provides access to a previously inaccessible area) generally commit future generations to similar uses. Also, irreversible damage can result from environmental accidents associated with the project. Irretrievable commitments of resources should be evaluated to assure that such current consumption is justified.

Generally, a project would result in significant irreversible and irretrievable environmental changes if:

- The primary and secondary impacts would generally commit future generations to similar uses;
- The project would involve a large commitment of nonrenewable resources;
- The project would involve uses in which irreversible damage could result from any potential environmental accidents associated with the project; or
- The proposed consumption of resources is not justified (e.g., the project involves the wasteful use of energy).

The Proposed Project represents the continued operation and maintenance of an existing project with no substantive commitment of nonrenewable resources. The Oroville Facilities produce clean energy from a renewable resource, thereby avoiding the wasteful consumptive use of other energy sources. The Proposed Project includes many actions that address the ongoing and incremental degradation of resources by the continued existence and/or operations of the Oroville Facilities.

Implementation of the Proposed Project would result in the continued commitment of the Oroville Facilities for electric power generation and other project purposes, including water supply, water quality, flood management, recreation, and fish and wildlife protection, including implementation of any terms and conditions to be considered for inclusion in the new FERC hydroelectric license, thereby precluding any other uses for the lifespan of the project. Implementation of the Proposed Project would not conflict or alter any existing environmental commitment of resources outside of the existing or new FERC license conditions and requirements (e.g., Delta water quality management standards, OCAP, COA).

Irretrievable commitments of resources that could result from implementation of the Proposed Project include a potential reduction in power generation as water is redirected from power plants to increase minimum streamflows in the LFC and water temperature management flows for salmonid spawning, holding, and rearing. Other energy resource commitments would occur during construction of SA actions and for operation and maintenance of both existing and new facilities.

Resources that would be permanently and continually consumed by project implementation include electricity, natural gas, and fossil fuels; however, the amount and rate of consumption of these resources would not result in the unnecessary, inefficient, or wasteful use of resources. With respect to operational activities, compliance with all applicable resource protection laws and codes, as well as mitigation measures, planning policies, and standard conservation features, would conserve natural resources to the maximum extent possible. It is also possible that new technologies or systems will emerge, or will become more cost-effective to further reduce the reliance upon nonrenewable natural resources. Nonetheless, construction activities related to the Proposed Project would result in the irretrievable commitment of nonrenewable energy resources, primarily in the form of fossil fuels (including fuel oil), natural gas, and gasoline for automobiles and construction equipment. Operations associated with the Proposed Project would also consume natural gas and electrical energy; however, benefits of the Proposed Project and the ability to generate clean, reliable energy far outweigh the consumption impact.

The State CEQA Guidelines also require a discussion of the potential for irreversible environmental damage caused by an accident associated with the project. While the project would result in the use, transport, storage, and disposal of hazardous wastes, all activities would comply with applicable State and federal laws related to hazardous materials, dam safety, and flood management, which significantly reduces the likelihood and severity of accidents that could result in irreversible environmental damage.

6.4 SIGNIFICANT ENVIRONMENTAL EFFECTS WHICH CANNOT BE AVOIDED IF THE PROPOSED PROJECT IS IMPLEMENTED

The physical presence of the Oroville Facilities and the on-going facilities operations made irreversible changes in the environmental conditions within and downstream of the Project area. The resulting environmental conditions form the baseline conditions for the Project CEQA analysis. In some instances there are no feasible means to improve these conditions such as the inundation of oak woodlands, grasslands and other native communities. However, the implementation of both the Proposed Project and the FERC Staff Alternative would result in improvements in most resource categories over baseline conditions.

The purpose of this Section 15126.2(b) is to analyze the actions that will be taken under the Proposed Project and the significant impacts which cannot be avoided as a result of those actions.

The environmental effects of the No-Project Alternative, Proposed Project, and FERC Staff Alternative on various aspects of the environment are discussed in detail in Chapter 5 of this DEIR. There are no significant impacts that cannot be avoided if the Proposed Project or FERC Staff Alternative is implemented.

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6.5 RELATIONSHIP BETWEEN SHORT-TERM USES OF THE ENVIRONMENT AND THE MAINTENANCE AND ENHANCEMENT OF LONG-TERM PRODUCTIVITY

Short-term impacts are those of a limited duration, such as impacts that would occur during the construction of a project. Long-term impacts are those of greater duration, including those that would endure for the life of a project and beyond. Both short-term and long-term impacts are described in detail in Chapter 5.0 of this DEIR, including mitigation measures intended to avoid or reduced potentially significant impacts. The following discussion addresses how implementation of the Proposed Project would affect the long-term productivity of the natural and human environment.

Resources that could be adversely impacted in the short term, but that would realize long-term beneficial effects with the implementation of the Proposed Project, include power generation, aquatic resources, terrestrial resources, recreational resources, water quality, and geological, cultural, and agricultural resources.

6.5.1 Power Generation

Implementation of the Proposed Project would continue operation of the Oroville Facilities for electrical power generation and alleviate the need for new power resources that would otherwise be required to replace the 762 megawatts of capacity and roughly 2.4 million megawatt-hours per year of energy generated by the three power plants.

6.5.2 Geological Resources

The Oroville Facilities have altered natural geological processes that would occur in the Feather River below Oroville Dam. Processes that have been altered include sediment and LWD recruitment, dampening of flow regime changes that lead to channel complexity, and loss of floodplain connectivity. Construction activities associated with implementation of some actions under the Proposed Project could potentially alter geological processes on a short-term basis; however, this alteration of geological processes would be offset by measures that address the loss of connectivity between upstream and downstream reaches of the Feather River. For example, gravel supplementation, LWD supplementation, the Channel Improvement Program, and the Riparian and Floodplain Improvement Programs all serve to partially simulate pre-project conditions and would result in long-term improvements to fluvial geomorphic functions.

6.5.3 Water Quality

Water quality may be adversely affected by short-term construction-related activities associated with implementation of the Proposed Project. Implementation of Best Management Practices as described in Appendix D during construction would minimize temporary, localized adverse effects on water quality. Longer term water quality, as it pertains to aquatic life criteria, particularly anadromous salmonids, would improve relative to Existing Conditions and would more than offset short-term water quality degradations associated with construction activities.

6.5.4 Aquatic Resources

In addition to the short-term construction-related effects with implementation of the Proposed Project, there would be short-term localized disruptions to habitat and disturbance of fish during construction and for a short duration following construction. Fish utilizing affected habitats during these disruptions would be displaced to other available habitats. Once the short period of disturbance is past, the resulting habitat values and benefits created would be substantial in comparison to the amount of habitat disturbance and short duration of disruption created by implementation of the Proposed Project.

All of the Proposed Project actions that have short-term and localized adverse effects on aquatic resources are included in the Lower Feather River Habitat Improvement Plan (SA Article A101). While these actions have a short-term localized adverse effect on aquatic resources, they result in long-term overall habitat enhancements. These actions include the Gravel Supplementation and Improvement Program (SA Article A102), Channel Improvement Program (SA Article A103), Structural Habitat Supplementation and Improvement Program (SA Article A104), Fish Weir Program (SA Article A105), and Riparian and Floodplain Improvement Program (SA Article A106).

Gravel supplementation would result in localized disturbance of fish utilizing these habitats prior to construction. Disturbance would be minimized by selecting a construction period during times of the year in which habitat utilization is at a minimum. In addition to construction disturbance, supplemented gravel must “naturalize” in the river for 1–3 years prior to the fish fully utilizing the enhanced habitat. This delay in utilization of the habitat after construction would result in a short-term overall reduction in the amount of available salmonid spawning habitat, but would result in a long-term increase in the quality and quantity of available salmonid spawning habitat.

LWD supplementation and side-channel enhancement and creation would result in the short-term loss of juvenile salmonid rearing habitat. Once the constructed and enhanced features have naturalized with the river, the quantity, quality, and duration of habitat values created would more than offset the short-term and localized loss of juvenile rearing habitat.

Overall, actions that would result in short-term effects on aquatic resources would result in a long-term increase in the productivity of aquatic resources.

6.5.5 Terrestrial Resources

Wildlife species can be adversely affected by indirect habitat loss associated with disturbance or displacement resulting from short-term construction-related activities or long-term increases in recreational use. Actions with the potential to result in short-term reduction in wildlife use include increased human disturbance and the impacts of construction-related activities. Long-term increases in wildlife disturbance/displacement are likely to be associated with those measures that serve to increase recreational use, extend the period of recreational use, or expand the area of recreational use. However,

although increased recreational use may result in localized increases in wildlife disturbance or displacement, resource actions associated with endangered species protection, terrestrial habitat improvement, and invasive plant management included in the Proposed Project would result in a long-term increase in the productivity of terrestrial resources.

6.5.6 Recreational Resources

Recreational resources may be adversely affected by short-term construction-related activities associated with implementation of resource actions included in the SA RMP. Overall, actions that would result in short-term adverse effects on recreation would provide an increase in recreational opportunities in the project area. Some resource actions related to the improvement of aquatic resources may result in localized adverse effects on recreation. For example, lower water temperatures in the lower Feather River may adversely affect contact recreation (i.e., swimming) and potential obstacles to boating may be created by the installation of fish segregation weirs and LWD installation. These potential localized adverse effects are expected to be more than offset by enhanced recreation opportunities provided by implementation of the SA RMP.

6.5.7 Cultural Resources

Construction-related activities associated with the Proposed Project have the potential to adversely affect cultural resources. Increased protection of cultural resources in the long-term is provided by implementation of an HPMP, including the improved and redirected recreation usage at Foreman Creek. Additionally, elements of the draft HPMP such as public information and education programs, establishment of a local curation facility, and opportunities that would protect traditional plant gathering areas are expected to enhance cultural resource values in the project area over the long term.

6.5.8 Agricultural Resources

Actions under the Proposed Project designed to lower water temperatures downstream of Lake Oroville have the potential to incrementally decrease rice yield in the FRSA due to coldwater effects. However, potential decreases in rice yield are offset by the long-term reliability of the water supply to the FRSA.

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